UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,116,710 B1
APPLICATION NO. : 09/861102
DATED : October 3, 2006
INVENTOR(S) : Hui Jin, Aamod Khandekar and Robert J. McEliece

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Specification

Column 1, Line 8:
"This application claims the priority of U.S. Provisional Application Ser. No. 60/205,095, filed on May 18, 2000, and is a continuation-in-part of U.S. application Ser. No. 09/922,852, filed on Aug. 18, 2000 and entitled Interleaved Serial Concatenation Forming Turbo-Like Codes."

Should read:
-- This application claims the priority of U.S. Provisional Application Ser. No. 60/205,095, filed on May 18, 2000. --

Signed and Sealed this
Fifth Day of July, 2022

Katherine Kelly Vidal

Katherine Kelly Vidal
Director of the United States Patent and Trademark Office

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/861,102	05/18/2001	Hui Jin		6026

83559 7590 06/03/2022

Bryan Cave Leighton Paisner LLP
1290 Avenue Of the Americas
New York, NY 10104

EXAMINER
HA, DAC V

ART UNIT	PAPER NUMBER
2611	

NOTIFICATION DATE	DELIVERY MODE
06/03/2022	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

PATENTS-NY@bclplaw.com

Response to the Request for Certificate of Correction	Patent No. 7116710	Applicant(s) Jin et al.
	Issue Date 10/03/2006	Docket No.

This is in response to the request for a Certificate of Correction filed _____

☑ **Request Denied** - Consideration has been given to your request for the issuance of a Certificate of Correction under the provisions of 37 CFR 1.322 and/or 37 CFR 1.323. The Request is improper and denied for the reason(s) below:

1. ☐ Assignees' names and addresses (assignment data) printed in a patent, are based solely on information supplied in the appropriate space for identifying the assignment data on the Issue Fee Transmittal Form (PTOL-85b). Any request for a patent to be corrected to state the name of the assignee, must state that the assignment was submitted for recordation as set forth in in 37 CFR 3.11 before issuance of the patent. Petition under 3.81 is to be filed for consideration of correction to assignee. The petition fee set forth in 37 CFR 1.17(i)(1) (currently $140, $70, $35 for large, small and micro entities, respectively.

2. ☐ The alleged error in _____, is in fact an Amendment and/or Change made by the examiner and considered to be in accordance with the permissible amendments enumerated in the Manual of Patent Examining Procedure (MPEP) Section 1302.04. Applicant did not file objection or amendment under 37 CFR 1.312 prior to payment of the issue fee.

3. ☐A petition under CFR 1.182 is required to correct the alleged errors in spelling or order of inventor's names, since inventor's names are printed solely in accordance with the type-written names, and in the order of the type-written names on the Application Data Sheet (ADS). The required fee currently under rule 1.17(f) (small entity $200, large entity $400, micro entity fee $100).

4. ☐ With respect to the alleged error in changing the inventor name on the patent due to clerical error in ADS/OATH of related patents. The inventors name is printed in accordance with the OATH/ADS submitted at the time of filing the application. However, your attention is directed to C.F.R. 1.324, wherein a request is being made to change, add or delete inventor(s), after issuance of the patent.

5. ☐ With respect to the alleged error in _____, comparison of the printed patent with the corresponding location in the application file reveals that there is no discrepancy.

6. ☐ With respect to 37 CFR 1.72, the title should be brief but technically accurate and descriptive and should contain fewer than 500 characters. Inasmuch as the words "new," "improved," "improvement of," and "improvement in" are not considered as part of the title of an invention, these words should not be included at the beginning of the title of the invention and will be deleted when the Office enters the title into the Offices computer records, and when any patent issues.

7. ☐ The fee for correction under 37 CFR 1.323 is set forth in 37 CFR 1.20(a). ☐Partial fee ☐No fee was received with your request. Full fee payment is required before further action is taken on this request.

8. ☐ With respect to the request for corrected Letters Patent (Grant), corrections to the original Letters Patent are made under the provisions of Rule 1.322(b), not Rule1.323, unless a petition is granted.

9. ☑ Other Comments: A petition letter is showing the record is dismissed by the petitions office.

Further correspondence concerning this matter should be filed and directed to the Certificates of Correction Branch.

Legal Instrument Examiner: HENRY D RANDALL Phone: (703)756-5778

Certificates of Correction Branch email: CustomerServiceCoC@uspto.gov CoC Central Phone Number: (703)756-1814

If applicable, information regarding a petition under 37 CFR 1.183 should be directed to the attention of the Commissioner for Patents using the FAX number (571) 273-8300

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/861,102	05/18/2001	Hui Jin		6026

83559 7590 04/06/2022

Bryan Cave Leighton Paisner LLP
1290 Avenue Of the Americas
New York, NY 10104

EXAMINER	
HA, DAC V	

ART UNIT	PAPER NUMBER
2611	

NOTIFICATION DATE	DELIVERY MODE
04/06/2022	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

PATENTS-NY@bclplaw.com

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

In re Patent No. 7,116,710
Issue Date: October 3, 2006
Application No. 09/861,102
Filing or 371(c) Date: 18 May 2001
Attorney Docket No.

DECISION ON PETITION

This is a decision on the petition under 37 CFR 1.182, filed December 13, 2019, requesting issuance of a duplicate Letters Patent and concurrently filed a petition under 1.182 for expedited consideration.

The petition for expedited consideration under 37 CFR 1.182 is **DISMISSED**.
The Office acknowledges the request for expedited handling of the petition for duplicate letters patent. However, as the petition was not accorded expedited handling, the fee therefor has not been charged.

The petition under 37 CFR 1.182 for issuance of a duplicate Letters Patent is **GRANTED**.

The Office of Data Management is directed to issue a duplicate Letters Patent.

Telephone inquiries concerning this decision may be directed to Kimberly Inabinet at (571) 272-4618. Inquiries regarding the issuance of a duplicate Letters Patent may be directed to the Office of Data Management at (571-272-4200).

A copy of this decision is being forwarded to the Publishing Division for issuance of duplicate Letters Patent.

/KIMBERLY A INABINET/
Paralegal Specialist, OPET

cc: Charles C. Hagadorn, III
Wilson, Sonsini, Goodrich & Rosati
650 Page Mill Road
Palo Alto, CA 94304-1050

cc: Rochaun Hardwick (Fax - 571-270-9958)

Transmittal Communication on Petition	Application/Control No. 09/861,102	Applicant(s)/Patent Under Reexamination Jin et al.	
	Deciding Official HA, DAC V	Office of Petitions OPET	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address. --

(ADDITIONAL PARTY'S CORRESPONDENCE ADDRESS)

Charles C. Hagadorn, III
Wilson, Sonsini, Goodrich & Rosati
650 Page Mill Road
Palo Alto, CA 94304-1050

Enclosed is a copy of the latest communication from the United States Patent and Trademark Office in the above-identified Application/Patent.

United States Patent and Trademark Office

Office of the Chief Financial Officer

Document Code:WFEE

User :C47345

Sale Adjustment Accounting Date:04/06/2022

Effective Date	Sale Accounting Date	Sale Item Reference Number
12/13/2019	04/06/2022	09861102

Document Number	Fee Code	Fee Code Description	Amount Paid	Payment Method
I202246933443206	1462	PETITION FEE- 37 CFR 1.17(F) (GROUP I)	$400.00	DA

United States Patent and Trademark Office

Office of the Chief Financial Officer

Document Code:WFEE

User :C47345

Refund Accounting Date:04/06/2022

Effective Date	Sale Item Reference Number	Refund Total
12/13/2019	09861102	$400.00

Document Number	Fee Code	Fee Code Description	Amount Paid	Payment Method	Account Number
I202246933443206	1462	PETITION FEE- 37 CFR 1.17(F) (GROUP I)	$400.00	DA	232415

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/861,102	05/18/2001	Hui Jin	06618-637001 / CIT3220

CONFIRMATION NO. 6026

29690
CALIFORNIA INSTITUTE OF TECHNOLOGY
1200 E.CALIFORNIA BLVD.
MC 6 - 32
PASADENA, CA 91125

POWER OF ATTORNEY NOTICE

OC00000132626780

Date Mailed: 03/23/2022

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 03/21/2022.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/sharris/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/861,102	05/18/2001	Hui Jin	

CONFIRMATION NO. 6026

83559
Bryan Cave Leighton Paisner LLP
1290 Avenue Of the Americas
New York, NY 10104

POA ACCEPTANCE LETTER

OC000000132626841

Date Mailed: 03/23/2022

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 03/21/2022.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/sharris/

PTO/SB/44 (09-07)
Approved for use through 03/31/2023. OMB 0651-0033
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.
(Also Form PTO-1050)

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 7,116,710

APPLICATION NO.: 09/861,102

ISSUE DATE : October 3, 2006

INVENTOR(S) : Hui Jin; Aamod Khandekar; Robert J. McEliece

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

At column 1, line 8, the sentence (as amended by the Certificate of Correction issued on July 22, 2008) reading

"This application claims the priority of U.S. Provisional Application Ser. No. 60/205,095, filed on May 18, 2000, and is a continuation-in-part of U.S. application Ser. No. 09/922,852, filed on Aug. 18, 2000 and entitled Interleaved Serial Concatenation Forming Turbo-Like Codes."

should read

-- This application claims the priority of U.S. Provisional Application Ser. No. 60/205,095, filed on May 18, 2000. --

MAILING ADDRESS OF SENDER (Please do not use Customer Number below):
Kevin C. Hooper
BRYAN CAVE LEIGHTON PAISNER LLP
1290 Avenue of the Americas
New York, NY 10104

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	09861102
Filing Date:	18-May-2001
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Filer:	Ethan Richard Fitzpatrick/Teresa Rodriguez
Attorney Docket Number:	06618-637001 / CIT3220

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
CERTIFICATE OF CORRECTION	1811	1	160	160

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**160**

Electronic Acknowledgement Receipt	
EFS ID:	45280826
Application Number:	09861102
International Application Number:	
Confirmation Number:	6026
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Customer Number:	29690
Filer:	Ethan Richard Fitzpatrick/Teresa Rodriguez
Filer Authorized By:	Ethan Richard Fitzpatrick
Attorney Docket Number:	06618-637001 / CIT3220
Receipt Date:	21-MAR-2022
Filing Date:	18-MAY-2001
Time Stamp:	19:13:03
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$160
RAM confirmation Number	E20223KJ13273458
Deposit Account	024467
Authorized User	Teresa Rodriguez
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	7116710_Request-for-CoC.pdf	129732 46c331ea0a1b704eacaf0f53ac4df8fcee1304c1	no	2
Warnings:					
Information:					
2	Request for Certificate of Correction	CoC-Form-US7116710.pdf	646143 69efab7f6d177057e72d1ed1e38b0e5616d37371	no	2
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	38020 87419a502134938d0b25109e7423399cc0c02638	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	813895		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re U.S. Patent No. 7,116,710		)	
Inventors:	Hui Jin *et al.*	)	Examiner Dac V. Ha
Issued:	October 3, 2006	)	Art Unit 2611
Serial No.:	09/861,102	)	
Filed:	May 18, 2001	)	
For:	**SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES**	)	

March 21, 2022

REQUEST FOR ISSUANCE OF CERTIFICATE OF CORRECTION

Attention: Certificate of Corrections Branch
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The issuance of a Certificate of Correction for the above-identified patent as set forth on the attached PTO/SB/44 form is requested.

The following correction is requested under 37 CFR § 1.323:

At column 1, line 8, the sentence (as amended by the Certificate of Correction issued on July 22, 2008) reading

"This application claims the priority of U.S. Provisional Application Ser. No. 60/205,095, filed on May 18, 2000, and is a continuation-in-part of U.S. application Ser. No. 09/922,852, filed on Aug. 18, 2000 and entitled Interleaved Serial Concatenation Forming Turbo-Like Codes."

should read

-- This application claims the priority of U.S. Provisional Application Ser. No. 60/205,095, filed on May 18, 2000. --

REMARKS

A Certificate of Correction is requested to correct the foregoing errors under 37 CFR § 1.323.

The inclusion of a reference to U.S. application Ser. No. 09/922,852 was a clerical mistake/mistake of minor character and its removal does not constitute new matter or require reexamination. Pursuant to Rule 78(h), a corrected Application Data Sheet is not required with this paper. *See* 37 C.F.R. 1.78(h) (The requirement of a specific reference to a prior-filed application is "satisfied by the presentation of such specific reference in the first sentence(s) of the specification following the title in a nonprovisional application filed under 35 U.S.C. 111(a) before September 16, 2012 . . . .")

For the reason set forth above, we submit that a Certificate of Correction is appropriate. Accordingly, correction is requested under 37 CFR 1.323. Please charge the required fee to Deposit Account No. 02-4467.

Prompt issuance of the Certificate of Correction is respectfully requested.

I hereby certify that this correspondence is being transmitted in accordance with 37 CFR §§1.6(a)(4) and 1.8 via the U.S. Patent and Trademark Office (USPTO) electronic filing system (EFS-Web) to: Attention: Certificate of Corrections Branch, Commissioner For Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on March 21, 2022.

/Teresa C. Rodriguez/
Teresa C. Rodriguez

Respectfully submitted,

By: /Kevin C. Hooper/

Kevin C. Hooper
Registration No. 40,402
BRYAN CAVE LEIGHTON PAISNER LLP
1290 Avenue of the Americas
New York, NY 10104-3300
Ph: (212) 541-2000
Fx: (212) 541-4630
kchooper@bclplaw.com

PTO/SB/81A (12-08)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995 no persons are required to respond to a collection of information unless it displays a valid OMB control number

PATENT - POWER OF ATTORNEY OR REVOCATION OF POWER OF ATTORNEY WITH A NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

Patent Number	7,116,710
Issue Date	October 3, 2006
First Named Inventor	Hui JIN
Title	Serial Concatenation of Interleaved Convolutional Codes Forming Turbo-Like Codes
Attorney Docket No.	

I hereby revoke all previous powers of attorney given in the above-identified patent.

☐ A Power of Attorney is submitted herewith.

OR

☒ I hereby appoint Practitioner(s) associated with the Customer Number identified in the box at right as my/our attorney(s) or agent(s) with respect to the patent identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

83559

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s) with respect to the patent identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

Practitioner(s) Name	Registration Number

Please recognize or change the correspondence address for the above-identified patent to:

☒ The address associated with the above-identified Customer Number.

OR

☐ The address associated with the Customer Number identified in the box at right:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the:

☐ Inventor, having ownership of the patent.

OR

☒ Patent owner.

Statement under 37 CFR 3.73(b) (Form PTO/SB/96) submitted herewith or filed on _____.

SIGNATURE of Inventor or Patent Owner

Signature	[signature]	Date	3/18/2022
Name	Fred Farina	Telephone	626-395-3058
Title and Company	Chief Innovation and Corporate Partnerships Officer		

NOTE: Signatures of all the inventors or patent owners of the entire interest or their representative(s) are required. If more than one signature is required, submit multiple forms, check the box below, and identify the total number of forms submitted in the blank below.

☒ A total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public, which is to update (and by the USPTO to process) the file of a patent or reexamination proceeding. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 15 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/SB/96 (11-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: California Institute of Technology

Application No./Patent No.: 7,116,710 Filed/Issue Date: October 3, 2006

Titled: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

California Institute of Technology, a non-profit corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.

states that it is:

1. ☒ the assignee of the entire right, title, and interest in;

2. ☐ an assignee of less than the entire right, title, and interest in (The extent (by percentage) of its ownership interest is _____ %); or

3. ☐ the assignee of an undivided interest in the entirety of (a complete assignment from one of the joint inventors was made)

the patent application/patent identified above, by virtue of either:

A. ☒ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 012225, Frame 0885, or a copy* is attached.

OR

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel_____, Frame_____, or a copy* is attached.

2. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel_____, Frame_____, or a copy* is attached.

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel_____, Frame_____, or a copy* is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☒ *As required by 37 CFR 3.73(b)(1)(i), if a copy/copies is/are attached, the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (*i.e.*, a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Kevin C. Hooper/ March 21, 2022

Signature Date

Kevin C. Hooper 40,402

Printed or Typed Name Title or Registration Number

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt	
EFS ID:	45276288
Application Number:	09861102
International Application Number:	
Confirmation Number:	6026
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Customer Number:	29690
Filer:	Ethan Richard Fitzpatrick/Teresa Rodriguez
Filer Authorized By:	Ethan Richard Fitzpatrick
Attorney Docket Number:	06618-637001 / CIT3220
Receipt Date:	21-MAR-2022
Filing Date:	18-MAY-2001
Time Stamp:	14:57:56
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	7116710-POA.pdf	604606 908c718f88f194d06f96a2017101ae3c6a48628a	no	2

Warnings:

Information:					
2	Assignee showing of ownership per 37 CFR 3.73	7116710-sb0096_2.pdf	171039 0a146ec491df08b2d93fb173052350128a1cf29a	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	775645	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court WESTERN DISTRICT OF TEXAS on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
6:20-cv-1042	11/11/2020	WESTERN DISTRICT OF TEXAS

PLAINTIFF	DEFENDANT
The CALIFORNIA INSTITUTE OF TECHNOLOGY	DELL TECHNOLOGIES INC. and DELL INC.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	U.S. 7,116,710	10/3/2006	CALIFORNIA INSTITUTE OF TECHNOLOGY
2	U.S. 7,421,032	9/2/2008	CALIFORNIA INSTITUTE OF TECHNOLOGY
3	U.S. 7,916,781	3/29/2011	CALIFORNIA INSTITUTE OF TECHNOLOGY
4			
5			

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

Print Save As... Reset

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court WESTERN DISTRICT OF TEXAS on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
6:20-cv-1041	11/11/2020	WESTERN DISTRICT OF TEXAS

PLAINTIFF	DEFENDANT
The CALIFORNIA INSTITUTE OF TECHNOLOGY	HP INC.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	U.S. 7,116,710	10/3/2006	CALIFORNIA INSTITUTE OF TECHNOLOGY
2	U.S. 7,421,032	9/2/2008	CALIFORNIA INSTITUTE OF TECHNOLOGY
3	U.S. 7,916,781	3/29/2011	CALIFORNIA INSTITUTE OF TECHNOLOGY
4			
5			

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director **Copy 3—Upon termination of action, mail this copy to Director**
Copy 2—Upon filing document adding patent(s), mail this copy to Director **Copy 4—Case file copy**

Print Save As... Reset

(12) **INTER PARTES REVIEW CERTIFICATE** (1909th)
United States Patent
Jin et al.
(10) **Number: US 7,116,710 K1**
(45) **Certificate Issued: Feb. 16, 2021**

(54) **SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES**

(75) Inventors: **Hui Jin**; **Aamod Khandekar**; **Robert J. McEliece**

(73) Assignee: **CALIFORNIA INSTITUTE OF TECHNOLOGY**

Trial Numbers:

IPR2017-00210 filed Nov. 15, 2016
IPR2017-00219 filed Nov. 15, 2016

Inter Partes Review Certificate for:

Patent No.: **7,116,710**
Issued: **Oct. 3, 2006**
Appl. No.: **09/861,102**
Filed: **May 18, 2001**

The results of IPR2017-00210 and IPR2017-00219 are reflected in this inter partes review certificate under 35 U.S.C. 318(b).

INTER PARTES REVIEW CERTIFICATE
U.S. Patent 7,116,710 K1
Trial No. IPR2017-00210
Certificate Issued Feb. 16, 2021

AS A RESULT OF THE INTER PARTES REVIEW PROCEEDING, IT HAS BEEN DETERMINED THAT:

Claims **1-8**, **11-17**, **19-22** and **24-33** are found patentable.

* * * * *

AO 120 (Rev. 08/10)

TO:	Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Central District of California on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:16-cv-3714	5/26/2016	Central District of California

PLAINTIFF	DEFENDANT
California Institute of Technology	Broadcom Limited, Broadcom Corporation, Avago Technologies Limited, Apple Inc.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	7,116,710	10/3/2006	California Institute of Technology
2	7,421,032	9/2/2008	California Institute of Technology
3	7,916,781	3/29/2011	California Institute of Technology
4	8,284,833	10/9/2012	California Institute of Technology
5			

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

Application Number * 09/861,102 *	Application/Control No. 09/861,102	Applicant(s)/Patent under Reexamination Jin et al.	
	Examiner HA, DAC V	Art Unit 2611	

Document Code - DISQ	Internal Document - DO NOT MAIL

TERMINAL DISCLAIMER	☑ APPROVED	☐ DISAPPROVED
Date Filed: 13 August 2020	This patent is subject to a Terminal Disclaimer	

Approved/Disapproved by:
/TRINA STEPTOE/
Technology Center: OPLC
Telephone: (571)272-2577
7,421,032

PTO/SB/26a (02-14)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

TERMINAL DISCLAIMER IN A PATENT OR PROCEEDING IN VIEW OF ANOTHER PATENT

Docket Number (Optional)

06618-637001

Application/Control Number: 09/861,102
Filing Date: 2001-05-18
First Named Inventor: Hui JIN
Title: SERIAL CONCANTENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
Patent No.: 7.116.710

The patentee, California Institute of Technology, owner of 100 percent interest in the instant patent hereby disclaims, except as provided below, the terminal part of the statutory term of the instant patent which would extend beyond the expiration date of the full statutory term of patent No. 7.421.032 (the "**reference** patent"), as the term of said **reference** patent is presently shortened by any terminal disclaimer. The patentee hereby agrees that the instant patent shall be enforceable only for and during such period that the instant patent and the **reference** patent are commonly owned. This agreement runs with the instant patent and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the patentee does not disclaim the terminal part of the instant patent that would extend to the expiration date of the full statutory term of the **reference** patent, "as the term of said **reference patent** is presently shortened by any terminal disclaimer," in the event that said **reference** patent later: expires for failure to pay a maintenance fee; is held unenforceable; is found invalid by a court of competent jurisdiction; is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321; has all claims canceled by a reexamination certificate; is reissued; or is in any manner terminated prior to the expiration of its full statutory term as shortened by any terminal disclaimer.

I. Check either box 1, 2, or 3 below, as appropriate, if there is an assignment:

1. ☑ The current ownership was established by the filing of a statement under 37 CFR 3.73 during prosecution of the application that issued as the instant patent.

2. ☐ The instant patent was issued from an application filed on or after September 16, 2012, and the current patent owner was the applicant under 37 CFR 1.46.

3. ☐ A statement under 37 CFR 3.73 is attached herewith. Form PTO/SB/96 or PTO/AIA/96, as appropriate, may be used.

II. Authorization for Terminal Disclaimer - Check either box 1 or 2 below, if appropriate:

I hereby acknowledge that any willful false statements made are punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

1. ☑ For submissions on behalf of a business/organization (e.g., corporation, partnership, university, government agency, etc.), the undersigned is empowered to act on behalf of the business/organization.

2. ☑ The undersigned is an attorney or agent of record. Reg. No. 48467

Signature	Date
	08/13/2020

Typed or printed name	Telephone number
Frederic J. Farina	+1626-202-8976

☑ The terminal disclaimer fee under 37 CFR 1.20(d) is included.

NOTE: Submit multiple forms if more than one signature is required, see below.*

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

☐ *Total of _____ forms are submitted.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal	
Application Number:	09861102
Filing Date:	18-May-2001
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Filer:	Bing Ai/Amy Candeloro
Attorney Docket Number:	06618-637001 / CIT3220
Filed as Large Entity	
Filing Fees for Utility under 35 USC 111(a)	

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
STATUTORY OR TERMINAL DISCLAIMER	1814	1	160	160
		Total in USD ($)		**160**

Electronic Acknowledgement Receipt	
EFS ID:	40280817
Application Number:	09861102
International Application Number:	
Confirmation Number:	6026
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Customer Number:	29690
Filer:	Bing Ai/Amy Candeloro
Filer Authorized By:	Bing Ai
Attorney Docket Number:	06618-637001 / CIT3220
Receipt Date:	13-AUG-2020
Filing Date:	18-MAY-2001
Time Stamp:	18:16:01
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$160
RAM confirmation Number	E20208CI17190421
Deposit Account	500665
Authorized User	Amy Candeloro
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.17 (Patent application and reexamination processing fees) 37 CFR 1.21 (Miscellaneous fees and charges)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Terminal Disclaimer Filed	2020-08-13_Terminal-Disclaimer-7116710.pdf	186970 667cea7154bc3e9e5e1e2bbff9ebf0211c44bf87	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30357 ec0855e5e3fb73b5c229902762587a31abdf0834	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	217327		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

NOTE: This disposition is nonprecedential.

United States Court of Appeals for the Federal Circuit

APPLE INC.,
Appellant

v.

CALIFORNIA INSTITUTE OF TECHNOLOGY,
Appellee

2019-1580, 2019-1581

Appeals from the United States Patent and Trademark Office, Patent Trial and Appeal Board in Nos. IPR2017-00210, IPR2017-00219.

JUDGMENT

JAMES MURPHY DOWD, Wilmer Cutler Pickering Hale and Dorr LLP, Los Angeles, CA, argued for appellant. Also represented by MARK D. SELWYN, Palo Alto, CA; RUSSELL SPIVAK, New York City, NY; MARK CHRISTOPHER FLEMING, LAUREN B. FLETCHER, WILLIAM F. LEE, Boston, MA.

MICHAEL T. ROSATO, Wilson, Sonsini, Goodrich & Rosati, PC, Seattle, WA, argued for appellee. Also represented by MATTHEW A. ARGENTI, Palo Alto, CA; RICHARD TORCZON, Washington, DC.

THIS CAUSE having been heard and considered, it is

ORDERED and ADJUDGED:

PER CURIAM (WALLACH, TARANTO, and STOLL, *Circuit Judges*).

AFFIRMED. See Fed. Cir. R. 36.

ENTERED BY ORDER OF THE COURT

March 5, 2020
Date

/s/ Peter R. Marksteiner
Peter R. Marksteiner
Clerk of Court

United States Court of Appeals for the Federal Circuit

APPLE INC.,
Appellant

v.

CALIFORNIA INSTITUTE OF TECHNOLOGY,
Appellee

2019-1580, 2019-1581

Appeals from the United States Patent and Trademark Office, Patent Trial and Appeal Board in Nos. IPR2017-00210, IPR2017-00219.

MANDATE

In accordance with the judgment of this Court, entered March 5, 2020, and pursuant to Rule 41 of the Federal Rules of Appellate Procedure, the formal mandate is hereby issued.

FOR THE COURT

April 13, 2020

/s/ Peter R. Marksteiner
Peter R. Marksteiner
Clerk of Court

Attorney Docket No. 06618-637001 / CIT3220
WSGR No. 38075-700

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Patent of:	Confirmation No.: 6026
Inventors: Hui Jin *et al.*	Examiner: Dac V. Ha
Application No.: 09/861,102	Group Art Unit: 2611
Filed: May 18, 2001	Customer No.: 29690
Patent No.: 7,116,710	
Issued: October 3, 2006	Certificate of Electronic Filing
Title: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES	I hereby certify that the attached petition is being deposited by Electronic Filing on **December 13, 2019**, by using the EFS – Web patent filing system and addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450. By: /Hillary Pratt/ Hillary Pratt

Mail Stop Petition
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

PETITION UNDER 37 C.F.R § 1.182 FOR DUPLICATE LETTERS PATENT AND PETITION TO EXPEDITE REVIEW

Dear Sir/Madam:

Pursuant to 37 C.F.R. § 1.182, Applicants hereby respectfully Petition to receive a duplicate Letters Patent for U.S. Patent No. 7,116,710. The undersigned certifies that the original Letters Patent was lost.

It is hereby respectfully petitioned that the Office expedite processing of the Petition Under 37 C.F.R. § 1.182 for duplicate Letters Patent. In support of this petition, Applicants submit the expedited petition fee set forth in 37 C.F.R. § 1.17(f).

The Director is hereby authorized to charge the amount of $800 to cover the fees set forth in 37 CFR § 1.182, plus any deficiency in the fees filed, asserted to be filed or which should have been filed herewith to our Deposit Account No. 23-2415, referencing WSGR No. 38075-700.

Respectfully submitted,

WILSON SONSINI GOODRICH & ROSATI
Professional Corporation

Date: December 13, 2019

By: /Charles C. Hagadorn, III/
Charles C. Hagadorn, III
Registration No. 62,367

650 Page Mill Road
Palo Alto, CA 94304-1050
(650) 493-9300

Electronic Patent Application Fee Transmittal

Application Number:	09861102
Filing Date:	18-May-2001
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Filer:	Charles C. Hagadorn III/Hillary Pratt
Attorney Docket Number:	06618-637001 / CIT3220

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
PETITION FEE- 37 CFR 1.17(F) (GROUP I)	1462	1	400	400
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**400**

Electronic Acknowledgement Receipt	
EFS ID:	38031303
Application Number:	09861102
International Application Number:	
Confirmation Number:	6026
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Customer Number:	29690
Filer:	Charles C. Hagadorn III/Hillary Pratt
Filer Authorized By:	Charles C. Hagadorn III
Attorney Docket Number:	06618-637001 / CIT3220
Receipt Date:	13-DEC-2019
Filing Date:	18-MAY-2001
Time Stamp:	19:21:49
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$400
RAM confirmation Number	E2019BCJ22206043
Deposit Account	232415
Authorized User	Hillary Pratt
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Petition for review by the Office of Petitions	7_116_710_Petition_1_182.pdf	139340 fd318e7b45e7a3c704b9fa1c88f25c90cf7eb553	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30449 87fbb31b52d60b3bea6ceccd8c7faa7a1063bb51	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	169789		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Case No. IPR2017-00219
Docket No.: 1033300-00287US3

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Apple Inc.,
Petitioner

v.

California Institute of Technology,
Patent Owner

IPR2017-00219
Patent No. 7,116,710

PETITIONER'S NOTICE OF APPEAL

Director of the United States Patent and Trademark Office
c/o Office of the General Counsel
P.O. Box 1450
Alexandria, VA 22314-5793

Pursuant to 35 U.S.C. §§ 141-44 and 319, and 37 C.F.R. § 90.2-90.3, notice is hereby given that Petitioner Apple Inc. appeals to the United States Court of Appeals for the Federal Circuit from the Final Written Decision entered December 27, 2018 (Paper 76) in IPR2017-00219 (Exhibit A), and all prior and interlocutory rulings related thereto or subsumed therein.

In accordance with 37 C.F.R. § 90.2(a)(3)(ii), Petitioner further indicates that the issues on appeal include, but are not limited to, whether the Patent Trial and Appeal Board erred in determining that Petitioner had not established by a preponderance of the evidence that claims 1–8 and 11–14 of the '710 patent would have been obvious over the combination of Divsalar and Luby; and that claims 15–17, 19–22, and 24–33 of the '710 patent would have been obvious over the combination of Divsalar, Luby, and Luby97; and any finding or determination supporting or related to those issues, as well as all other issues decided adversely to Petitioner in any orders, decisions, rulings, and opinions.

Pursuant to 37 C.F.R. § 90.3, this Notice of Appeal is timely, having been duly filed within 63 days after the date of the Final Written Decision.

A copy of this Notice of Appeal is being filed simultaneously with the Patent Trial and Appeal Board, the Clerk's Office for the United States Court of Appeals for the Federal Circuit, and the Director of the Patent and Trademark Office.

Respectfully submitted,

Date: February 22, 2019

/Michael Smith/

Michael H. Smith
Registration No. 71,190
Counsel for Petitioner

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 90.2(a)(1) and 104.2(a), I hereby certify that, in addition to being filed electronically through the Patent Trial and Appeal Board's End to End (PTAB E2E), a true and correct original version of the foregoing Petitioner's Notice of Appeal is being filed by Express Mail (Express Mail Label EF 183495769 US) on this 22nd day of February 2019, with the Director of the United States Patent and Trademark Office, at the following address:

Director of the United States Patent and Trademark Office
c/o Office of the General Counsel
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

Pursuant to 37 C.F.R. § 90.2(a)(2) and Federal Circuit Rule 15(a)(1), and Rule 52(a),(e), I hereby certify that a true and correct copy of the foregoing Petitioner's Notice of Appeal is being filed in the United States Court of Appeals for the Federal Circuit using the Court's CM/ECF filing system on this 22nd day of February 2019, and the filing fee is being paid electronically using pay.gov.

I hereby certify that on February 22, 2019 I caused a true and correct copy of the Petitioner's Notice of Appeal to be served via e-mail on the following attorneys of record:

Michael Rosato (mrosato@wsgr.com)

Matthew Argenti (margenti@wsgr.com)

Richard Torczon (rtorczon@wsgr.com)

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/Michael Smith/

Michael H. Smith
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EXHIBIT A

Trials@uspto.gov
571-272-7822

Paper 76
Entered: December 27, 2018

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

CALIFORNIA INSTITUTE OF TECHNOLOGY,
Patent Owner.

Case IPR2017-00219
Patent 7,116,710 B1

Before KEN B. BARRETT, TREVOR M. JEFFERSON, and JOHN A. HUDALLA, *Administrative Patent Judges*.

JEFFERSON, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

Petitioner, Apple, Inc. ("Apple"), filed a Petition (Paper 5, "Pet.") requesting an *inter partes* review of claims 1–8, 10–17, and 19–33 of U.S. Patent No. 7,116,710 B1 (Ex. 1201, "the '710 patent") pursuant to 35 U.S.C. §§ 311–319. Patent Owner, California Institute of Technology ("Caltech"), filed a Preliminary Response (Paper 16, "Prelim. Resp.") to the Petition.

We instituted an *inter partes* review on claims 1–8, 11–17, 19–22, and 24–33 of the '710 patent on certain grounds of unpatentability presented. (Paper 17, "Inst. Dec."). Caltech filed a Patent Owner Response (Paper 34, "PO Resp."), and Apple filed a Petitioner Reply (Paper 45, "Pet. Reply"). Caltech also filed a Sur-Reply (Paper 61, "PO Sur-Reply"), as was authorized by our Order of March 2, 2018 (Paper 54). An oral hearing was held on April 19, 2018, and a transcript of the hearing is included in the record. Paper 71 ("Tr.").

Petitioner filed a Declaration of James A. Davis, Ph.D. (Ex. 1206) submitted with its Petition and a Declaration of Brendan Frey, Ph.D. (Ex. 1265) submitted with its Petitioner's Reply. Patent Owner filed Declarations of Dr. Dariush Divsalar (Ex. 2031) and Dr. Michael Mitzenmacher (Ex. 2004) with its Response.

As authorized in our Order of February 10, 2018 (Paper 47), Patent Owner filed a motion for sanctions (Paper 49) related to Petitioner's cross-examination of Patent Owner's witnesses, Dr. Mitzenmacher and Dr. Divsalar, and Petitioner filed an opposition (Paper 51).

In light of the U.S. Supreme Court's decision in *SAS Institute, Inc. v. Iancu*, 138 S. Ct. 1348 (2018), we modified our Institution Decision to institute on all of the challenged claims and all of the grounds. Paper 68.

Subsequently, the parties filed a joint motion to limit the Petitions to the claims and grounds that were originally instituted. Paper 70. We granted their motion. Paper 72. As a result, the remaining instituted claims and grounds are the same as they had been at the time of the Institution Decision. *See id.* at 2.

The one-year period normally available to issue a Final Written Decision was extended under 37 C.F.R. § 42.100(c). Paper 74, 1–2.

We have jurisdiction under 35 U.S.C. § 6. This decision is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of claims 1–8, 11–17, 19–22, and 24–33 of the '710 patent. For the reasons discussed below, Petitioner has not demonstrated by a preponderance of the evidence that claims that claims 1–8, 11–17, 19–22, and 24–33 are unpatentable.

A. Related Proceedings

The parties indicate that the '710 patent was involved in the following active case, *Cal. Inst. of Tech. v. Broadcom Ltd.*, No. 2:16-cv-03714 (C.D. Cal. filed May 26, 2016), and in concluded cases, *Cal. Inst. of Tech. v. Hughes Commc'ns, Inc.*, No. 2:15-cv-01108 (C.D. Cal. filed Feb. 17, 2015); and *Cal. Inst. of Tech. v. Hughes Commc'ns, Inc.*, 2:13-cv-07245 (C.D. Cal. filed Oct. 1, 2013). Pet. 3, Paper 8, 2–3.

The parties also identify co-pending case IPR2017-00210, in which Apple filed a petition for *inter partes* review of the '710 patent. Pet. 3; Paper 8, 2–3. The Board previously denied petitions for *inter partes* review of the '710 patent in *Hughes Network Sys. v. Cal. Inst. of Tech.*, Case IPR2015-00067 (PTAB April 27, 2015) (Paper 18) ("IPR2015-00067") and

Hughes Network Sys. v. Cal. Inst. of Tech., Case IPR2015-00068 (PTAB April 27, 2015) (Paper 18) ("IPR2015-00068"). Finally, certain patents related to the '710 patent were challenged in IPR2015-00059, IPR2015-00060, IPR2015-00061, and IPR2015-00081. Pet. 3. A Final Written Decision cancelling claims 1 and 2 of U.S. Patent No. 7,916,781 B2 was issued in *Hughes Network Sys. v. Cal. Inst. of Tech.*, Case IPR2015-00059 (PTAB April 21, 2016) (Paper 42).

B. The '710 Patent

The '710 patent describes the serial concatenation of interleaved convolutional codes forming turbo-like codes. Ex. 1201, Title. It explains some of the prior art with reference to its Fig. 1, reproduced below.

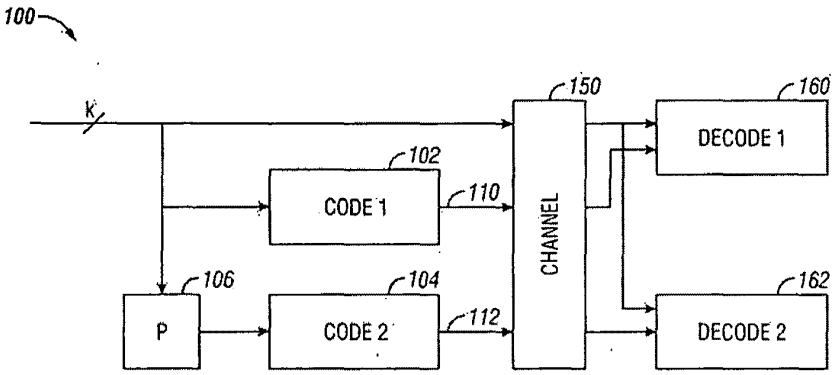

FIG. 1
(Prior Art)

Figure 1 is a schematic diagram of a prior "turbo code" system. *Id.* at 2:14–15. The '710 patent specification describes Figure 1 as follows:

> A standard turbo coder 100 is shown in FIG. 1. A block of k information bits is input directly to a first coder 102. A k bit interleaver 106 also receives the k bits and interleaves them prior to applying them to a second coder 104. The second coder produces an output that has more bits than its input, that

> is, it is a coder with rate that is less than 1. The coders 102,104 are typically recursive convolutional coders.
>
> Three different items are sent over the channel 150: the original k bits, first encoded bits 110, and second encoded bits 112. At the decoding end, two decoders are used: a first constituent decoder 160 and a second constituent decoder 162. Each receives both the original k bits, and one of the encoded portions 110, 112. Each decoder sends likelihood estimates of the decoded bits to the other decoders. The estimates are used to decode the uncoded information bits as corrupted by the noisy channel.

Id. at 1:38–53 (emphasis omitted).

A coder 200, according to a first embodiment of the invention, is described with respect to Figure 2, reproduced below.

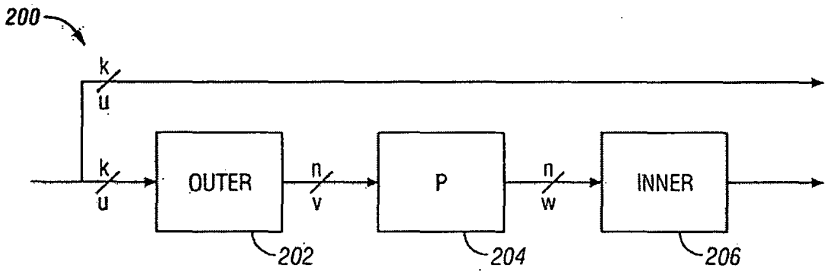

FIG. 2

Figure 2 of the '710 patent is a schematic diagram of coder 200. *Id.* at 2:16–17.

The specification states that "coder 200 may include an outer coder 202, an interleaver 204, and inner coder 206." *Id.* at 2:34–35. It further states as follows.

> The outer coder 202 receives uncoded data. The data may be partitioned into blocks of fixed size, say k bits. The outer coder may be an (n,k) binary linear block coder, where n>k. The coder accepts as input a block u of k data bits and produces an output block v of n data bits. The mathematical

> relationship between u and v is $v=T_0u$, where T_0 is an $n\times k$ matrix, and the rate[1] of the coder is k/n.
>
> The rate of the coder may be irregular, that is, the value of T_0 is not constant, and may differ for sub-blocks of bits in the data block. In an embodiment, the outer coder 202 is a repeater that repeats the k bits in a block a number of times q to produce a block with n bits, where n=qk. Since the repeater has an irregular output, different bits in the block may be repeated a different number of times. For example, a fraction of the bits in the block may be repeated two times, a fraction of bits may be repeated three times, and the remainder of bits may be repeated four times. These fractions define a degree sequence, or degree profile, of the code.
>
> The inner coder 206 may be a linear rate-1 coder, which means that then-bit output block x can be written as $x=T_Iw$, where T_I is a nonsingular $n\times n$ matrix. The inner coder 210 can have a rate that is close to 1, e.g., within 50%, more preferably 10% and perhaps even more preferably within 1% of 1.

Id. at 2:41–64 (emphasis omitted). Codes characterized by a regular repeat of message bits into a resulting codeword are referred to as "regular repeat," whereas codes characterized by irregular repeat of message bits into a resulting codeword are referred to as "irregular repeat." The second ("inner") encoder 206 performs an "accumulate" function. Thus, the two step encoding process illustrated in Figure 2, including a first encoding ("outer encoding") followed by a second encoding ("inner encoding"), results in either a "regular repeat accumulate" ("RRA") code or an "irregular repeat accumulate ("IRA") code, depending upon whether the repetition in the first encoding is regular or irregular.

---

[1] The "rate" of an encoder refers to the ratio of the number of input bits to the number of resulting encoded output bits related to those input bits. *See* Pet. 9.

Figure 4 of the '710 patent, reproduced below, shows an alternative embodiment in which the first encoding is carried out by a low density generator matrix.

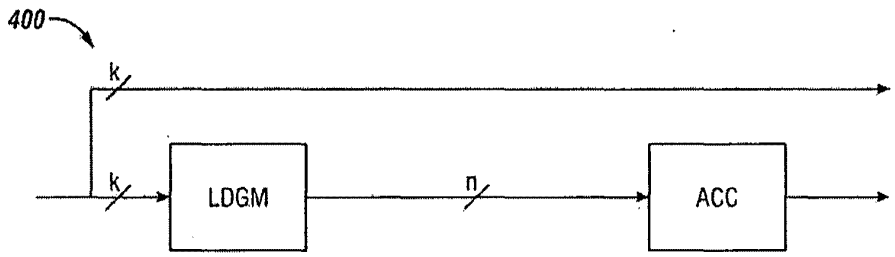

FIG. 4

Figure 4 of the '710 patent is a schematic of an irregular repeat and accumulate coder using a low density generator matrix (LDGM)[2] coder. *Id.* at 2:20–21, 3:25. The LDGM coder "performs an irregular repeat of the k bits in the block, as shown in FIG. 4." *Id.* at 3:52–54. LDGM codes are a special class of low density parity check codes that allow for less encoding and decoding complexity. LDGM codes are systematic linear codes generated by a "sparse" generator matrix. No interleaver (as in the Figure 2 embodiment) is required in the Figure 4 embodiment because the LDGM provides scrambling otherwise provided by the interleaver.

[2] A "generator" matrix (typically referred to by "G") is used to create (generate) codewords. A parity check matrix (typically referred to by "H") is used to decode a received message.

C. Challenged Claims

We instituted challenges on claims 1–8, 10–17, and 19–33 of the '710 patent, of which claims 1, 11, 15, and 25 are independent. Inst. Dec 25; Pet. 21. Claims 1, 3, and 11 are illustrative and reproduced below:

1. A method of encoding a signal, comprising:

obtaining a block of data in the signal to be encoded;

partitioning said data block into a plurality of sub-blocks, each sub-block including a plurality of data elements;

first encoding the data block to from a first encoded data block, said first encoding including repeating the data elements in different sub-blocks a different number of times;

interleaving the repeated data elements in the first encoded data block; and

second encoding said first encoded data block using an encoder that has a rate close to one.

3. The method of claim 1, wherein said first encoding is carried out by a first coder with a variable rate less than one, and said second encoding is carried out by a second coder with a rate substantially close to one.

11. A method of encoding a signal, comprising:

receiving a block of data in the signal to be encoded, the data block including a plurality of bits;

first encoding the data block such that each bit in the data block is repeated and two or more of said plurality of bits are repeated a different number of times in order to form a first encoded data block; and

second encoding the first encoded data block in such a way that bits in the first encoded data block are accumulated.

Ex. 1201, 7:14–25, 7:28–31, 7:50–59.

D. The Remaining Grounds of Unpatentability

The following instituted grounds remain at issue in this case (Inst. Dec. 25; Paper 72, 2):

References	Basis	Claim(s) Challenged
Divsalar[3] and Luby[4]	§ 103(a)	1–8 and 11–14
Divsalar, Luby, and Luby97[5]	§ 103(a)	15–17, 19–22, and 24–33

II. ANALYSIS

A. Claim Interpretation

Because this *inter partes* review is based on a petition filed before November 13, 2018, we construe the claims by applying the broadest reasonable interpretation in light of the specification. 37 C.F.R. § 42.100(b) (2016); *see Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). In applying a broadest reasonable construction, claim terms generally are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Any special definition for a claim term must be set forth in

---

[3] Dariush Divsalar, et al., *Coding Theorems for "Turbo-Like" Codes*, PROCEEDINGS OF THE THIRTY-SIXTH ANNUAL ALLERTON CONFERENCE ON COMMUNICATION, CONTROL, AND COMPUTING, Sept. 23–25, 1998, at 201–209 (Ex. 1203, "Divsalar").

[4] "Luby, M., et al, *Analysis of Low Density Codes and Improved Designs Using Irregular Graphs*, PROCEEDINGS OF THE THIRTIETH ANNUAL ACM SYMPOSIUM ON THEORY OF COMPUTING, May 23–26, 1997, at 249–258 (Ex. 1204, "Luby").

[5] Luby, M. et al., *Practical Loss-Resilient Codes*, PROCEEDINGS OF THE TWENTY-NINTH ANNUAL ACM SYMPOSIUM ON THEORY OF COMPUTING, May 4–6, 1997, at 150–159 (Ex. 1211, "Luby97").

the specification with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

1. "close to one" (claims 1 and 3)

Petitioner argues that the broadest reasonable construction of "close to one" as recited in claims 1 and 3 is "within 50% of one." Pet. 24–25. Petitioner argues that this is consistent with the '710 patent specification, which states that the inner code 210 of Figure 1, "can have a rate that is close to one, e.g., within 50%, more preferably 10% and perhaps even more preferably within 1% of 1." Pet. 24–25 (quoting Ex. 1201, 2:62–64 and citing Ex. 1206 ¶¶ 102–103) (emphasis omitted). Patent Owner does not provide an express claim construction in this proceeding. In related proceeding IPR2017-00210, Patent Owner argues that the term "close to one" does not require construction and that the '710 patent explains that the rate of a coder is the number of input bits divided by the number of output bits. IPR2017-00210, Paper 35, 18.

We determine that "close to one" as recited in the challenged claims is construed as "within 50% of one."

B. Level of Ordinary Skill in the Art

Petitioner cites Dr. Davis's testimony that "[a] person of ordinary skill in the art is a person with a Ph.D. in mathematics, electrical or computer engineering, or computer science with emphasis in signal processing, communications, or coding, or a master's degree in the above area with at least three years of work experience in this field at the time of the alleged invention." Pet. 23 (citing Ex. 1206, ¶ 95). Patent Owner expresses no position on the level of ordinary skill in the art, but their declarant,

Dr. Mitzenmacher, applies the same standard advanced by Petitioner. Ex. 2004 ¶ 70.

We determine that Petitioner's proposed definition comports with the qualifications a person would have needed to understand and implement the teachings of the '710 patent and the prior art of record. Accordingly, we apply Petitioner's definition of the level of ordinary skill in the art.

C. Obviousness based on Luby and Divsalar: Claims 1–8 and 11–14

Petitioner contends that claims 1–8 and 11–14 would have been obvious over the combination of Divsalar and Luby. Pet. 42–60 (citing Ex. 1206 ¶¶ 399–456). Patent Owner disputes Petitioner's contentions. PO Resp. 19–47.

1. Divsalar

Divsalar discloses "turbo-like" coding systems that are built from fixed convolutional codes interconnected with random interleavers, including both parallel concatenated convolutional codes and serial concatenated convolutional codes as special cases. Ex. 1203, 1. With fixed component codes and interconnection topology, Divsalar demonstrates that as the block length approaches infinity, the ensemble (over all possible interleavers) maximum likelihood error probability approaches zero, if the ratio of energy per bit to noise power spectral density exceeds some threshold. *Id.*

The general class of concatenated coding systems is depicted in Figure 1 of Divsalar as follows:

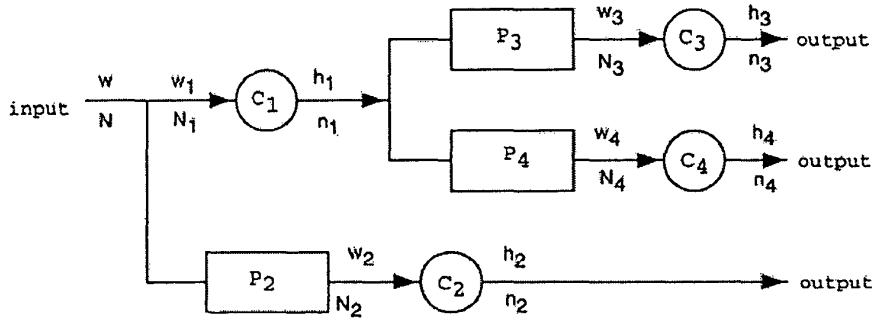

Figure 1. A "turbo-like" code with $s_I = \{1,2\}$, $s_O = \{2,3,4\}$, $\bar{s}_O = \{1\}$.

Figure 1 illustrates that encoders C_2, C_3, and C_4 are preceded by interleavers (permuters) P_2, P_3, and P_4, except C_1, which is connected to an input rather than an interleaver. *Id.* at 2–3. The overall structure must have no loops and, therefore, is called a "turbo-like" code. *Id.*

Divsalar further discloses that "turbo-like" codes are repeat and accumulate (RA) codes. *Id.* at 5. The general scheme is depicted in Figure 3 as follows:

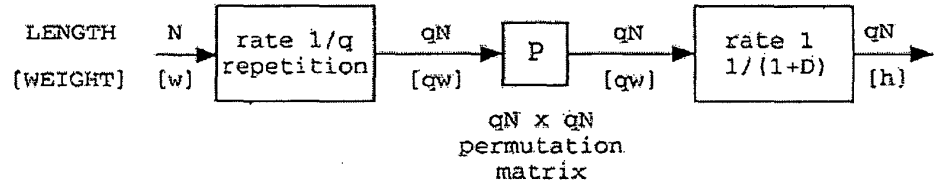

Figure 3. Encoder for a (qN, N) repeat and accumulate code. The numbers above the input-output lines indicate the length of the corresponding block, and those below the lines indicate the weight of the block.

Figure 3 illustrates that information block of length N is repeated q times, scrambled by interleaver of size qN, and then encoded by a rate 1 accumulator. *Id.* The accumulator can be viewed as a truncated rate-1 recursive convolutional encoder. *Id.* Figure 3 further illustrates a simple class of rate 1/q serially concatenated codes where the outer code is a q-fold

repetition code and the inner code is a rate 1 convolutional code with a transfer function 1/(1+ D). *Id.* at 1, 5.

2. Luby

Luby discloses derivation of irregular random graphs that improve upon the performance of Gallager's low-density parity-check (LDPC) codes, and finds that irregular codes described in the paper resulted in codes with improved error correcting capabilities. Ex. 1204, 257. Luby discloses that irregular codes are represented by random irregular bipartite graphs, while regular codes are represented using regular graphs derived from Gallager codes based on sparse bipartite graphs. *Id.* at 249.

Luby discloses that irregular codes are those represented by bipartite graphs in which different message nodes have different degrees (*i.e.*, where different message nodes are connected to different numbers of check nodes). Luby. *Id.* at 257. Luby further states that message nodes with high degree tend to correct their value quickly and then provide good information for check nodes. *Id.* at 253.

3. Analysis

Petitioner contends that claims 1–8 and 11–14 would have been obvious over the combination of Divsalar and Luby. Pet. 34–55 (citing Ex. 1206 ¶¶ 127–456). Petitioner contends that Luby was a significant advance in error-correcting codes using irregularity to design codes that were superior to regular codes. *Id.* at 34–35. Petitioner cites Frey,[6] which credits Luby for providing motivation to study irregular codes, in particular citing

[6] Brendan J. Frey and David J.C. MacKay, *Irregular Turbocodes*, PROCEEDINGS OF THE 37TH ALLERTON CONFERENCE ON COMMUNICATION, CONTROL, AND COMPUTING (1999) at 241–248 (Ex. 1202, "Frey).

Luby's advancements regarding irregular Gallager codes. *Id.* at 35 (citing Ex. 1202, 1 (discussing Luby as reference [1])). Petitioner notes that Luby is expressly discussed as motivation to incorporate irregularity into turbo-like codes, and identifies the codes in Divsalar as such turbo-like codes. *Id.* (citing Ex. 1206 ¶ 401). Petitioner argues that a person of ordinary skill following Frey "would have understood that incorporating irregularity into RA codes would be even more likely to produce favorable results. *Id.* at 36 (citing Ex. 1206 ¶ 403). Petitioner also relies on the Khandekar thesis (Ex. 1218), a thesis written by a co-inventor of the '710 patent, to support the rationale to combine Divsalar and Luby. Pet. 35. Finally, Petitioner argues that a person of ordinary skill in the art would have combined Luby and Divsalar "for research" purposes to "study irregularity." *Id.* at 36.

Petitioner argues that incorporating irregularity into Divsalar's RA codes would have been a simple matter, accomplished in a number of ways requiring minimal modification. Pet. 37–38. Petitioner argues that each of their proposed modifications would have been a routine matter for an ordinarily skilled artisan. *Id.*; Ex. 1206 ¶ 407.

Patent Owner argues that Petitioner's articulated rationale is insufficient to support the motivation to combine the Divsalar and Luby as Petitioner proposes. PO Resp. 30–47. Patent Owner first asserts that Luby does not teach irregular repetition of information bits because Luby's irregularity is different than the '710 patent's irregular repetition of information bits. PO Resp. 26, 30–31; Ex. 2004 ¶¶ 96–97 (testimony from Dr. Mitzenmacher, a coauthor of Luby reference, distinguishing the irregularity discussed in Luby from the irregularity of the '710 patent). Thus, Patent Owner argues that Luby would not have motivated a person of

ordinary skill to modify Divsalar. PO Resp. 31–32. Indeed, Petitioner's expert, Dr. Davis, struggled to define irregularity as it was used in Luby and could not determine whether Luby's irregularity was depicted in an example from his own testimony. *Id.* (citing Ex. 2033 181:4–183:9; 194:4–18). Patent Owner also argues that "[g]iven the limited scope of Luby's findings, a [person of ordinary skill in the art] would not be motivated to modify Divsalar in any way based on Luby." PO Resp. 33 (citing Ex. 2004 ¶¶ 98–100). Patent Owner further asserts that "there was nothing simple about developing improved error-correcting codes, and many advancements in the field were the product of laborious experimentation and surprising, unexpected and unpredictable results." PO Resp. 37 (citing Ex. 2004 ¶¶ 46, 49–50, 53, 104–107); *see also* Ex. 2031 ¶¶ 9–13, 33–34.

Finally, Patent Owner argues that the petition fails to make a sufficient showing that the obviousness combination would have had a reasonable expectation of success. PO Resp. 44–45 (citing *Intelligent Bio-Sys. v. Illumina Cambridge*, 821 F.3d 1359, 1367–68 (Fed. Cir. 2016)). Patent Owner asserts that the evidence shows "that developing error-correction codes that showed an improvement was challenging and unpredictable." PO Resp. 45 (citing Ex. 2004 ¶¶ 116–117; Ex. 2033, 256:21–257:12; Ex. 2031 ¶ 33–35). Indeed, Patent Owner presents persuasive argument and evidence that the combinations proposed by Petitioner would not have been simple substitutions or modifications with a reasonable expectation of success. PO Resp. 45–47.

We agree with Patent Owner that Petitioner has not established that an ordinarily skilled artisan reasonably would have expected success from the combination of Divsalar and Luby. *See* PO Resp. 44–45. We also agree

with Patent Owner that neither Frey (Ex. 1202) nor the Khandekar thesis (Ex. 1218) sufficiently or persuasively support modifications to Divsalar in view of Luby or a reasonable expectation of success in making those modifications. PO Resp. 35–37, 39–44.

The Khandekar thesis (Ex. 1218) fails to support the combination of references. Petitioner provides no arguments or evidence that explains how the thesis supports its contention about how or why a person of ordinary skill in the art would have modified or combined Luby and Divsalar at the time of the '710 patent. Moreover, Petitioner has not explained adequately why or how the thesis of a co-inventor of the '710 patent, which postdates the '710 patent's priority date, is timely corroborating evidence of how a person of ordinary skill in the art would have applied Luby's teachings to Divsalar at the time of patenting. *See* Pet. 45; Inst. Dec. 25. We also find Petitioner's argument and evidence regarding research motivating the combination to be vague and not supported adequately by the declarant testimony (Ex. 1206 ¶ 405).

With respect to Frey,[7] Patent Owner argues that Frey did not show superior results for all error codes, and instead showed that most irregular codes were inferior to other codes. PO Resp. 36–37; Ex. 2004 ¶¶ 102–103. Patent Owner contends that a person of skill in the art would not have been motivated to apply aspects of Frey with a reasonable expectation of success

[7] Patent Owner's contention that Frey is not a prior art publication (PO Resp. 36) is not persuasive. Our Final Written Decision in IPR2017-00210 considered and rejected Patent Owner's argument that the '710 patent inventors conceived and reduced the '710 patent invention before the March 20, 2000, publication date of Frey. IPR2017-00210, Paper 77.

based on Frey only showing improvement in one out of nine profiles. PO Resp. 37. We are persuaded by Patent Owner's arguments that Petitioner's reliance on Frey to does not cure the Petitioner's deficiencies in addressing a reasonable expectation of success.

Petitioner's argument in response acknowledges the missing expectation of success evidence by turning to the experimental nature of the field as being routine practice. Pet. Reply 9. Petitioner states that

> [a]s [Patent Owner] concedes, *rigorous mathematical analysis of codes is difficult, and, as a result, POSAs routinely developed codes by experimentation.* POR, 2. Encouraged by Luby's results, a POSA would have been motivated to use Luby's irregularity in Divsalar. The Petition showed that POSAs would have had an expectation of success because it was simple to modify Divsalar to repeat information bits different numbers of times, which meets the limitations of the claimed invention. Pet., 37-41. . . . Dr. Mitzenmacher agreed that that [simply] repeating some bits in Divsalar "q+10" times and others "q" times would make the code irregular. Ex. 1262, 153:11-154:8.

Pet. Reply 9–10 (emphasis added). To support this contention, Petitioner introduces new testimony and simulations from a new declarant, Dr. Frey, to confirm that using Frey's irregularity in Divsalar would not have been difficult and would have yielded a reasonable expectation of success. *Id.* at 10–11 (citing Ex. 1265).

Even if we were to deem the testimony and simulation from Dr. Frey to be within the proper scope of a reply brief,[8] they do not support a reasonable expectation of success *at the time of the invention.* We agree

[8] We need not reach this issue, because we do not rely on this evidence in a manner adverse to Patent Owner. *See infra* § III.A. (dismissing Patent Owner's Motion to Exclude as moot on the same basis).

with Patent Owner that "[i]t is completely irrelevant what Dr. Frey claims he could do in the year 2018 when armed with Caltech's patent disclosures and publications, [the inventor's] original coding work, contemporary resources, (e.g., Dr. Frey (¶51) used Matlab, a software program that received over 35 version updates since May 2000), and 18 years of post-filing date knowledge" PO Sur-Reply 7. Because this evidence is not tied to the state of the art at the time of the invention, it is not probative of anticipated success. *See Millennium Pharm., Inc. v. Sandoz Inc.*, 862 F.3d 1356, 1367 (Fed. Cir. 2017) (quoting *Interconnect Planning Corp. v. Feil*, 774 F.2d 1132, 1138 (Fed. Cir. 1985)) ("Those charged with determining compliance with 35 U.S.C. § 103 are required to place themselves in the minds of those of ordinary skill in the relevant art *at the time the invention was made*, to determine whether that which is now plainly at hand would have been obvious at such earlier time." (emphasis added)).

As part of our obviousness analysis, we consider "the scope and content of the prior art." *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). In this regard, we credit Patent Owner's testimony and evidence that an important aspect of the art in this case is the relative unpredictability of developing error-correction codes. *See* PO Resp. 5–6, 45–46 (citing Ex. 2004 ¶¶ 116–117; Ex. 2033, 256:21–257:12) ("The field of error correction coding has historically been characterized by significant experimentation and unpredictable results . . . . Even when well-performing codes are identified, the reasons for the improved performance are often not understood.")); Ex. 2004 ¶ 47.

We do not agree with Petitioner that the need to run experiments in an unpredictable field, such as error-correction coding, indicates anything about

whether such experiments ultimately would have been successful at the time of the invention. Importantly, "[u]npredictability of results equates more with nonobviousness rather than obviousness, whereas that which is predictable is more likely to be obvious." *Honeywell Int'l Inc. v. Mexichem Amanco Holding S.A.*, 865 F.3d 1348, 1356 (Fed. Cir. 2017). In the absence of any evidence rooted in the Petition that substantiates a reasonable expectation of success, Petitioner's reliance on a known need for experimentation is not sufficient to support its obviousness rationale.[9] *See Arctic Cat Inc. v. Bombardier Recreational Prod. Inc.*, 876 F.3d 1350, 1360–61 (Fed. Cir. 2017) ("[W]here a party argues a skilled artisan would have been motivated to combine references, it must show the artisan would have had a reasonable expectation of success from doing so." (internal quotation omitted)).

We are also not persuaded by Petitioner's deposition testimony of Dr. Divsalar as confirmation that a person of ordinary skill in the art would have been motivated to combine Divsalar and Frey. Pet. Reply 12–13 (citing Ex. 1264). Dr. Divsalar's testimony does not address the expectation of success for the modifications to Divsalar proposed by Petitioner. PO Sur-Reply 6; Ex. 2031 ¶¶ 33–35; Ex. 1264 60:1–21, 183:15–186:20.

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[9] Petitioner does not contend that its proposed combination should be analyzed under obvious-to-try case law. *Cf.* Tr., 14:1–6 (Petitioner acknowledging that it was not putting forth an obvious-to-try argument). Nor could Petitioner, because Petitioner does not develop an obvious-to-try theory. Specifically, Petitioner does not establish that the prior art directs which parameters to try and/or guides an inventor toward a particular solution. *See Bayer Schering Pharma AG v. Barr Labs., Inc.*, 575 F.3d 1341, 1347 (Fed. Cir. 2009).

Furthermore, the alleged email from Dr. Frey to Dr. Divsalar suggesting further work on irregular turbocodes (Pet. Reply 12; Ex. 1264, 183:15–186:20) does not indicate an expectation that a particular irregular code would prove successful. As discussed above, the unpredictable nature of the field and need for experimentation for error correcting codes does not resolve the need to address the expectation of success for a proposed modification or combination. Dr. Divsalar's deposition testimony does not persuasively address Petitioner's lack of expectation of success evidence and argument.

For these reasons, we are not persuaded that an ordinarily skilled artisan would have been motivated to combine the teachings of Divsalar and Luby in the manner suggested by Petitioner. Thus, we determine Petitioner has not shown by a preponderance of the evidence that claims 1–8 and 11–14 would have been obvious over the combination of Divsalar and Luby.

D. Obviousness based on Divsalar, Luby, and Luby97: Claims 15—17, 19–22, and 24–33

Petitioner contends that claims 15–17, 19–22, and 24–33 would have been obvious over the combination of Divsalar, Luby, and Luby97. Pet. 55–69 (citing Ex. 1206 ¶¶ 457–503). Patent Owner disputes Petitioner's contentions. PO Resp. 48–50.

1. Luby97 (Ex. 1211)

Luby97 describes randomized constructions of linear-time encodable and decodable codes that can transmit over lossy channels at rates extremely close to capacity." Ex. 1211, Abstract. Luby97 describes receiving data to be encoded in a stream of data symbols, such as bits, where the "*stream of*

data symbols [] is partitioned and transmitted in logical units of blocks." *Id.* at 150 (emphasis added).

2. Analysis

Building upon the reasoning offered to combine Divsalar and Luby, Petitioner contends that a person of ordinary skill in the art would be motivated to combine Divsalar, and Luby97, arguing that both relate to error correcting codes, where Luby97 introduces a stream of data symbols or bits as the blocks of data to encode to the encoders of Divsalar. Pet. 55–56 (citing Ex. 1206 ¶¶ 457–460). Petitioner argues that a person of ordinary skill in the art would have understood using the teaching of streaming in Luby97 to make an encoder capable of receiving and processing streams as opposed to blocks. *Id.* at 56.

Petitioner's analysis for claims 15–17, 19–22, and 24–33 relies on the same rationales and reasoning offered to combine Divsalar and Luby discussed above. Pet. 55–56. Accordingly, Petitioner's rationale for this ground incorporates the same deficiencies discussed above. For this reason, we determine that Petitioner has not shown by a preponderance of the evidence that claims 15–17, 19–22, and 24–33 would have been obvious over the combination of Divsalar, Luby, and Luby97.

III. MOTIONS

A. Patent Owner's Motion to Exclude

Patent Owner moves to exclude Exhibits 1212, 1213, 1216, 1219, 1229–1249, 1253, 1255, 1257–1261, 1265, 1267, 1268 and portions of Exhibits 1262 and 1264. Paper 56, 1. Patent Owner's motion is dismissed as moot with respect to these exhibits, as we do not rely on them in a manner

adverse to Patent Owner.

B. Patent Owner's Motion for Sanctions

Patent Owner requests sanctions against Petitioner for allegedly failing to stay within the proper scope of cross-examination during the deposition of Dr. Mitzenmacher. Paper 49, 1. Specifically, Patent Owner details questioning of Dr. Mitzenmacher that allegedly "ventured into various topics beyond the scope of the witness' direct testimony." *Id.* at 7–9. For example, Patent Owner cites "extensive questioning regarding Tanner graphs and figures newly created by Petitioner's lawyers, but absent from any petition materials or the witness' direct testimony." *Id.* at 8. As sanctions, Patent Owner asks us to: (1) strike the out-of-scope testimony elicited by Petitioner; (2) hold the direct testimony of Dr. Mitzenmacher to be facts established in this proceeding; and (3) impose "reasonable compensatory expenses, including attorney fees, for costs reasonably related to excessive questioning and deposition time." *Id.* at 9–10.

Petitioner contends that "each question posed by Petitioner during Dr. Mitzenmacher's deposition pertained directly to topics and opinions in his declaration." Paper 51, 5. Regarding the Tanner graphs and figures, Petitioner contends these were properly served upon Petitioner at Dr. Mitzenmacher's deposition in accordance with 37 C.F.R. § 42.53(f)(3). *Id.* at 6. According to Petitioner, Patent Owner's proposed sanctions are unwarranted, particularly because Patent Owner suffered no harm. *Id.* at 7–8.

The "Board may impose a sanction against a party for misconduct." 37 C.F.R. § 42.12(a); *see also* 35 U.S.C. § 316(a)(6) (requiring regulations

prescribing sanctions). As the moving party, Patent Owner has the burden to persuade the Board that sanctions are warranted. *See* 37 C.F.R. § 42.20(c). In general, a motion for sanctions should address three factors: (i) whether a party has performed conduct that warrants sanctions; (ii) whether the moving party has suffered harm from that conduct; and (iii) whether the sanctions requested are proportionate to the harm suffered by the moving party. *See Square, Inc. v. Think Comput. Corp.*, Case CBM2014-00159, slip op. at 2 (PTAB Nov. 27, 2015) (Paper 48) (citing *Ecclesiastes 9:10-11-12, Inc. v. LMC Holding Co.*, 497 F.3d 1135, 1143 (10th Cir. 2007)).

Having reviewed the relevant portions of Dr. Mitzenmacher's deposition, we agree with Petitioner that sanctions are not warranted. Petitioner's attempts to elicit testimony regarding the Tanner graphs and figures, while inartful, did not rise to the level of sanctionable conduct because they were reasonably related to Dr. Mitzenmacher's direct testimony. Furthermore, we agree with Petitioner that Patent Owner suffered no harm, particularly in light of our Decision. For these reasons, we deny Patent Owner's motion for sanctions.

IV. CONCLUSION

For the foregoing reasons, Petitioner has not shown by a preponderance of the evidence that claims 1–8 and 11–14 of the '710 patent would have been obvious over the combination of Divsalar and Luby; and that claims 15–17, 19–22, and 24–33 of the '710 patent would have been obvious over the combination of Divsalar, Luby, and Luby97.

V. ORDER

Accordingly, it is:

ORDERED that claims 1–8, 11–17, 19–22, and 24–33 of the '710 patent are not held to be unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Exclude is *dismissed as moot*;

FURTHER ORDERED that Patent Owner's Motion for Sanctions is *denied*; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to this proceeding seeking judicial review of our decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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Case No. IPR2017-00210
Docket No.: 1033300-00287US1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Apple Inc.,
Petitioner

v.

California Institute of Technology,
Patent Owner

IPR2017-00210
Patent No. 7,116,710

PETITIONER'S NOTICE OF APPEAL

Director of the United States Patent and Trademark Office
c/o Office of the General Counsel
P.O. Box 1450
Alexandria, VA 22314-5793

Pursuant to 35 U.S.C. §§ 141-44 and 319, and 37 C.F.R. § 90.2-90.3, notice is hereby given that Petitioner Apple Inc. appeals to the United States Court of Appeals for the Federal Circuit from the Final Written Decision entered December 27, 2018 (Paper 77) in IPR2017-00210 (Exhibit A), and all prior and interlocutory rulings related thereto or subsumed therein.

In accordance with 37 C.F.R. § 90.2(a)(3)(ii), Petitioner further indicates that the issues on appeal include, but are not limited to, whether the Patent Trial and Appeal Board erred in determining that Petitioner had not established by a preponderance of the evidence that claims 1 and 3 of the '710 patent are anticipated by Frey pursuant to 35 U.S.C. § 102(b); claims 1–8 and 11–14 of the '710 patent would have been obvious over Divsalar and Frey; and claims 15–17, 19–22, and 24–33 of the '710 patent would have been obvious over Divsalar, Frey, and Luby97; and any finding or determination supporting or related to those issues, as well as all other issues decided adversely to Petitioner in any orders, decisions, rulings, and opinions.

Pursuant to 37 C.F.R. § 90.3, this Notice of Appeal is timely, having been duly filed within 63 days after the date of the Final Written Decision.

A copy of this Notice of Appeal is being filed simultaneously with the Patent Trial and Appeal Board, the Clerk's Office for the United States Court of Appeals for the Federal Circuit, and the Director of the Patent and Trademark Office.

Respectfully submitted,

Date: February 22, 2019

/Michael Smith/

Michael H. Smith
Registration No. 71,190
Counsel for Petitioner

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 90.2(a)(1) and 104.2(a), I hereby certify that, in addition to being filed electronically through the Patent Trial and Appeal Board's End to End (PTAB E2E), a true and correct original version of the foregoing Petitioner's Notice of Appeal is being filed by Express Mail (Express Mail Label EF 183495755 US) on this 22nd day of February 2019, with the Director of the United States Patent and Trademark Office, at the following address:

Director of the United States Patent and Trademark Office
c/o Office of the General Counsel
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

Pursuant to 37 C.F.R. § 90.2(a)(2) and Federal Circuit Rule 15(a)(1), and Rule 52(a),(e), I hereby certify that a true and correct copy of the foregoing Petitioner's Notice of Appeal is being filed in the United States Court of Appeals for the Federal Circuit using the Court's CM/ECF filing system on this 22nd day of February 2019, and the filing fee is being paid electronically using pay.gov.

I hereby certify that on February 22, 2019 I caused a true and correct copy of the Petitioner's Notice of Appeal to be served via e-mail on the following attorneys of record:

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EXHIBIT A

Trials@uspto.gov
571-272-7822

Paper 77
Entered: December 27, 2018

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

CALIFORNIA INSTITUTE OF TECHNOLOGY,
Patent Owner.

Case IPR2017-00210
Patent 7,116,710 B1

Before KEN B. BARRETT, TREVOR M. JEFFERSON, and JOHN A. HUDALLA, *Administrative Patent Judges*.

JEFFERSON, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

Petitioner, Apple, Inc. ("Apple"), filed a Petition (Paper 5, "Pet.") requesting an *inter partes* review of claims 1–8, 10–17, and 19–33 of U.S. Patent No. 7,116,710 B1 (Ex. 1001, "the '710 patent") pursuant to 35 U.S.C. §§ 311–319. Patent Owner, California Institute of Technology ("Caltech"), filed a Preliminary Response (Paper 17, "Prelim. Resp.") to the Petition.

We instituted an *inter partes* review on claims 1–8, 11–17, 19–22, and 24–33 of the '710 patent on certain grounds of unpatentability presented. (Paper 18, "Inst. Dec."). Caltech filed a Patent Owner Response (Paper 35, "PO Resp."), and Apple filed a Petitioner Reply (Paper 46, "Pet. Reply"). Caltech also filed a Sur-Reply (Paper 62, "PO Sur-Reply"), as was authorized by our Order of March 2, 2018 (Paper 55). An oral hearing was held on April 19, 2018, and a transcript of the hearing is included in the record. Paper 72 ("Tr.").

Apple filed a Declaration of James A. Davis, Ph.D. (Ex. 1006) with its Petition and a Declaration of Brendan Frey, Ph.D. (Ex. 1065) with its Reply. Caltech filed Declarations of Dr. Dariush Divsalar (Ex. 2031) and Dr. Michael Mitzenmacher (Ex. 2004) with its Response.

As authorized in our Order of February 10, 2018 (Paper 48), Patent Owner filed a motion for sanctions related to Petitioner's cross-examination of Patent Owner's witnesses, Dr. Mitzenmacher (Paper 50) and Dr. Divsalar, and Petitioner filed an opposition (Paper 52).

In light of the U.S. Supreme Court's decision in *SAS Institute, Inc. v. Iancu*, 138 S. Ct. 1348 (2018), we modified our Institution Decision to institute on all of the challenged claims and all of the grounds. Paper 69. Subsequently, the parties filed a joint motion to limit the Petitions to the

claims and grounds that were originally instituted. Paper 71. We granted their motion. Paper 73. As a result, the remaining instituted claims and grounds are the same as they had been at the time of the Institution Decision. *See id.* at 3.

The one-year period normally available to issue a Final Written Decision was extended under 37 C.F.R. § 42.100(c). Papers 74, 75, 1–2.

We have jurisdiction under 35 U.S.C. § 6. This decision is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of claims 1–8, 11–17, 19–22, and 24–33 of the '710 patent. For the reasons discussed below, Petitioner has not demonstrated by a preponderance of the evidence that claims that claims 1–8, 11–17, 19–22, and 24–33 are unpatentable.

A. Related Proceedings

The parties indicate that the '710 patent was involved in the following active case, *Cal. Inst. of Tech. v. Broadcom Ltd.*, No. 2:16-cv-03714 (C.D. Cal. filed May 26, 2016), and in concluded cases, *Cal. Inst. of Tech. v. Hughes Commc'ns, Inc.*, No. 2:15-cv-01108 (C.D. Cal. filed Feb. 17, 2015); and *Cal. Inst. of Tech. v. Hughes Commc'ns, Inc.*, 2:13-cv-07245 (C.D. Cal. filed Oct. 1, 2013). Pet. 3, Paper 8, 2–3.

The parties also identify co-pending case IPR2017-00219, in which Apple filed a petition for *inter partes* review of the '710 patent. Pet. 3; Paper 8, 2–3. *Inter partes* review of the '710 patent was previously considered and denied in *Hughes Network Sys., LLC v. Cal. Inst. of Tech.*, IPR2015-00067 (PTAB April 27, 2015) (Paper 18) ("IPR2015-00067") and *Hughes Network Sys., LLC v. Cal. Inst. of Tech.*, IPR2015-00068 (PTAB

April 27, 2015) ("IPR2015-00068"). Finally, patents related to the '710 patent were challenged in IPR2015-00059, IPR2015-00060, IPR2015-00061, and IPR2015-00081. Pet. 3.

B. The '710 Patent

The '710 patent describes the serial concatenation of interleaved convolutional codes forming turbo-like codes. Ex. 1001, Title. It explains some of the prior art with reference to its Fig. 1, reproduced below.

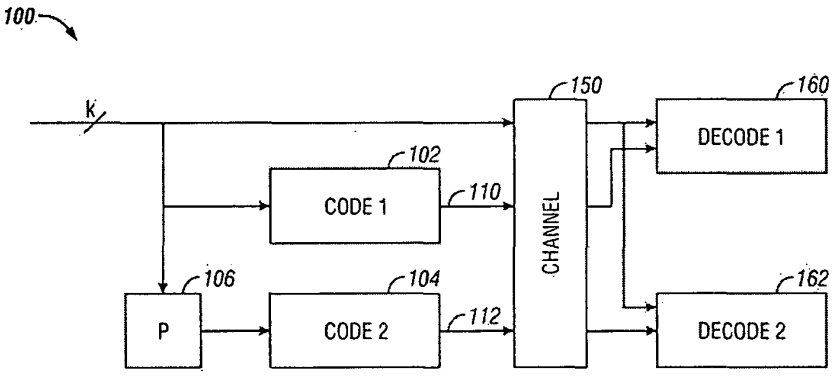

FIG. 1
(Prior Art)

Figure 1 is a schematic diagram of a prior "turbo code" system. *Id.* at 2:14–15. The '710 patent specification describes Figure 1 as follows:

> A standard turbo coder 100 is shown in FIG. 1. A block of k information bits is input directly to a first coder 102. A k bit interleaver 106 also receives the k bits and interleaves them prior to applying them to a second coder 104. The second coder produces an output that has more bits than its input, that is, it is a coder with rate that is less than 1. The coders 102,104 are typically recursive convolutional coders.
>
> Three different items are sent over the channel 150: the original k bits, first encoded bits 110, and second encoded bits 112. At the decoding end, two decoders are used: a first

> constituent decoder 160 and a second constituent decoder 162. Each receives both the original k bits, and one of the encoded portions 110, 112. Each decoder sends likelihood estimates of the decoded bits to the other decoders. The estimates are used to decode the uncoded information bits as corrupted by the noisy channel.

Id. at 1:38–53(emphasis omitted).

A coder 200, according to a first embodiment of the invention, is described with respect to Figure 2, reproduced below.

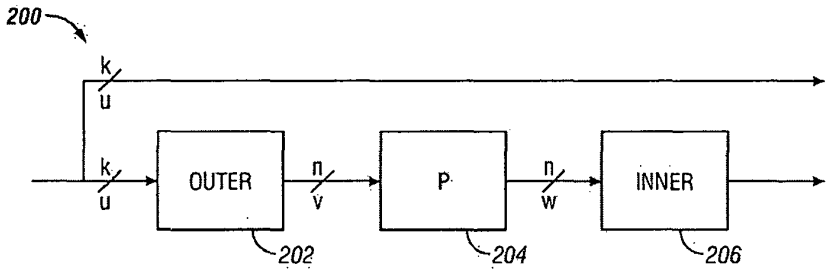

FIG. 2

Figure 2 of the '710 patent is a schematic diagram of coder 200. *Id.* at 2:16–17.

The specification states that "coder 200 may include an outer coder 202, an interleaver 204, and inner coder 206." *Id.* at 2:34–35. It further states as follows:

> The outer coder 202 receives uncoded data. The data may be partitioned into blocks of fixed size, say k bits. The outer coder may be an (n,k) binary linear block coder, where n>k. The coder accepts as input a block u of k data bits and produces an output block v of n data bits. The mathematical relationship between u and v is $v=T_0u$, where T_0 is an $n\times k$ matrix, and the rate[1] of the coder is k/n.

[1] The "rate" of an encoder refers to the ratio of the number of input bits to the number of resulting encoded output bits related to those input bits. *See* Pet. 9.

> The rate of the coder may be irregular, that is, the value of T_0 is not constant, and may differ for sub-blocks of bits in the data block. In an embodiment, the outer coder 202 is a repeater that repeats the k bits in a block a number of times q to produce a block with n bits, where n=qk. Since the repeater has an irregular output, different bits in the block may be repeated a different number of times. For example, a fraction of the bits in the block may be repeated two times, a fraction of bits may be repeated three times, and the remainder of bits may be repeated four times. These fractions define a degree sequence, or degree profile, of the code.
>
> The inner coder 206 may be a linear rate-1 coder, which means that then-bit output block x can be written as $x=T_I w$, where T_I is a nonsingular $n \times n$ matrix. The inner coder 210 can have a rate that is close to 1, e.g., within 50%, more preferably 10% and perhaps even more preferably within 1% of 1.

Id. at 2:41–64 (emphasis omitted). Codes characterized by a regular repeat of message bits into a resulting codeword are referred to as "regular repeat," whereas codes characterized by irregular repeat of message bits into a resulting codeword are referred to as "irregular repeat." The second ("inner") encoder 206 performs an "accumulate" function. Thus, the two-step encoding process illustrated in Figure 2, including a first encoding ("outer encoding") followed by a second encoding ("inner encoding"), results in either a "regular repeat accumulate" ("RRA") code or an "irregular repeat accumulate ("IRA") code, depending upon whether the repetition in the first encoding is regular or irregular.

Figure 4 of the '710 patent, reproduced below, shows an alternative embodiment in which the first encoding is carried out by a low density generator matrix.

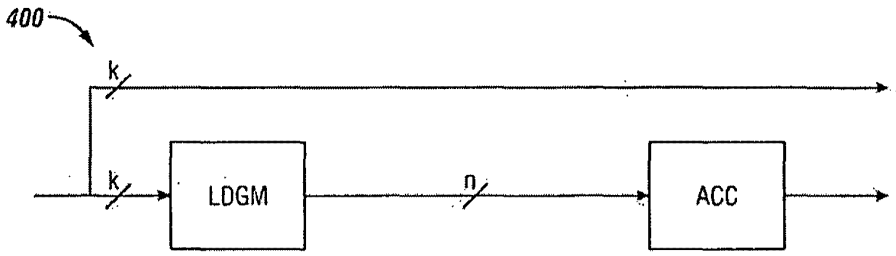

FIG. 4

Figure 4 of the '710 patent is a schematic of an irregular repeat and accumulate coder using a low density generator matrix (LDGM)[2] coder. *Id.* at 2:20–21, 3:24–25, 3:51–54. The LDGM coder "performs an irregular repeat of the k bits in the block, as shown in FIG. 4." *Id.* LDGM codes are a special class of low density parity check codes that allow for less encoding and decoding complexity. LDGM codes are systematic linear codes generated by a "sparse" generator matrix. No interleaver (as in the Figure 2 embodiment) is required in the Figure 4 embodiment because the LDGM provides scrambling otherwise provided by the interleaver.

C. Challenged Claims

Claims 1, 11, 15, and 25 of the '710 patent are independent. Claims 1 and 3 are illustrative of the claims at issue and are reproduced below:

1. A method of encoding a signal, comprising:

obtaining a block of data in the signal to be encoded;

partitioning said data block into a plurality of sub-blocks, each sub-block including a plurality of data elements;

[2] A "generator" matrix (typically referred to by "G") is used to create (generate) codewords. A parity check matrix (typically referred to by "H") is used to decode a received message.

> first encoding the data block to from a first encoded data block, said first encoding including repeating the data elements in different sub-blocks a different number of times;
>
> interleaving the repeated data elements in the first encoded data block; and
>
> second encoding said first encoded data block using an encoder that has a rate close to one.
>
> 3. The method of claim 1, wherein said first encoding is carried out by a first coder with a variable rate less than one, and said second encoding is carried out by a second coder with a rate substantially close to one.

Ex. 1001, 7:14–25, 7:28–31.

D. The Remaining Grounds of Unpatentability

The following grounds of unpatentability remain at issue in this case (Inst. Dec. 31; Paper 72, 2–3):

Reference(s)	Basis	Claims Challenged
Frey[3]	§ 102(a)	1 and 3
Frey and Divsalar[4]	§ 103(a)	1–8 and 11–14
Frey, Divsalar, and Luby97[5]	§ 103(a)	15–17, 19–22, and 24–33

[3] Brendan J. Frey and David J.C. MacKay, *Irregular Turbocodes*, PROCEEDINGS OF THE 37TH ALLERTON CONFERENCE ON COMMUNICATION, CONTROL, AND COMPUTING (1999) at 241–248 (Ex.1002, "Frey).

[4] Dariush Divsalar, et al., *Coding Theorems for "Turbo-Like" Codes*, PROCEEDINGS OF THE THIRTY-SIXTH ANNUAL ALLERTON CONFERENCE ON COMMUNICATION, CONTROL, AND COMPUTING, Sept. 23–25, 1998, at 201–209 (Ex. 1003, "Divsalar").

[5] Luby, M. et al., *Practical Loss-Resilient Codes*, PROCEEDINGS OF THE TWENTY-NINTH ANNUAL ACM SYMPOSIUM ON THEORY OF COMPUTING, May 4–6, 1997, at 150–159 (Ex. 1011, "Luby97").

II. ANALYSIS

A. Claim Interpretation

Because this *inter partes* review is based on a petition filed before November 13, 2018, we construe the claims by applying the broadest reasonable interpretation in light of the specification. 37 C.F.R. § 42.100(b) (2016); *see Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). In applying a broadest reasonable construction, claim terms generally are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Any special definition for a claim term must be set forth in the specification with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

1. "close to one" and "rate" (claims 1 and 3)

Petitioner argues that the broadest reasonable construction of "close to one" as recited in claims 1 and 3 is "within 50% of one." Pet. 24. Petitioner argues that this is consistent with the '710 patent specification, which states that the inner code 210 of Figure 1, "can have a rate that is close to one, e.g., within 50%, more preferably 10% and perhaps even more preferably within 1% of 1." Pet. 24–25 (quoting Ex. 1001, 2:62–64 and citing Ex. 1006, ¶¶ 102–103).

Patent Owner argues that the term "close to one" does not need to need to be construed (PO Resp. 19), but argues that the "term 'rate' in the context of an encoder would be 'the ratio of the number of input bits to the number of output bits'" (*id.* at 18 (citing Ex. 2004 ¶¶ 59–60)). Citing the testimony of Mr. Mitzenmacher, Patent Owner argues that "there is no

dispute that 'rate' should be construed as 'the ratio of the number of input bits to the number of output bits.'" PO Resp. 19; *see* Ex. 2033, 43:18–44:7; Ex. 2004 ¶¶ 59–60. Further, Patent Owner argues that the '710 patent explains that the rate of the coder is the number of input bits divided by the number of output bits. PO Resp. 18; Ex. 1001, 2:44–47, 2:59–61.

We agree with the parties determining that "close to one" as recited in claims 1 and 3 is construed as "within 50% of one."

With respect to "rate," Petitioner does not challenge Patent Owner's argument, which is supported by the '710 specification. See Pet. Reply 5 (discussing rate). Accordingly, we agree that "rate" is construed as "the ratio of the number of input bits to the number of output bits."

B. Frey's Status as Prior Art

Petitioner contends Frey qualifies as a prior art printed publication under 35 U.S.C. § 102(a) relative to the May 18, 2000, filing date of the provisional application to which the '710 patent claims priority. Pet. 5–6; *see also* Ex. 1001, [60]. Specifically, Petitioner asserts that Frey was "published in the Proceedings of the 37th Allerton Conference on Communication, Control and Computing" and that the "conference proceedings were published on or before March 20, 2000." *Id.* at 25 (citing Ex. 1015 (showing stamps from the Cornell University Library and the table of contents for the conference) and Ex. 1006 ¶ 63).

Patent Owner contends that Petitioner has not established that Frey is prior art under 35 U.S.C. § 102(a). PO Resp. 13–17. Specifically, Patent Owner argues that Petitioner is bound by its assertion in the Petition that March 20, 2000, is the publication date for Frey. PO Resp. 15 (citing

Pet. 25). Patent Owner also argues that the invention of the '710 patent was conceived prior to March 20, 2000, and reduced to practice with reasonable diligence. PO Resp. 14–17 (citing *Perfect Surgical Techniques, Inc. v. Olympus Am., Inc.*, 841 F.3d 1004, 1007 (Fed. Cir. 2016)). Patent Owner cites testimony from Dr. Hue Jin, a co-inventor and various contemporaneous records in support of its attempt to antedate the alleged March 20, 2000, publication date for Frey.

With respect to conception, Patent Owner argues that the declaration of Dr. Jin (Ex. 2020) with corroborating exhibits supports prior conception of the invention and removes Frey as prior art. Dr. Jin is a co-inventor and provides testimony and supporting documents that Patent Owner contends show that by early March 2000 the inventors "had developed the Irregular Repeat Accumulate code of the '710 patent, including an outer coder that could be generalized as a low-density generator matrix (LDGM), permitting elimination of an interleaver and focus on irregularity, and an inner coder comprising an accumulator." PO Resp. 15–16 (citing Ex. 2020 ¶¶ 5–7; Ex. 2022; Ex. 2031 ¶¶ 13–15). Specifically, Patent Owner argues that in early March 2000, Dr. Jin created and ran simulations using files and code that reflected the structure identical to the IRA code of Figure 3 in the '710 patent. PO Resp. 16 (Ex. 2020 ¶¶ 8–14). Moreover, Patent Owner avers that actual reduction to practice occurred on March 20, 2000, when a simulation ran using the irregular degree profile written on March 13, 2000. PO Resp. 16 (citing Ex. 2020 ¶¶ 8, 15–18). Patent Owner asserts that the inventors proceeded diligently to constructive reduction to practice on May 18, 2000, which is the filing date for the '710 patent. PO Resp. 16–17; Ex. 1001, [22].

In reply, Petitioner attempts to show that Frey was published even earlier—February 2000—based on testimony "from former co-chairs of the conference at which Frey was presented" regarding the shipment of conference proceedings. Pet. Reply 17 (citing Exs. 1032–1034). Petitioner also argues that Patent Owner's evidence does not corroborate the alleged date conception or demonstrate sufficient diligence. *Id.* at 18–22. Patent Owner's conception date, Petitioner argues, relies improperly on uncorroborated testimony from a co-inventor where corroboration beyond the inventor is necessary to avoid self-serving testimony. Pet. Reply 18 (*Singh v. Burke*, 317 F.3d 1334, 1340–41 (Fed. Cir. 2003)). Petitioner also argues that Patent Owner's documents and testimony fail to support Patent Owner's dates because (1) Exhibit 2022 is an unwitnessed excerpt from an inventor's notebook that fails to show a key feature of the invention (Pet. Reply 19); (2) the parameter files and software files cited as part of the pre-March 20, 2000, activity are undated or uncertain, at best, as to the date the files or software were run or updated (*id.* at 19–20 (discussing Exhibits 2025, 2027, 2029 (undated parameter files) and Exhibits 2023, 2024, 2026, and 2028 (simulation software files)). *See also* Pet. Reply 20 n.5 (arguing that the inventor's testimony regarding parameter files is the sole support for the dates for those files and that such testimony is not consistent or reliable).

In its sur-reply, Patent Owner asserts that Petitioner's shifting publication date is improper as untimely and prejudicial. PO Sur-Reply 2.

1. Printed Publication Analysis

We look to the underlying facts to make a legal determination as to whether a reference is a printed publication. *Suffolk Techs., LLC v. AOL Inc.*, 752 F.3d 1358, 1364 (Fed. Cir. 2014). The determination of whether a

given reference qualifies as a prior art "printed publication" involves a case-by-case inquiry into the facts and circumstances surrounding its disclosure to members of the public. *In re Klopfenstein*, 380 F.3d 1345, 1350 (Fed. Cir. 2004). The key inquiry is whether the reference was made "sufficiently accessible to the public interested in the art" before the critical date. *In re Cronyn*, 890 F.2d 1158, 1160 (Fed. Cir. 1989); *In re Wyer*, 655 F.2d 221, 226 (CCPA 1981). "A given reference is 'publicly accessible' upon a satisfactory showing that such document has been disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it." *Bruckelmyer v. Ground Heaters, Inc.*, 445 F.3d 1374, 1378 (Fed. Cir. 2006) (citation omitted).

Petitioner has put forth date stamp evidence that a copy of the conference proceedings including Frey was at least received in the Cornell University Library by March 20, 2000. Ex. 1015, 16. Petitioner also put forth a declaration of Pamela Stansbury, an employee in the Original Cataloging Unit of the Cornell University Library, who testifies that, based upon her review of library records and her knowledge of standard operating procedures, Frey was "publicly available at the Cornell University Library as of March 20, 2000." Ex. 1031 ¶ 4; *see also* Paper 22, 5 (Petitioner's motion to submit supplemental information, which includes a description of Exhibit 1031); Paper 32 (granting Petitioner's motion to submit supplemental information). Patent Owner does not dispute that Frey was publicly available as of March 20, 2000. *See* PO Resp. 15. Based on Petitioner's evidence, we determine that Frey qualifies as a prior art printed publication as of March 20, 2000.

We need not consider Petitioner's purported evidence of an even earlier publication date (*see* Pet. Reply 17–18), because we determine below that Patent Owner's evidence is insufficient to antedate Frey's March 20, 2000, publication date.

2. Patent Owner's Attempt to Antedate Frey

We now consider Patent Owner's arguments attempting to antedate Frey by showing an earlier conception date and diligent reduction to practice. Regarding the type of proof required to corroborate inventor testimony on conception and reduction to practice, the Federal Circuit has stated:

> It is well established that when a party seeks to prove conception via the oral testimony of a putative inventor, the party must proffer evidence corroborating that testimony. . . . There is no particular formula that an inventor must follow in providing corroboration of his testimony of conception. Rather, whether a putative inventor's testimony has been sufficiently corroborated is determined by a 'rule of reason' analysis, in which 'an evaluation of all pertinent evidence must be made so that a sound determination of the credibility of the inventor's story may be reached.' However, that 'rule of reason' analysis does not alter the requirement of corroboration of an inventor's testimony. Evidence of the inventive facts must not rest alone on the testimony of the inventor himself.

Singh, 317 F.3d 1240–41 (internal citations omitted) (quoting *Price v. Symsek*, 988 F.2d 1187, 1195 (Fed. Cir. 1993)). With respect to priority and antedating a reference, the Federal Circuit has stated the following regarding burdens and required documentary support:

> When the issue of priority concerns the antedating of a reference, the applicant is required to demonstrate, *with sufficient documentation*, that the applicant was in possession of the later-claimed invention before the effective date of the reference.

> *Demonstration of such priority requires documentary support, from which factual findings and inferences are drawn, in application of the rules and law of conception, reduction to practice, and diligence.* The purpose is not to determine priority of invention—the province of the interference practice—but to ascertain whether the applicant was in possession of the claimed invention sufficiently to overcome the teachings and effect of an earlier publication of otherwise invalidating weight.

In re Steed, 802 F.3d 1311, 1316 (Fed. Cir. 2015) (emphases added); *see also Perfect Surgical Techniques, Inc. v. Olympus America, Inc.*, 841 F.3d 1004, 1008 (Fed. Cir. 2016) (citing *Steed*). "The principles are legal, but the conclusions of law focus on the evidence, for which the Board's factual findings are reviewed for support by substantial evidence." *Steed*, 802 F.3d at 1316; *see also NFC Tech., LLC v. Matal*, 871 F.3d 1367, 1371 (Fed. Cir. 2017).

Upon review of the parties' evidence and argument, we are faced with conception evidence that is not corroborated and fails to show full possession of the entire invention. See PO Resp. 15–16 (Ex. 2020 ¶¶ 3–4; Ex, 2031 ¶¶ 13–15). The evidence Patent Owner cites are general directions to consider irregular outer codes (Ex. 2021) and an unwitnessed inventor notebook entry (Ex. 2022). Patent Owner does not provide sufficient corroboration for these exhibits or sufficient explanation that these documents show possession of the invention. *In re Steed*, 802 F.3d at 1316. Indeed, Patent Owner's arguments do not point to any particular date of conception, but merely states that it was "before" March 20, 2000, based on these uncorroborated documents (Ex. 2021; Ex. 2022). PO Resp. 15–16. When pressed to establish a date, Patent Owner points only to early March dates, but does not point to a date by which possession was established.

Tr. 37:9–38:12 (discussing conception and reduction to practice dates). Based on the full record before us, Patent Owner has not provided sufficient and persuasive corroborated evidence of conception prior to March 20, 2000, based on the Exhibits 2020, 2021 and 2022.

Patent Owner's antedating argument further posits that in early March, March 10 and March 20, 2000, simulations refelecting the structure of Figure 3 of the '710 patent were produced. PO Resp. 15–16. (citing Ex. 2020 ¶¶ 8–15). To evaluate this arugment, Patent Owner relies on inventor testimony interpreting uncorroborated parameter and software files. PO Resp. 15–16. (citing Ex. 2020 ¶¶ 8–15); *see, e.g.*, Ex. 2023; Pet. Reply 20 n.5. In particular, Patent Owner's arguments rely on the testimony of Dr. Jin to establish the dates of creation of parameter files and simulation programs along with the dates these programs would have been run based on Dr. Jin's regular practices regarding changelogs for the program files. PO Resp. 15–17; Ex. 2020 ¶¶ 3–19.

We agree with Petitioner that on their face, the parameter files about which Mr. Jin testifies are undated. Pet. Reply 19 (Exhibits 2025, 2027, 2029 (undated parameter files)). Dr. Jin testifies to his typical practices of noting significant changes in the logs and relies on that practice and file metadata to establish the date the simulations were run and the invention was reduced to practice. PO Resp. 16 (asserting that March 20, 2000 was when the undated degree profiles written on March 13, 2000, were run in the simulation); Ex. 2020 ¶¶ 8, 15–18. Yet the undated files do not corroborate Dr. Jin's testimony on the relevant dates.

Under the rule of reason, we require corroborating evidence sufficient to support Dr. Jin's testimony that early March, either March 10 or March

20, 2000, was the reduction to practice date. PO Resp. 16; *see* Tr. 38:4–11. Yet the documents put forth by Patent Owner to allegedly support Dr. Jin's testimony are not probative evidence on their own; they too rely on Dr. Jin's testimony for interpretation. *See, e.g.* Ex. 2020 ¶¶ 3–19 (discussing Ex. 2023–2029). We also note that Patent Owner has not submitted the metadata Dr. Jin relies on to establish the dates in his testimony. *See* Ex. 2020 ¶¶ 15–18. And, even if we were to credit the existence of the metadata, we find that Dr. Jin's testimony establishes that his practices regarding changelog dating for programs did not always reflect whether the contents of the files were altered after the change date. Pet. Reply 20 n.5 (citing Ex. 1063). Absent other corroborating evidence, Dr. Jin's testimony about metadata and about his usual practices is not sufficient to establish the date on which the simulation was run as the reduction to practice date. PO Resp. 16.

Upon review of the parties' evidence and argument, Patent Owner's evidence is not sufficient to establish conception in early March 2000 or an actual reduction to practice date of March 20, 2000, by a preponderance of the evidence. Although we agree that the evidence shows activity in the form of an email (Ex. 2021) and an inventor notebook entry (Ex. 2022), both of these documents require interpretation by the inventor relative to the reduction to practice inquiry and Patent Owner has not provided persuasive evidence showing possession of the invention of the '710 patent. Weighing the evidence from the co-inventor Dr. Jin in its entirety, we are not persuaded that the evidence sufficiently shows reduction to practice of the invention by March 20, 2000. Dr. Jin's testimony as an inventor in this instance lacks sufficient corroborating evidence. Ex. 2020 ¶¶ 3–19. On the

full record, Patent Owner's evidence is not sufficient to establish conception in early March 2000 or that March 20, 2000 is the date of actual reduction to practice.

Thus, on the full record, Patent Owner fails to establish sufficient evidence that the invention was conceived and reduced to practice before Frey's March 20, 2000, publication date. PO Resp. 15; Ex. 2020 ¶¶ 3–19. Accordingly, we determine that Frey qualifies as a prior art prior art printed publication under 35 U.S.C. § 102(a).

C. Level of Ordinary Skill in the Art

Petitioner cites Dr. Davis's testimony that "[a] person of ordinary skill in the art is a person with a Ph.D. in mathematics, electrical or computer engineering, or computer science with emphasis in signal processing, communications, or coding, or a master's degree in the above area with at least three years of work experience in this field at the time of the alleged invention." Pet. 23 (citing Ex. 1006, ¶ 95). Patent Owner expresses no position on the level of ordinary skill in the art, but its declarant, Dr. Mitzenmacher, applies the same standard advanced by Petitioner. Ex. 2004 ¶ 58.

We determine that Petitioner's proposed definition comports with the qualifications a person would have needed to understand and implement the teachings of the '710 patent and the prior art of record. Accordingly, we apply Petitioner's definition of the level of ordinary skill in the art.

D. Anticipation by Frey of Claim 1 and 3

Petitioner contends that Frey anticipates the limitations of independent claim 1 and dependent claim 3 of the '710 patent. Pet. 34–42 (citing

Ex. 1006 ¶¶ 106–126). Patent Owner disputes Petitioner's contentions. PO Resp. 20–30; PO Sur-Reply 2–4.

1. Frey (Ex. 1002)

Frey describes adding irregularity to turbocodes with systematic bits that participate in varying numbers of parity check equations. Ex. 1002, 1 (Abstract). Frey discloses how a turbocode is made irregular, showing a graphical representation in the fifth image of Figure 1, provided below.

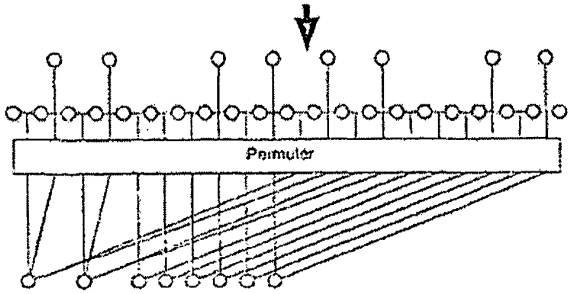

Figure 1, excerpted above, shows the systemic bits at the bottom with 2 or 4 lines going into the permuter. The fifth image of Figure 1 "shows how a turbocode can be made irregular by 'tying" some of the systematic bits together, i.e., by having some systematic bits replicated more than once." Ex. 1002, 3. Frey states that the fifth image of Figure 1 "illustrates one way the [] turbocode can be made irregular. Some of the systematic bits are 'tied' together, in effect causing some systematic bits to be replicated more than once." *Id.* at 2. Frey further discloses "that too [sic] keep the rate of the overall code fixed at 1/2, some extra parity bits must he punctured." *Id.*

In describing the decoding of irregular turbocodes, Frey provides a graphical model for the irregular turbocode shown in Figure 2, below.

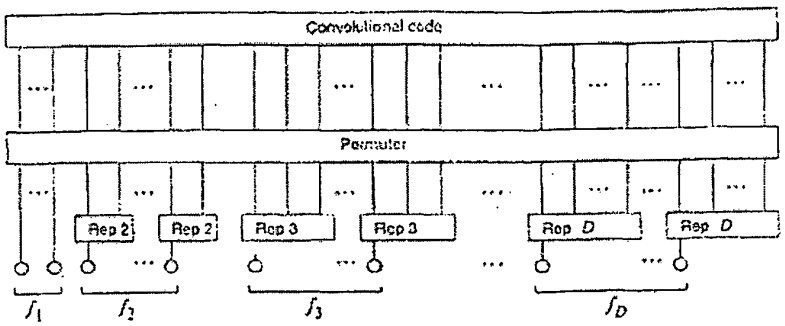

Figure 2: A general *irregular turbocode*. For $d = 1, \ldots, D$, fraction f_d of the codeword bits are repeated d times, permuted and connected to a convolutional code.

Figure 2 shows irregular turbocodes where f_d —the fraction of the codeword where each bit is repeated d times. Ex. 1002, 4. Frey discloses that "an irregular turbocode has the form shown [above] in Fig. 2, which is a type of 'trellis-constrained code'" where "f_d is the fraction of codeword bits that have degree d and D is the maximum degree." *Id.* at 2. Frey further discloses that "[e]ach codeword bit with degree d is repeated d times before being fed into the permuter. Several classes of permuter lead to linear-time encodable codes. In particular, if the bits in the convolutional code are partitioned into 'systematic bits' and 'parity bits', then by connecting each parity bit to a degree 1 codeword bit, we can encode in linear time." *Id.* at 2.

2. Analysis

To anticipate a patent claim under 35 U.S.C. § 102, "a reference must describe, either expressly or inherently, each and every claim limitation and enable one of skill in the art to practice an embodiment of the claimed invention without undue experimentation." *Am. Calcar, Inc. v. Am. Honda Motor Co.*, 651 F.3d 1318, 1341 (Fed. Cir. 2011) (citing *In re Gleave*, 560 F.3d 1331, 1334 (Fed. Cir. 2009)). When evaluating a prior art reference in the context of anticipation, the reference must be "considered together with

the knowledge of one of ordinary skill in the pertinent art." *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994) (citing *In re Samour*, 571 F.2d 559, 562 (CCPA 1978)). "[A] reference can anticipate a claim even if it 'd[oes] not expressly spell out' all the limitations arranged or combined as in the claim, if a person of skill in the art, reading the reference, would 'at once envisage' the claimed arrangement or combination." *Kennametal, Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376, 1381 (Fed. Cir. 2015) (quoting *In re Petering,* 49 CCPA 993, 301 F.2d 676, 681 (1962)). We analyze the instant ground with these principles in mind.

Claim 1 requires a second encoder that has a "rate close to one" as recited in claim 1 or a "rate substantially close to one" as recited in claim 3. Petitioner relies on the express disclosure in Frey that the second encoder has a rate of 2/3. Pet. 38–42 (citing Ex. 1002, 5); Pet. Reply 5–6. In the Petition, Petitioner relies on the equation and description disclosed in Frey which states that "[f]or a rate 1/2 turbocode, each constituent convolutional code should be rate 2/3 (which may, for example, be obtained by puncturing a lower-rate convolutional code.)" Ex. 1002, 2; Pet. 40; Ex. 1006 ¶ 121. Applying the equation in Frey, Petitioner argues that the convolution coder (second coder) yields a rate of 0.74, which is "close to one" as required by the claim. Pet. 40–41.

Patent Owner argues that Frey does not apply the term "rate" as properly construed, which refers to the number of input bits divided by the number of output bits. PO Resp. 18; Ex. 1001, 2:44–47, 2:59–61. Patent Owner further argues that when the proper construction of rate is applied to Frey's second coder, the convolution coder, it does not have a rate close to one. PO Resp. 24–27. Petitioner's evidence and analysis, Patent Owner

argues, rests on an equation in Frey that Dr. Davis acknowledged is in error. Ex. 2033, 13:19–14:3. Indeed, Patent Owner asserts that Frey's rate is accurate only if an "unconventional" definition of rate is applied to the second coder. PO Resp. 27 n.6. To obtain the rate in Frey requires treating the non-systemic code of the second coder in Frey as a systemic code. *Id.*

In reply, Petitioner argues that Patent Owner ignores the express statements in Frey that the convolution coder has a rate of 2/3 and then ignores the evidence regarding the second coder that would yield the 2/3 rate that Frey identifies. We are not persuaded by Petitioner's arguments.

First, we note that Petitioner's arguments on reply abandon the arguments and evidence of the Petition. Pet. Reply 5–6. This is not surprising, as Petitioner's expert declarant, Dr. Davis, acknowledged the error in the equation in Frey that is applied in the Petition and offered a corrected equation and analysis in his deposition. Ex. 2033, 13:19–14:3. Thus, Petitioner's declarant admits the calculations in the Petition are not correct. Despite this reversal, Petitioner offers no persuasive argument or explanation that the rate in the '710 patent is disclosed by Dr. Davis's corrected Frey equation and calculations or even the statements and rate equations in Frey. Pet. Reply 5–6.

Attempting to rebut Patent Owner's analysis of the convolution coder in Frey, Petitioner nakedly asserts that a person of ordinary skill in the art would have understood that Frey's second encoder outputs both systemic and parity bits, because that is the only way to achieve the 2/3 rate described in Frey. *Id.* Petitioner fails to cite any evidence for this conclusory statement regarding what a skilled artisan would have understood. Indeed, Petitioner's argument is undermined by Frey and Dr. Davis's testimony,

which both indicate that the convolution code step in Frey yields parity bits and not systemic bits as Petitioner alleges. *Compare* Ex. 2033, 128:8–10, 131:1–5; Ex. 1002, Figure 1, *with* Pet. 5–6. We are not persuaded by Petitioner's revised argument and evidence supporting the rate of the second encoder in Frey.

Petitioner fails to explain how a person of skill in the art would have understood that the output of the convolution coder in Frey yields a 2/3 rate under the construction of rate described in the '710 patent and adopted above. Pet. Reply 5–6. Indeed, Petitioner has not shown persuasively and by a preponderance of the evidence that the rate of the convolution coder in Frey yields a rate close to one under the construction of rate applicable to the '710 patent. Based on the full record, Petitioner has not shown by a preponderance of the evidence that Frey discloses that the second encoder has a rate close to one as required in claims 1 and 3.

Thus, on this record, we find that Petitioner has not shown has not presented sufficient information that Frey discloses the second encoder rate limitations of claims 1 and 3.

E. Obviousness based on Frey and Divsalar: Claims 1–8 and 11–14

Petitioner contends that claims 1–8 and 11–14 would have been obvious over the combination of Divsalar and Frey. Pet. 42–60 (citing Ex. 1006 ¶¶ 127–183). Patent Owner disputes Petitioner's contentions. PO Resp. 30–50.

1. Divsalar

Divsalar discloses "turbo-like" coding systems that are built from fixed convolutional codes interconnected with random interleavers,

including both parallel concatenated convolutional codes and serial concatenated convolutional codes as special cases. Ex. 1003, 1. With fixed component codes and interconnection topology, Divsalar demonstrates that as the block length approaches infinity, the ensemble (over all possible interleavers) maximum likelihood error probability approaches zero, if the ratio of energy per bit to noise power spectral density exceeds some threshold. *Id.*

The general class of concatenated coding systems is depicted in Figure 1 of Divsalar as follows:

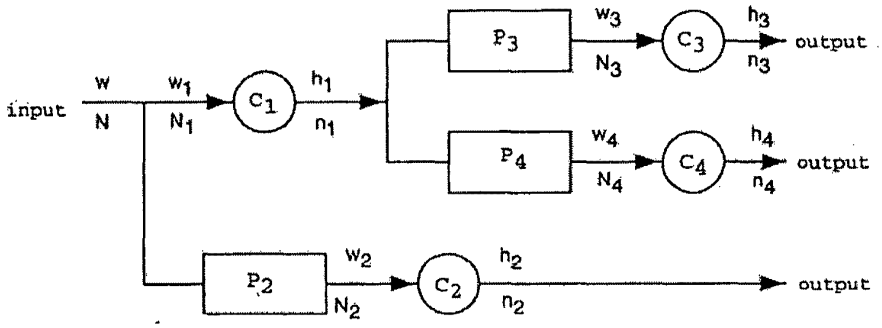

Figure 1. A "turbo-like" code with $s_I = \{1,2\}$, $s_O = \{2,3,4\}$, $\bar{s}_O = \{1\}$.

Figure 1 illustrates that encoders C_2, C_3, and C_4 are preceded by interleavers (permuters) P_2, P_3, and P_4, except C_1, which is connected to an input rather than an interleaver. *Id.* at 2–3. The overall structure must have no loops and, therefore, is called a "turbo-like" code. *Id.*

Divsalar further discloses that "turbo-like" codes are repeat and accumulate (RA) codes. *Id.* at 5. The general scheme is depicted in Figure 3 as follows:

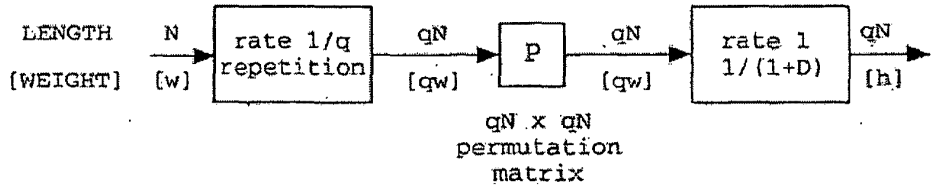

Figure 3. Encoder for a (qN, N) repeat and accumulate code. The numbers above the input-output lines indicate the length of the corresponding block, and those below the lines indicate the weight of the block.

Figure 3 illustrates that information block of length N is repeated q times, scrambled by interleaver of size qN, and then encoded by a rate 1 accumulator. *Id.* The accumulator can be viewed as a truncated rate-1 recursive convolutional encoder. *Id.* Figure 3 further illustrates a simple class of rate 1/q serially concatenated codes where the outer code is a q-fold repetition code and the inner code is a rate 1 convolutional code with a transfer function 1/(1+ D). *Id.* at 1, 5.

2. Analysis

A claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) where in evidence, so-called secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). We also recognize that prior art references must be "considered together

with the knowledge of one of ordinary skill in the pertinent art." *In re Paulsen*, 30 F.3d at 1480 (citing *In re Samour*, 571 F.2d 559, 562 (CCPA 1978)). We analyze Petitioner's obviousness grounds with the principles identified above in mind.

Petitioner contends that claims 1–8 and 11–14 would have been obvious over the combination of Divsalar and Frey. Pet. 42–60 (citing Ex. 1006 ¶¶ 127–183). With respect to the reasons to combine the references, Petitioner contends that Frey and Divsalar are directed to the same field of error-correcting codes (variations on turbocodes). *Id.* at 42–43 (citing Ex. 1006 ¶ 128). Petitioner argues that a person of ordinary skill in the art would have been motivated by Frey's teaching of better performance over classical turbo codes to apply irregularity to Divsalar's repeat accumulate codes. *Id.* at 43 (citing Ex. 1006 ¶ 129). Petitioner further asserts that a person of ordinary skill in the art would have understood that the components used in Frey and Divsalar could be substituted, requiring a trivial modification to the implementation of the Divsalar encoder to combine the references. *Id.* at 43–45 (citing Ex. 1006 ¶¶ 130–131). Petitioner also relies on a thesis by the co-inventor of the '710 patent (Pet. 45–47 (citing Ex. 1006 ¶ 132)) and an email from Dr. Frey to Dariush Divsalar (Pet. 44–45 (citing Ex. 1017, 52) in support of the combination of Divsalar and Frey.

Patent Owner argues that Petitioner's motivations to combine Divsalar and Frey are insufficient because (1) Frey teaches introducing irregularity leads to worse results; (2) Frey and Divsalar are not similar codes; (3) the proposed modifications to Frey are not trivial or simple changes; (4) Petitioner did not advance a sufficient obvious to try argument; and (5)

Petitioner did not show a reasonable expectation of success. PO Resp. 32–50. For the reasons discussed below, we agree with Patent Owner.

With respect to modification of Divsalar and Frey, the petition states that "[i]ncorporating the irregular repetition of Frey into the RA codes of Divsalar would have required only a trivial change." Pet. 44. Petitioner describes it as a "trivial modification for a person of ordinary skill to make to an existing RA coder." Pet. 45 (citing Ex. 1006 ¶ 131).

In response, Patent Owner argues that Frey acknowledges that finding a good profile for irregularity is not trivial. Ex. 1002, 5; PO Resp. 32. We agree. Indeed, Patent Owner argues that Frey's profiles only yielded one functional result that would not have been trivial to incorporate into Divsalar. PO Resp. 41. Furthermore, Petitioner fails to explain how an ordinarily skilled artisan would have incorporated Frey's irregular repetition into Dvisalar, beyond generic statements of adding irregularity. Pet. 45.

With respect to modification, we are not persuaded by Petitioner's citation to the thesis of a co-inventor of the '710 patent, Aamod Khandekar, to support the ease of modifying Divsalar with Frey. Pet. 45–47 (citing Ex. 1006 ¶ 132.). The Khandekar thesis is not prior art to the '710 patent because it was submitted in June 2002, more than two years after the '710 patent's priority date. Prelim. Resp 29–30. In addition, Petitioner provides no arguments or evidence that explain how the thesis supports its contention that a person of ordinary skill in the art would have modified or combined Frey and Divsalar at the time of the '710 patent. We do not find the thesis of a co-inventor of the '710 patent, which appears to postdate the '710 patent's priority date, to be timely corroborating evidence of the ease with which a person of ordinary skill in the art would have combined Frey

and Divsalar at the time of patenting. Accordingly, we give Petitioner's argument and evidence based on the Khandekar thesis no weight with respect to the motivation to combine or expectation of success in combining Divsalar and Frey.

Petitioner's vague and unsupported statements regarding the combination of references and their proposed modifications fail to establish or even address whether such modifications produce a reasonable expectation of success. PO Resp. 42. In contrast, Patent Owner presents evidence and argument that Frey teaches that finding an irregular degree profile is difficult and that such codes often lead to non-functioning results. *Id.* (citing Ex. 1002, 5–6; Ex. 2004 ¶ 102).

We are persuaded by Patent Owner's arguments that Petitioner failed to establish a reasonable expectation of success for the proposed modifications to Frey and Divsalar. Petitioner's argument in response acknowledges the missing expectation of success evidence by relying on the experimental nature of the field. Pet. Reply 9. Petitioner states that

> [a]s [Patent Owner] concedes, *rigorous mathematical analysis of codes is difficult, and, as a result, POSAs routinely developed codes by experimentation*. POR, 4. Encouraged by Frey's results, POSAs would have been motivated to use Frey's irregularity in Divsalar. Indeed, this is exactly what Dr. Frey suggested to Dr. Divsalar in an email dated December 8, 1999. Ex. 1035, App. A; Ex. 1064, 185:5–8. The Petition showed that POSAs would have had a reasonable expectation of success because it was trivial to modify Divsalar to make it irregular by repeating some of the information bits more than others, which meets the limitations of the claimed invention. Pet., 44–47. . . . Dr. Mitzenmacher agreed that simply repeating the first two bits in Divsalar "q+10" times and the rest "q" times would make the code irregular. Ex. 1062, 153:11-154:8.

Pet. Reply 9 (emphasis added). To buttress the argument that a skilled artisan would have had a reasonable expectation of success in the proposed modifications, Petitioner introduces new testimony and simulations from a new declarant, Dr. Frey, to confirm that using Frey's irregularity in Divsalar would not have been difficult and would have yielded a reasonable expectation of success. *Id.* at 10 (citing Ex. 1068).

Yet, even if we were to deem the testimony and simulation to be within the proper scope of a reply brief,[6] they do not support a reasonable expectation of success *at the time of the invention.* We agree with Patent Owner that "[i]t is completely irrelevant what Dr. Frey claims he could do in the year 2018 when armed with Caltech's patent disclosures and publications, [the inventor's] original coding work, contemporary resources, and some 18 years of post-filing date knowledge." PO Sur-Reply 6. Because this evidence is not tied to the state of the art at the time of the invention, it is not probative of anticipated success. *See Millennium Pharm., Inc. v. Sandoz Inc.*, 862 F.3d 1356, 1367 (Fed. Cir. 2017) (quoting *Interconnect Planning Corp. v. Feil*, 774 F.2d 1132, 1138 (Fed. Cir. 1985)) ("Those charged with determining compliance with 35 U.S.C. § 103 are required to place themselves in the minds of those of ordinary skill in the relevant art *at the time the invention was made*, to determine whether that which is now plainly at hand would have been obvious at such earlier time." (emphasis added)).

[6] We need not reach this issue, because we do not rely on this evidence in a manner adverse to Patent Owner. *See infra* § III.A. (dismissing Patent Owner's Motion to Exclude as moot on the same basis).

As part of our obviousness analysis, we consider "the scope and content of the prior art." *See Graham*, 383 U.S. at 17–18. In this regard, we credit Patent Owner's testimony and evidence that an important aspect of the art in this case is the relative unpredictability of developing error-correction codes. *See* PO Resp. 4–5 (citing Ex. 2004 ¶¶ 37–60; Ex. 2033, 256:21–257:12) ("The field of error correction coding has historically been characterized by significant experimentation and unpredictable results. . . . Even when well-performing codes are identified, the reasons for the improved performance are often not understood.").

Petitioner embraces the unpredictability in the art and advancement through experimentation (Pet. Reply 9), arguing that Dr. Frey suggested the combination of Frey with Divsalar's encoder to Dr. Divsalar in an email dated December 8, 1999.[7] Ex. 1035; App. A; Ex. 1064, 185:5–8. We do not agree with Petitioner that the need to run experiments in an unpredictable field, such as error-correction coding, indicates anything about whether such experiments ultimately would have been successful at the time of the invention. Importantly, "[u]npredictability of results equates more with nonobviousness rather than obviousness, whereas that which is predictable is more likely to be obvious." *Honeywell Int'l Inc. v. Mexichem Amanco*

[7] Petitioner's reliance on the purported email between Frey and Divsalar, as evidenced by an expert report from Frey in a related district court litigation (Ex. 1017) is not adequately supported by persuasive and corroborating evidence sufficient to assess the content of these purported communications. Petitioner fails to provide an exhibit with sworn testimony in support of this alleged Frey to Divsalar email. Accordingly, we give Petitioner's arguments and evidence regarding the Frey email no weight with respect to the expectation of success in combining Divsalar and Frey.

Holding S.A., 865 F.3d 1348, 1356 (Fed. Cir. 2017). In the absence of any evidence rooted in the Petition that substantiates a reasonable expectation of success, Petitioner's reliance on a known need for experimentation is not sufficient to support its obviousness rationale.[8] *See Arctic Cat Inc. v. Bombardier Recreational Prod. Inc.*, 876 F.3d 1350, 1360–61 (Fed. Cir. 2017) ("[W]here a party argues a skilled artisan would have been motivated to combine references, it must show the artisan would have had a reasonable expectation of success from doing so." (internal quotation omitted)).

For these reasons, we are not persuaded that an ordinarily skilled artisan would have been motivated to combine the teachings of Frey and Divsalar in the manner suggested by Petitioner. Thus, we determine Petitioner has not shown by a preponderance of the evidence that claims 1–8 and 11–14 would have been obvious over the combination of Frey and Divsalar.

[8] Despite a bare statement that a skilled artisan would have found it obvious to try improving codes by adding irregularity (Pet. 48), Petitioner does not contend that its proposed combination should be analyzed under obvious-to-try case law. *Cf.* Tr., 14:1–6 (Petitioner acknowledging that it was not putting forth an obvious-to-try argument). Nor could Petitioner, because Petitioner does not develop an obvious-to-try theory. Specifically, Petitioner does not establish that the prior art directs which parameters to try and/or guides an inventor toward a particular solution. *See Bayer Schering Pharma AG v. Barr Labs., Inc.*, 575 F.3d 1341, 1347 (Fed. Cir. 2009).

F. Obviousness based on Frey, Divsalar, and Luby97: Claims 15—17, 19–22, and 24–33

Petitioner contends that claims 15–17, 19–22, and 24–33 would have been obvious over the combination of Divsalar, Frey, and Luby97. Pet. 61–72 (citing Ex. 1006 ¶¶ 188–250). Patent Owner disputes Petitioner's contentions. PO Resp. 50–52.

1. Luby97 (Ex. 1011)

Luby97 describes "randomized constructions of linear-time encodable and decodable codes that can transmit over lossy channels at rates extremely close to capacity." Ex. 1011, 150 (Abstract). Luby97 describes receiving data to be encoded in a stream of data symbols, such as bits, where the "*stream of data symbols* [] is partitioned and transmitted in logical units of blocks." *Id.* (emphasis added).

2. Analysis

Because Petitioner's obviousness analysis for claims 15–17, 19–22, and 24–33 rely on the same rationale for combining Frey and Divsalar discussed above, Petitioner's rationale for this ground also incorporates the same deficiencies. Thus for the reasons discussed above, we determine Petitioner has not shown by a preponderance of the evidence that claims 15–17, 19–22, and 24–33 would have been obvious over the combination of Divsalar, Frey, and Luby97.

Accordingly, upon review of full record, we are not persuaded that an ordinarily skilled artisan would have been motivated to combine the teachings of Frey and Divsalar with Luby97 in the manner suggested by Petitioner. Thus, we determine Petitioner has not shown by a preponderance

of the evidence that claims 15–17, 19–22, and 24–33 would have been obvious in view of Divsalar, Frey, and, Luby97.

III. MOTIONS

A. Patent Owner's Motion to Exclude

Patent Owner moves to exclude Exhibits 1013, 1029-1049, 1053, 1055, 1057–1061, 1065, 1067, 1068 and portions of Exhibits 1062 and 1064. Paper 57, 1. Patent Owner's motion is dismissed as moot with respect to these exhibits, as we do not rely on them in a manner adverse to Patent Owner.

B. Patent Owner's Motion for Sanctions

Patent Owner requests sanctions against Petitioner for allegedly failing to stay within the proper scope of cross-examination during the deposition of Dr. Mitzenmacher. Paper 50, 1. Specifically, Patent Owner details questioning of Dr. Mitzenmacher that allegedly "ventured into various topics beyond the scope of the witness' direct testimony." *Id.* at 7–9. For example, Patent Owner cites "extensive questioning regarding Tanner graphs and figures newly created by Petitioner's lawyers, but absent from any petition materials or the witness' direct testimony." *Id.* at 8. As sanctions, Patent Owner asks us to: (1) strike the out-of-scope testimony elicited by Petitioner; (2) hold the direct testimony of Dr. Mitzenmacher to be facts established in this proceeding; and (3) impose "reasonable compensatory expenses, including attorney fees, for costs reasonably related to excessive questioning and deposition time." *Id.* at 9–10.

Petitioner contends that "each question posed by Petitioner during Dr. Mitzenmacher's deposition pertained directly to topics and opinions in

his declaration." Paper 52, 5. Regarding the Tanner graphs and figures, Petitioner contends these were properly served upon Petitioner at Dr. Mitzenmacher's deposition in accordance with 37 C.F.R. § 42.53(f)(3). *Id.* at 6. According to Petitioner, Patent Owner's proposed sanctions are unwarranted, particularly because Patent Owner suffered no harm. *Id.* at 7–8.

The "Board may impose a sanction against a party for misconduct." 37 C.F.R. § 42.12(a); *see also* 35 U.S.C. § 316(a)(6) (requiring regulations prescribing sanctions). As the moving party, Patent Owner has the burden to persuade the Board that sanctions are warranted. *See* 37 C.F.R. § 42.20(c). In general, a motion for sanctions should address three factors: (i) whether a party has performed conduct that warrants sanctions; (ii) whether the moving party has suffered harm from that conduct; and (iii) whether the sanctions requested are proportionate to the harm suffered by the moving party. *See Square, Inc. v. Think Comput. Corp.*, Case CBM2014-00159, slip op. at 2 (PTAB Nov. 27, 2015) (Paper 48) (citing *Ecclesiastes 9:10-11-12, Inc. v. LMC Holding Co.*, 497 F.3d 1135, 1143 (10th Cir. 2007)).

Having reviewed the relevant portions of Dr. Mitzenmacher's deposition, we agree with Petitioner that sanctions are not warranted. Petitioner's attempts to elicit testimony regarding the Tanner graphs and figures, while inartful, did not rise to the level of sanctionable conduct because they were reasonably related to Dr. Mitzenmacher's direct testimony. Furthermore, we agree with Petitioner that Patent Owner suffered no harm, particularly in light of our Decision. For these reasons, we deny Patent Owner's motion for sanctions.

IV. CONCLUSION

For the foregoing reasons, Petitioner has not shown by a preponderance of the evidence that claims 1 and 3 of the '710 patent are anticipated by Frey pursuant to 35 U.S.C. § 102(b); claims 1–8 and 11–14 of the '710 patent would have been obvious over Divsalar and Frey; and claims 15–17, 19–22, and 24–33 of the '710 patent would have been obvious over Divsalar, Frey, and Luby97.

V. ORDER

Accordingly, it is:

ORDERED that claims 1–8, 11–17, 19–22, and 24–33 of the '710 patent are not held to be unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Exclude is *dismissed as moot*;

FURTHER ORDERED that Patent Owner's Motion for Sanctions is *denied*; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to this proceeding seeking judicial review of our decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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Paper 76
Entered: December 27, 2018

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

CALIFORNIA INSTITUTE OF TECHNOLOGY,
Patent Owner.

Case IPR2017-00219
Patent 7,116,710 B1

Before KEN B. BARRETT, TREVOR M. JEFFERSON, and JOHN A. HUDALLA, *Administrative Patent Judges*.

JEFFERSON, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

Petitioner, Apple, Inc. ("Apple"), filed a Petition (Paper 5, "Pet.") requesting an *inter partes* review of claims 1–8, 10–17, and 19–33 of U.S. Patent No. 7,116,710 B1 (Ex. 1201, "the '710 patent") pursuant to 35 U.S.C. §§ 311–319. Patent Owner, California Institute of Technology ("Caltech"), filed a Preliminary Response (Paper 16, "Prelim. Resp.") to the Petition.

We instituted an *inter partes* review on claims 1–8, 11–17, 19–22, and 24–33 of the '710 patent on certain grounds of unpatentability presented. (Paper 17, "Inst. Dec."). Caltech filed a Patent Owner Response (Paper 34, "PO Resp."), and Apple filed a Petitioner Reply (Paper 45, "Pet. Reply"). Caltech also filed a Sur-Reply (Paper 61, "PO Sur-Reply"), as was authorized by our Order of March 2, 2018 (Paper 54). An oral hearing was held on April 19, 2018, and a transcript of the hearing is included in the record. Paper 71 ("Tr.").

Petitioner filed a Declaration of James A. Davis, Ph.D. (Ex. 1206) submitted with its Petition and a Declaration of Brendan Frey, Ph.D. (Ex. 1265) submitted with its Petitioner's Reply. Patent Owner filed Declarations of Dr. Dariush Divsalar (Ex. 2031) and Dr. Michael Mitzenmacher (Ex. 2004) with its Response.

As authorized in our Order of February 10, 2018 (Paper 47), Patent Owner filed a motion for sanctions (Paper 49) related to Petitioner's cross-examination of Patent Owner's witnesses, Dr. Mitzenmacher and Dr. Divsalar, and Petitioner filed an opposition (Paper 51).

In light of the U.S. Supreme Court's decision in *SAS Institute, Inc. v. Iancu*, 138 S. Ct. 1348 (2018), we modified our Institution Decision to institute on all of the challenged claims and all of the grounds. Paper 68.

Subsequently, the parties filed a joint motion to limit the Petitions to the claims and grounds that were originally instituted. Paper 70. We granted their motion. Paper 72. As a result, the remaining instituted claims and grounds are the same as they had been at the time of the Institution Decision. *See id.* at 2.

The one-year period normally available to issue a Final Written Decision was extended under 37 C.F.R. § 42.100(c). Paper 74, 1–2.

We have jurisdiction under 35 U.S.C. § 6. This decision is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of claims 1–8, 11–17, 19–22, and 24–33 of the '710 patent. For the reasons discussed below, Petitioner has not demonstrated by a preponderance of the evidence that claims that claims 1–8, 11–17, 19–22, and 24–33 are unpatentable.

A. Related Proceedings

The parties indicate that the '710 patent was involved in the following active case, *Cal. Inst. of Tech. v. Broadcom Ltd.*, No. 2:16-cv-03714 (C.D. Cal. filed May 26, 2016), and in concluded cases, *Cal. Inst. of Tech. v. Hughes Commc'ns, Inc.*, No. 2:15-cv-01108 (C.D. Cal. filed Feb. 17, 2015); and *Cal. Inst. of Tech. v. Hughes Commc'ns, Inc.*, 2:13-cv-07245 (C.D. Cal. filed Oct. 1, 2013). Pet. 3, Paper 8, 2–3.

The parties also identify co-pending case IPR2017-00210, in which Apple filed a petition for *inter partes* review of the '710 patent. Pet. 3; Paper 8, 2–3. The Board previously denied petitions for *inter partes* review of the '710 patent in *Hughes Network Sys. v. Cal. Inst. of Tech.*, Case IPR2015-00067 (PTAB April 27, 2015) (Paper 18) ("IPR2015-00067") and

Hughes Network Sys. v. Cal. Inst. of Tech., Case IPR2015-00068 (PTAB April 27, 2015) (Paper 18) ("IPR2015-00068"). Finally, certain patents related to the '710 patent were challenged in IPR2015-00059, IPR2015-00060, IPR2015-00061, and IPR2015-00081. Pet. 3. A Final Written Decision cancelling claims 1 and 2 of U.S. Patent No. 7,916,781 B2 was issued in *Hughes Network Sys. v. Cal. Inst. of Tech.*, Case IPR2015-00059 (PTAB April 21, 2016) (Paper 42).

B. The '710 Patent

The '710 patent describes the serial concatenation of interleaved convolutional codes forming turbo-like codes. Ex. 1201, Title. It explains some of the prior art with reference to its Fig. 1, reproduced below.

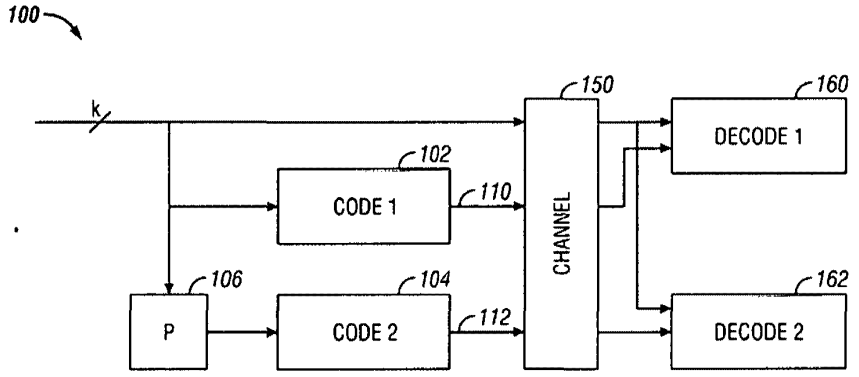

FIG. 1
(Prior Art)

Figure 1 is a schematic diagram of a prior "turbo code" system. *Id.* at 2:14–15. The '710 patent specification describes Figure 1 as follows:

> A standard turbo coder 100 is shown in FIG. 1. A block of k information bits is input directly to a first coder 102. A k bit interleaver 106 also receives the k bits and interleaves them prior to applying them to a second coder 104. The second coder produces an output that has more bits than its input, that

> is, it is a coder with rate that is less than 1. The coders 102,104 are typically recursive convolutional coders.
>
> Three different items are sent over the channel 150: the original k bits, first encoded bits 110, and second encoded bits 112. At the decoding end, two decoders are used: a first constituent decoder 160 and a second constituent decoder 162. Each receives both the original k bits, and one of the encoded portions 110, 112. Each decoder sends likelihood estimates of the decoded bits to the other decoders. The estimates are used to decode the uncoded information bits as corrupted by the noisy channel.

Id. at 1:38–53 (emphasis omitted).

A coder 200, according to a first embodiment of the invention, is described with respect to Figure 2, reproduced below.

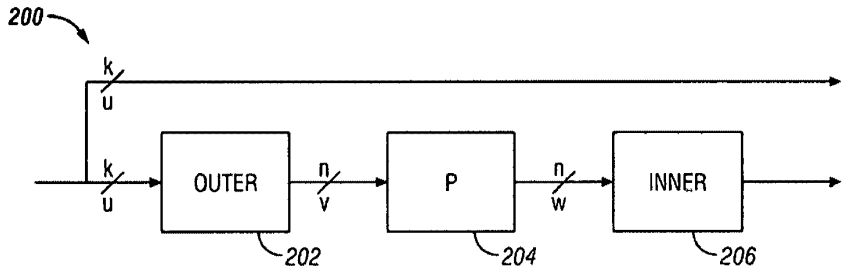

FIG. 2

Figure 2 of the '710 patent is a schematic diagram of coder 200. *Id.* at 2:16–17.

The specification states that "coder 200 may include an outer coder 202, an interleaver 204, and inner coder 206." *Id.* at 2:34–35. It further states as follows.

> The outer coder 202 receives uncoded data. The data may be partitioned into blocks of fixed size, say k bits. The outer coder may be an (n,k) binary linear block coder, where n>k. The coder accepts as input a block u of k data bits and produces an output block v of n data bits. The mathematical

> relationship between u and v is $v=T_0u$, where T_0 is an $n\times k$ matrix, and the rate[1] of the coder is k/n.
>
> The rate of the coder may be irregular, that is, the value of T_0 is not constant, and may differ for sub-blocks of bits in the data block. In an embodiment, the outer coder 202 is a repeater that repeats the k bits in a block a number of times q to produce a block with n bits, where n=qk. Since the repeater has an irregular output, different bits in the block may be repeated a different number of times. For example, a fraction of the bits in the block may be repeated two times, a fraction of bits may be repeated three times, and the remainder of bits may be repeated four times. These fractions define a degree sequence, or degree profile, of the code.
>
> The inner coder 206 may be a linear rate-1 coder, which means that then-bit output block x can be written as $x=T_Iw$, where T_I is a nonsingular $n\times n$ matrix. The inner coder 210 can have a rate that is close to 1, e.g., within 50%, more preferably 10% and perhaps even more preferably within 1% of 1.

Id. at 2:41–64 (emphasis omitted). Codes characterized by a regular repeat of message bits into a resulting codeword are referred to as "regular repeat," whereas codes characterized by irregular repeat of message bits into a resulting codeword are referred to as "irregular repeat." The second ("inner") encoder 206 performs an "accumulate" function. Thus, the two step encoding process illustrated in Figure 2, including a first encoding ("outer encoding") followed by a second encoding ("inner encoding"), results in either a "regular repeat accumulate" ("RRA") code or an "irregular repeat accumulate ("IRA") code, depending upon whether the repetition in the first encoding is regular or irregular.

---

[1] The "rate" of an encoder refers to the ratio of the number of input bits to the number of resulting encoded output bits related to those input bits. *See* Pet. 9.

Figure 4 of the '710 patent, reproduced below, shows an alternative embodiment in which the first encoding is carried out by a low density generator matrix.

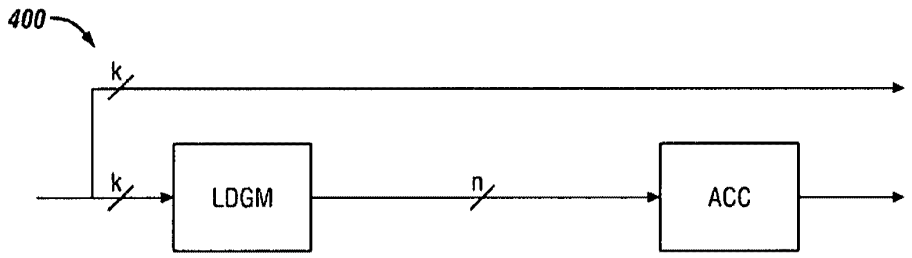

FIG. 4

Figure 4 of the '710 patent is a schematic of an irregular repeat and accumulate coder using a low density generator matrix (LDGM)[2] coder. *Id.* at 2:20–21, 3:25. The LDGM coder "performs an irregular repeat of the k bits in the block, as shown in FIG. 4." *Id.* at 3:52–54. LDGM codes are a special class of low density parity check codes that allow for less encoding and decoding complexity. LDGM codes are systematic linear codes generated by a "sparse" generator matrix. No interleaver (as in the Figure 2 embodiment) is required in the Figure 4 embodiment because the LDGM provides scrambling otherwise provided by the interleaver.

[2] A "generator" matrix (typically referred to by "G") is used to create (generate) codewords. A parity check matrix (typically referred to by "H") is used to decode a received message.

C. Challenged Claims

We instituted challenges on claims 1–8, 10–17, and 19–33 of the '710 patent, of which claims 1, 11, 15, and 25 are independent. Inst. Dec 25; Pet. 21. Claims 1, 3, and 11 are illustrative and reproduced below:

1. A method of encoding a signal, comprising:

obtaining a block of data in the signal to be encoded;

partitioning said data block into a plurality of sub-blocks, each sub-block including a plurality of data elements;

first encoding the data block to from a first encoded data block, said first encoding including repeating the data elements in different sub-blocks a different number of times;

interleaving the repeated data elements in the first encoded data block; and

second encoding said first encoded data block using an encoder that has a rate close to one.

3. The method of claim 1, wherein said first encoding is carried out by a first coder with a variable rate less than one, and said second encoding is carried out by a second coder with a rate substantially close to one.

11. A method of encoding a signal, comprising:

receiving a block of data in the signal to be encoded, the data block including a plurality of bits;

first encoding the data block such that each bit in the data block is repeated and two or more of said plurality of bits are repeated a different number of times in order to form a first encoded data block; and

second encoding the first encoded data block in such a way that bits in the first encoded data block are accumulated.

Ex. 1201, 7:14–25, 7:28–31, 7:50–59.

D. The Remaining Grounds of Unpatentability

The following instituted grounds remain at issue in this case (Inst. Dec. 25; Paper 72, 2):

References	Basis	Claim(s) Challenged
Divsalar[3] and Luby[4]	§ 103(a)	1–8 and 11–14
Divsalar, Luby, and Luby97[5]	§ 103(a)	15–17, 19–22, and 24–33

II. ANALYSIS

A. Claim Interpretation

Because this *inter partes* review is based on a petition filed before November 13, 2018, we construe the claims by applying the broadest reasonable interpretation in light of the specification. 37 C.F.R. § 42.100(b) (2016); *see Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). In applying a broadest reasonable construction, claim terms generally are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Any special definition for a claim term must be set forth in

[3] Dariush Divsalar, et al., *Coding Theorems for "Turbo-Like" Codes*, PROCEEDINGS OF THE THIRTY-SIXTH ANNUAL ALLERTON CONFERENCE ON COMMUNICATION, CONTROL, AND COMPUTING, Sept. 23–25, 1998, at 201–209 (Ex. 1203, "Divsalar").

[4] "Luby, M., et al, *Analysis of Low Density Codes and Improved Designs Using Irregular Graphs*, PROCEEDINGS OF THE THIRTIETH ANNUAL ACM SYMPOSIUM ON THEORY OF COMPUTING, May 23–26, 1997, at 249–258 (Ex. 1204, "Luby").

[5] Luby, M. et al., *Practical Loss-Resilient Codes*, PROCEEDINGS OF THE TWENTY-NINTH ANNUAL ACM SYMPOSIUM ON THEORY OF COMPUTING, May 4–6, 1997, at 150–159 (Ex. 1211, "Luby97").

the specification with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

1. "close to one" (claims 1 and 3)

Petitioner argues that the broadest reasonable construction of "close to one" as recited in claims 1 and 3 is "within 50% of one." Pet. 24–25. Petitioner argues that this is consistent with the '710 patent specification, which states that the inner code 210 of Figure 1, "can have a rate that is close to one, e.g., within 50%, more preferably 10% and perhaps even more preferably within 1% of 1." Pet. 24–25 (quoting Ex. 1201, 2:62–64 and citing Ex. 1206 ¶¶ 102–103) (emphasis omitted). Patent Owner does not provide an express claim construction in this proceeding. In related proceeding IPR2017-00210, Patent Owner argues that the term "close to one" does not require construction and that the '710 patent explains that the rate of a coder is the number of input bits divided by the number of output bits. IPR2017-00210, Paper 35, 18.

We determine that "close to one" as recited in the challenged claims is construed as "within 50% of one."

B. Level of Ordinary Skill in the Art

Petitioner cites Dr. Davis's testimony that "[a] person of ordinary skill in the art is a person with a Ph.D. in mathematics, electrical or computer engineering, or computer science with emphasis in signal processing, communications, or coding, or a master's degree in the above area with at least three years of work experience in this field at the time of the alleged invention." Pet. 23 (citing Ex. 1206, ¶ 95). Patent Owner expresses no position on the level of ordinary skill in the art, but their declarant,

Dr. Mitzenmacher, applies the same standard advanced by Petitioner. Ex. 2004 ¶ 70.

We determine that Petitioner's proposed definition comports with the qualifications a person would have needed to understand and implement the teachings of the '710 patent and the prior art of record. Accordingly, we apply Petitioner's definition of the level of ordinary skill in the art.

C. Obviousness based on Luby and Divsalar: Claims 1–8 and 11–14

Petitioner contends that claims 1–8 and 11–14 would have been obvious over the combination of Divsalar and Luby. Pet. 42–60 (citing Ex. 1206 ¶¶ 399–456). Patent Owner disputes Petitioner's contentions. PO Resp. 19–47.

1. Divsalar

Divsalar discloses "turbo-like" coding systems that are built from fixed convolutional codes interconnected with random interleavers, including both parallel concatenated convolutional codes and serial concatenated convolutional codes as special cases. Ex. 1203, 1. With fixed component codes and interconnection topology, Divsalar demonstrates that as the block length approaches infinity, the ensemble (over all possible interleavers) maximum likelihood error probability approaches zero, if the ratio of energy per bit to noise power spectral density exceeds some threshold. *Id.*

The general class of concatenated coding systems is depicted in Figure 1 of Divsalar as follows:

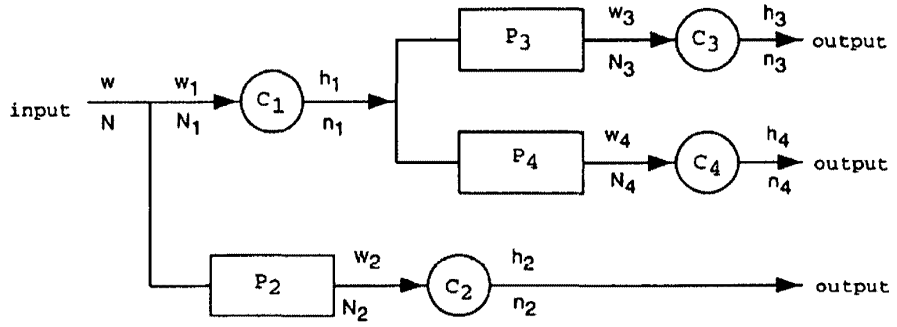

Figure 1. A "turbo-like" code with $s_I = \{1,2\}$, $s_O = \{2,3,4\}$, $\bar{s}_O = \{1\}$.

Figure 1 illustrates that encoders C_2, C_3, and C_4 are preceded by interleavers (permuters) P_2, P_3, and P_4, except C_1, which is connected to an input rather than an interleaver. *Id.* at 2–3. The overall structure must have no loops and, therefore, is called a "turbo-like" code. *Id.*

Divsalar further discloses that "turbo-like" codes are repeat and accumulate (RA) codes. *Id.* at 5. The general scheme is depicted in Figure 3 as follows:

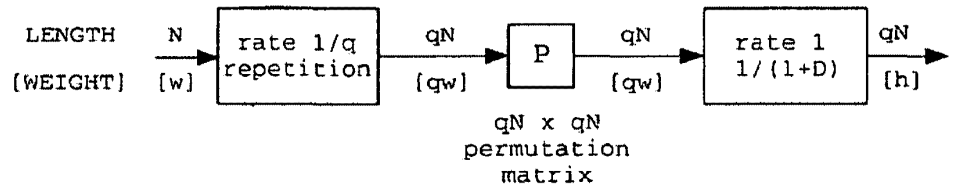

Figure 3. Encoder for a (qN, N) repeat and accumulate code. The numbers above the input-output lines indicate the length of the corresponding block, and those below the lines indicate the weight of the block.

Figure 3 illustrates that information block of length N is repeated q times, scrambled by interleaver of size qN, and then encoded by a rate 1 accumulator. *Id.* The accumulator can be viewed as a truncated rate-1 recursive convolutional encoder. *Id.* Figure 3 further illustrates a simple class of rate 1/q serially concatenated codes where the outer code is a q-fold

repetition code and the inner code is a rate 1 convolutional code with a transfer function 1/(1+ D). *Id.* at 1, 5.

2. Luby

Luby discloses derivation of irregular random graphs that improve upon the performance of Gallager's low-density parity-check (LDPC) codes, and finds that irregular codes described in the paper resulted in codes with improved error correcting capabilities. Ex. 1204, 257. Luby discloses that irregular codes are represented by random irregular bipartite graphs, while regular codes are represented using regular graphs derived from Gallager codes based on sparse bipartite graphs. *Id.* at 249.

Luby discloses that irregular codes are those represented by bipartite graphs in which different message nodes have different degrees (*i.e.*, where different message nodes are connected to different numbers of check nodes). Luby. *Id.* at 257. Luby further states that message nodes with high degree tend to correct their value quickly and then provide good information for check nodes. *Id.* at 253.

3. Analysis

Petitioner contends that claims 1–8 and 11–14 would have been obvious over the combination of Divsalar and Luby. Pet. 34–55 (citing Ex. 1206 ¶¶ 127–456). Petitioner contends that Luby was a significant advance in error-correcting codes using irregularity to design codes that were superior to regular codes. *Id.* at 34–35. Petitioner cites Frey,[6] which credits Luby for providing motivation to study irregular codes, in particular citing

[6] Brendan J. Frey and David J.C. MacKay, *Irregular Turbocodes*, PROCEEDINGS OF THE 37TH ALLERTON CONFERENCE ON COMMUNICATION, CONTROL, AND COMPUTING (1999) at 241–248 (Ex. 1202, "Frey).

Luby's advancements regarding irregular Gallager codes. *Id.* at 35 (citing Ex. 1202, 1 (discussing Luby as reference [1])). Petitioner notes that Luby is expressly discussed as motivation to incorporate irregularity into turbo-like codes, and identifies the codes in Divsalar as such turbo-like codes. *Id.* (citing Ex. 1206 ¶ 401). Petitioner argues that a person of ordinary skill following Frey "would have understood that incorporating irregularity into RA codes would be even more likely to produce favorable results. *Id.* at 36 (citing Ex. 1206 ¶ 403). Petitioner also relies on the Khandekar thesis (Ex. 1218), a thesis written by a co-inventor of the '710 patent, to support the rationale to combine Divsalar and Luby. Pet. 35. Finally, Petitioner argues that a person of ordinary skill in the art would have combined Luby and Divsalar "for research" purposes to "study irregularity." *Id.* at 36.

Petitioner argues that incorporating irregularity into Divsalar's RA codes would have been a simple matter, accomplished in a number of ways requiring minimal modification. Pet. 37–38. Petitioner argues that each of their proposed modifications would have been a routine matter for an ordinarily skilled artisan. *Id.*; Ex. 1206 ¶ 407.

Patent Owner argues that Petitioner's articulated rationale is insufficient to support the motivation to combine the Divsalar and Luby as Petitioner proposes. PO Resp. 30–47. Patent Owner first asserts that Luby does not teach irregular repetition of information bits because Luby's irregularity is different than the '710 patent's irregular repetition of information bits. PO Resp. 26, 30–31; Ex. 2004 ¶¶ 96–97 (testimony from Dr. Mitzenmacher, a coauthor of Luby reference, distinguishing the irregularity discussed in Luby from the irregularity of the '710 patent). Thus, Patent Owner argues that Luby would not have motivated a person of

ordinary skill to modify Divsalar. PO Resp. 31–32. Indeed, Petitioner's expert, Dr. Davis, struggled to define irregularity as it was used in Luby and could not determine whether Luby's irregularity was depicted in an example from his own testimony. *Id.* (citing Ex. 2033 181:4–183:9; 194:4–18). Patent Owner also argues that "[g]iven the limited scope of Luby's findings, a [person of ordinary skill in the art] would not be motivated to modify Divsalar in any way based on Luby." PO Resp. 33 (citing Ex. 2004 ¶¶ 98–100). Patent Owner further asserts that "there was nothing simple about developing improved error-correcting codes, and many advancements in the field were the product of laborious experimentation and surprising, unexpected and unpredictable results." PO Resp. 37 (citing Ex. 2004 ¶¶ 46, 49–50, 53, 104–107); *see also* Ex. 2031 ¶¶ 9–13, 33–34.

Finally, Patent Owner argues that the petition fails to make a sufficient showing that the obviousness combination would have had a reasonable expectation of success. PO Resp. 44–45 (citing *Intelligent Bio-Sys. v. Illumina Cambridge*, 821 F.3d 1359, 1367–68 (Fed. Cir. 2016)). Patent Owner asserts that the evidence shows "that developing error-correction codes that showed an improvement was challenging and unpredictable." PO Resp. 45 (citing Ex. 2004 ¶¶ 116–117; Ex. 2033, 256:21–257:12; Ex. 2031 ¶ 33–35). Indeed, Patent Owner presents persuasive argument and evidence that the combinations proposed by Petitioner would not have been simple substitutions or modifications with a reasonable expectation of success. PO Resp. 45–47.

We agree with Patent Owner that Petitioner has not established that an ordinarily skilled artisan reasonably would have expected success from the combination of Divsalar and Luby. *See* PO Resp. 44–45. We also agree

with Patent Owner that neither Frey (Ex. 1202) nor the Khandekar thesis (Ex. 1218) sufficiently or persuasively support modifications to Divsalar in view of Luby or a reasonable expectation of success in making those modifications. PO Resp. 35–37, 39–44.

The Khandekar thesis (Ex. 1218) fails to support the combination of references. Petitioner provides no arguments or evidence that explains how the thesis supports its contention about how or why a person of ordinary skill in the art would have modified or combined Luby and Divsalar at the time of the '710 patent. Moreover, Petitioner has not explained adequately why or how the thesis of a co-inventor of the '710 patent, which postdates the '710 patent's priority date, is timely corroborating evidence of how a person of ordinary skill in the art would have applied Luby's teachings to Divsalar at the time of patenting. *See* Pet. 45; Inst. Dec. 25. We also find Petitioner's argument and evidence regarding research motivating the combination to be vague and not supported adequately by the declarant testimony (Ex. 1206 ¶ 405).

With respect to Frey,[7] Patent Owner argues that Frey did not show superior results for all error codes, and instead showed that most irregular codes were inferior to other codes. PO Resp. 36–37; Ex. 2004 ¶¶ 102–103. Patent Owner contends that a person of skill in the art would not have been motivated to apply aspects of Frey with a reasonable expectation of success

[7] Patent Owner's contention that Frey is not a prior art publication (PO Resp. 36) is not persuasive. Our Final Written Decision in IPR2017-00210 considered and rejected Patent Owner's argument that the '710 patent inventors conceived and reduced the '710 patent invention before the March 20, 2000, publication date of Frey. IPR2017-00210, Paper 77.

based on Frey only showing improvement in one out of nine profiles. PO Resp. 37. We are persuaded by Patent Owner's arguments that Petitioner's reliance on Frey to does not cure the Petitioner's deficiencies in addressing a reasonable expectation of success.

Petitioner's argument in response acknowledges the missing expectation of success evidence by turning to the experimental nature of the field as being routine practice. Pet. Reply 9. Petitioner states that

> [a]s [Patent Owner] concedes, *rigorous mathematical analysis of codes is difficult, and, as a result, POSAs routinely developed codes by experimentation.* POR, 2. Encouraged by Luby's results, a POSA would have been motivated to use Luby's irregularity in Divsalar. The Petition showed that POSAs would have had an expectation of success because it was simple to modify Divsalar to repeat information bits different numbers of times, which meets the limitations of the claimed invention. Pet., 37-41. . . . Dr. Mitzenmacher agreed that that [simply] repeating some bits in Divsalar "q+10" times and others "q" times would make the code irregular. Ex. 1262, 153:11-154:8.

Pet. Reply 9–10 (emphasis added). To support this contention, Petitioner introduces new testimony and simulations from a new declarant, Dr. Frey, to confirm that using Frey's irregularity in Divsalar would not have been difficult and would have yielded a reasonable expectation of success. *Id.* at 10–11 (citing Ex. 1265).

Even if we were to deem the testimony and simulation from Dr. Frey to be within the proper scope of a reply brief,[8] they do not support a reasonable expectation of success *at the time of the invention.* We agree

[8] We need not reach this issue, because we do not rely on this evidence in a manner adverse to Patent Owner. *See infra* § III.A. (dismissing Patent Owner's Motion to Exclude as moot on the same basis).

with Patent Owner that "[i]t is completely irrelevant what Dr. Frey claims he could do in the year 2018 when armed with Caltech's patent disclosures and publications, [the inventor's] original coding work, contemporary resources, (e.g., Dr. Frey (¶51) used Matlab, a software program that received over 35 version updates since May 2000), and 18 years of post-filing date knowledge" PO Sur-Reply 7. Because this evidence is not tied to the state of the art at the time of the invention, it is not probative of anticipated success. *See Millennium Pharm., Inc. v. Sandoz Inc.*, 862 F.3d 1356, 1367 (Fed. Cir. 2017) (quoting *Interconnect Planning Corp. v. Feil*, 774 F.2d 1132, 1138 (Fed. Cir. 1985)) ("Those charged with determining compliance with 35 U.S.C. § 103 are required to place themselves in the minds of those of ordinary skill in the relevant art *at the time the invention was made*, to determine whether that which is now plainly at hand would have been obvious at such earlier time." (emphasis added)).

As part of our obviousness analysis, we consider "the scope and content of the prior art." *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). In this regard, we credit Patent Owner's testimony and evidence that an important aspect of the art in this case is the relative unpredictability of developing error-correction codes. *See* PO Resp. 5–6, 45–46 (citing Ex. 2004 ¶¶ 116–117; Ex. 2033, 256:21–257:12) ("The field of error correction coding has historically been characterized by significant experimentation and unpredictable results . . . . Even when well-performing codes are identified, the reasons for the improved performance are often not understood.")); Ex. 2004 ¶ 47.

We do not agree with Petitioner that the need to run experiments in an unpredictable field, such as error-correction coding, indicates anything about

whether such experiments ultimately would have been successful at the time of the invention. Importantly, "[u]npredictability of results equates more with nonobviousness rather than obviousness, whereas that which is predictable is more likely to be obvious." *Honeywell Int'l Inc. v. Mexichem Amanco Holding S.A.*, 865 F.3d 1348, 1356 (Fed. Cir. 2017). In the absence of any evidence rooted in the Petition that substantiates a reasonable expectation of success, Petitioner's reliance on a known need for experimentation is not sufficient to support its obviousness rationale.[9] *See Arctic Cat Inc. v. Bombardier Recreational Prod. Inc.*, 876 F.3d 1350, 1360–61 (Fed. Cir. 2017) ("[W]here a party argues a skilled artisan would have been motivated to combine references, it must show the artisan would have had a reasonable expectation of success from doing so." (internal quotation omitted)).

We are also not persuaded by Petitioner's deposition testimony of Dr. Divsalar as confirmation that a person of ordinary skill in the art would have been motivated to combine Divsalar and Frey. Pet. Reply 12–13 (citing Ex. 1264). Dr. Divsalar's testimony does not address the expectation of success for the modifications to Divsalar proposed by Petitioner. PO Sur-Reply 6; Ex. 2031 ¶¶ 33–35; Ex. 1264 60:1–21, 183:15–186:20.

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[9] Petitioner does not contend that its proposed combination should be analyzed under obvious-to-try case law. *Cf.* Tr., 14:1–6 (Petitioner acknowledging that it was not putting forth an obvious-to-try argument). Nor could Petitioner, because Petitioner does not develop an obvious-to-try theory. Specifically, Petitioner does not establish that the prior art directs which parameters to try and/or guides an inventor toward a particular solution. *See Bayer Schering Pharma AG v. Barr Labs., Inc.*, 575 F.3d 1341, 1347 (Fed. Cir. 2009).

Furthermore, the alleged email from Dr. Frey to Dr. Divsalar suggesting further work on irregular turbocodes (Pet. Reply 12; Ex. 1264, 183:15–186:20) does not indicate an expectation that a particular irregular code would prove successful. As discussed above, the unpredictable nature of the field and need for experimentation for error correcting codes does not resolve the need to address the expectation of success for a proposed modification or combination. Dr. Divsalar's deposition testimony does not persuasively address Petitioner's lack of expectation of success evidence and argument.

For these reasons, we are not persuaded that an ordinarily skilled artisan would have been motivated to combine the teachings of Divsalar and Luby in the manner suggested by Petitioner. Thus, we determine Petitioner has not shown by a preponderance of the evidence that claims 1–8 and 11–14 would have been obvious over the combination of Divsalar and Luby.

D. Obviousness based on Divsalar, Luby, and Luby97: Claims 15—17, 19–22, and 24–33

Petitioner contends that claims 15–17, 19–22, and 24–33 would have been obvious over the combination of Divsalar, Luby, and Luby97. Pet. 55–69 (citing Ex. 1206 ¶¶ 457–503). Patent Owner disputes Petitioner's contentions. PO Resp. 48–50.

1. Luby97 (Ex. 1211)

Luby97 describes randomized constructions of linear-time encodable and decodable codes that can transmit over lossy channels at rates extremely close to capacity." Ex. 1211, Abstract. Luby97 describes receiving data to be encoded in a stream of data symbols, such as bits, where the "*stream of*

data symbols [] is partitioned and transmitted in logical units of blocks." *Id.* at 150 (emphasis added).

2. Analysis

Building upon the reasoning offered to combine Divsalar and Luby, Petitioner contends that a person of ordinary skill in the art would be motivated to combine Divsalar, and Luby97, arguing that both relate to error correcting codes, where Luby97 introduces a stream of data symbols or bits as the blocks of data to encode to the encoders of Divsalar. Pet. 55–56 (citing Ex. 1206 ¶¶ 457–460). Petitioner argues that a person of ordinary skill in the art would have understood using the teaching of streaming in Luby97 to make an encoder capable of receiving and processing streams as opposed to blocks. *Id.* at 56.

Petitioner's analysis for claims 15–17, 19–22, and 24–33 relies on the same rationales and reasoning offered to combine Divsalar and Luby discussed above. Pet. 55–56. Accordingly, Petitioner's rationale for this ground incorporates the same deficiencies discussed above. For this reason, we determine that Petitioner has not shown by a preponderance of the evidence that claims 15–17, 19–22, and 24–33 would have been obvious over the combination of Divsalar, Luby, and Luby97.

III. MOTIONS

A. Patent Owner's Motion to Exclude

Patent Owner moves to exclude Exhibits 1212, 1213, 1216, 1219, 1229–1249, 1253, 1255, 1257–1261, 1265, 1267, 1268 and portions of Exhibits 1262 and 1264. Paper 56, 1. Patent Owner's motion is dismissed as moot with respect to these exhibits, as we do not rely on them in a manner

adverse to Patent Owner.

B. Patent Owner's Motion for Sanctions

Patent Owner requests sanctions against Petitioner for allegedly failing to stay within the proper scope of cross-examination during the deposition of Dr. Mitzenmacher. Paper 49, 1. Specifically, Patent Owner details questioning of Dr. Mitzenmacher that allegedly "ventured into various topics beyond the scope of the witness' direct testimony." *Id.* at 7–9. For example, Patent Owner cites "extensive questioning regarding Tanner graphs and figures newly created by Petitioner's lawyers, but absent from any petition materials or the witness' direct testimony." *Id.* at 8. As sanctions, Patent Owner asks us to: (1) strike the out-of-scope testimony elicited by Petitioner; (2) hold the direct testimony of Dr. Mitzenmacher to be facts established in this proceeding; and (3) impose "reasonable compensatory expenses, including attorney fees, for costs reasonably related to excessive questioning and deposition time." *Id.* at 9–10.

Petitioner contends that "each question posed by Petitioner during Dr. Mitzenmacher's deposition pertained directly to topics and opinions in his declaration." Paper 51, 5. Regarding the Tanner graphs and figures, Petitioner contends these were properly served upon Petitioner at Dr. Mitzenmacher's deposition in accordance with 37 C.F.R. § 42.53(f)(3). *Id.* at 6. According to Petitioner, Patent Owner's proposed sanctions are unwarranted, particularly because Patent Owner suffered no harm. *Id.* at 7–8.

The "Board may impose a sanction against a party for misconduct." 37 C.F.R. § 42.12(a); *see also* 35 U.S.C. § 316(a)(6) (requiring regulations

prescribing sanctions). As the moving party, Patent Owner has the burden to persuade the Board that sanctions are warranted. *See* 37 C.F.R. § 42.20(c). In general, a motion for sanctions should address three factors: (i) whether a party has performed conduct that warrants sanctions; (ii) whether the moving party has suffered harm from that conduct; and (iii) whether the sanctions requested are proportionate to the harm suffered by the moving party. *See Square, Inc. v. Think Comput. Corp.*, Case CBM2014-00159, slip op. at 2 (PTAB Nov. 27, 2015) (Paper 48) (citing *Ecclesiastes 9:10-11-12, Inc. v. LMC Holding Co.*, 497 F.3d 1135, 1143 (10th Cir. 2007)).

Having reviewed the relevant portions of Dr. Mitzenmacher's deposition, we agree with Petitioner that sanctions are not warranted. Petitioner's attempts to elicit testimony regarding the Tanner graphs and figures, while inartful, did not rise to the level of sanctionable conduct because they were reasonably related to Dr. Mitzenmacher's direct testimony. Furthermore, we agree with Petitioner that Patent Owner suffered no harm, particularly in light of our Decision. For these reasons, we deny Patent Owner's motion for sanctions.

IV. CONCLUSION

For the foregoing reasons, Petitioner has not shown by a preponderance of the evidence that claims 1–8 and 11–14 of the '710 patent would have been obvious over the combination of Divsalar and Luby; and that claims 15–17, 19–22, and 24–33 of the '710 patent would have been obvious over the combination of Divsalar, Luby, and Luby97.

V. ORDER

Accordingly, it is:

ORDERED that claims 1–8, 11–17, 19–22, and 24–33 of the '710 patent are not held to be unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Exclude is *dismissed as moot*;

FURTHER ORDERED that Patent Owner's Motion for Sanctions is *denied*; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to this proceeding seeking judicial review of our decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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Paper 77
Entered: December 27, 2018

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

CALIFORNIA INSTITUTE OF TECHNOLOGY,
Patent Owner.

Case IPR2017-00210
Patent 7,116,710 B1

Before KEN B. BARRETT, TREVOR M. JEFFERSON, and JOHN A. HUDALLA, *Administrative Patent Judges*.

JEFFERSON, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

Petitioner, Apple, Inc. ("Apple"), filed a Petition (Paper 5, "Pet.") requesting an *inter partes* review of claims 1–8, 10–17, and 19–33 of U.S. Patent No. 7,116,710 B1 (Ex. 1001, "the '710 patent") pursuant to 35 U.S.C. §§ 311–319. Patent Owner, California Institute of Technology ("Caltech"), filed a Preliminary Response (Paper 17, "Prelim. Resp.") to the Petition.

We instituted an *inter partes* review on claims 1–8, 11–17, 19–22, and 24–33 of the '710 patent on certain grounds of unpatentability presented. (Paper 18, "Inst. Dec."). Caltech filed a Patent Owner Response (Paper 35, "PO Resp."), and Apple filed a Petitioner Reply (Paper 46, "Pet. Reply"). Caltech also filed a Sur-Reply (Paper 62, "PO Sur-Reply"), as was authorized by our Order of March 2, 2018 (Paper 55). An oral hearing was held on April 19, 2018, and a transcript of the hearing is included in the record. Paper 72 ("Tr.").

Apple filed a Declaration of James A. Davis, Ph.D. (Ex. 1006) with its Petition and a Declaration of Brendan Frey, Ph.D. (Ex. 1065) with its Reply. Caltech filed Declarations of Dr. Dariush Divsalar (Ex. 2031) and Dr. Michael Mitzenmacher (Ex. 2004) with its Response.

As authorized in our Order of February 10, 2018 (Paper 48), Patent Owner filed a motion for sanctions related to Petitioner's cross-examination of Patent Owner's witnesses, Dr. Mitzenmacher (Paper 50) and Dr. Divsalar, and Petitioner filed an opposition (Paper 52).

In light of the U.S. Supreme Court's decision in *SAS Institute, Inc. v. Iancu*, 138 S. Ct. 1348 (2018), we modified our Institution Decision to institute on all of the challenged claims and all of the grounds. Paper 69. Subsequently, the parties filed a joint motion to limit the Petitions to the

claims and grounds that were originally instituted. Paper 71. We granted their motion. Paper 73. As a result, the remaining instituted claims and grounds are the same as they had been at the time of the Institution Decision. *See id.* at 3.

The one-year period normally available to issue a Final Written Decision was extended under 37 C.F.R. § 42.100(c). Papers 74, 75, 1–2.

We have jurisdiction under 35 U.S.C. § 6. This decision is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of claims 1–8, 11–17, 19–22, and 24–33 of the '710 patent. For the reasons discussed below, Petitioner has not demonstrated by a preponderance of the evidence that claims that claims 1–8, 11–17, 19–22, and 24–33 are unpatentable.

A. Related Proceedings

The parties indicate that the '710 patent was involved in the following active case, *Cal. Inst. of Tech. v. Broadcom Ltd.*, No. 2:16-cv-03714 (C.D. Cal. filed May 26, 2016), and in concluded cases, *Cal. Inst. of Tech. v. Hughes Commc'ns, Inc.*, No. 2:15-cv-01108 (C.D. Cal. filed Feb. 17, 2015); and *Cal. Inst. of Tech. v. Hughes Commc'ns, Inc.*, 2:13-cv-07245 (C.D. Cal. filed Oct. 1, 2013). Pet. 3, Paper 8, 2–3.

The parties also identify co-pending case IPR2017-00219, in which Apple filed a petition for *inter partes* review of the '710 patent. Pet. 3; Paper 8, 2–3. *Inter partes* review of the '710 patent was previously considered and denied in *Hughes Network Sys., LLC v. Cal. Inst. of Tech.*, IPR2015-00067 (PTAB April 27, 2015) (Paper 18) ("IPR2015-00067") and *Hughes Network Sys., LLC v. Cal. Inst. of Tech.*, IPR2015-00068 (PTAB

April 27, 2015) ("IPR2015-00068"). Finally, patents related to the '710 patent were challenged in IPR2015-00059, IPR2015-00060, IPR2015-00061, and IPR2015-00081. Pet. 3.

B. The '710 Patent

The '710 patent describes the serial concatenation of interleaved convolutional codes forming turbo-like codes. Ex. 1001, Title. It explains some of the prior art with reference to its Fig. 1, reproduced below.

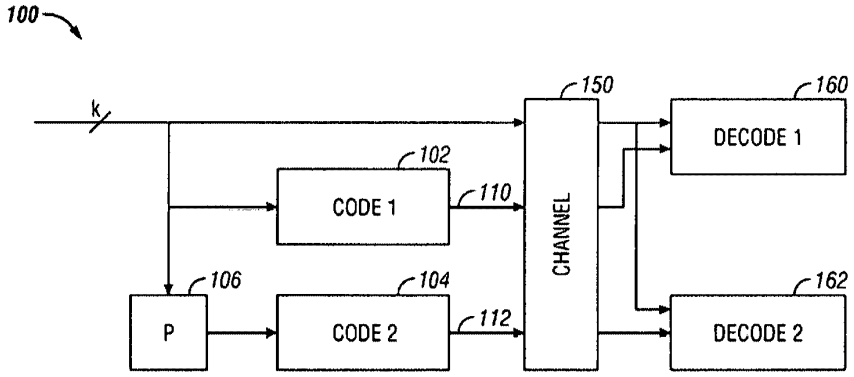

FIG. 1
(Prior Art)

Figure 1 is a schematic diagram of a prior "turbo code" system. *Id.* at 2:14–15. The '710 patent specification describes Figure 1 as follows:

> A standard turbo coder 100 is shown in FIG. 1. A block of k information bits is input directly to a first coder 102. A k bit interleaver 106 also receives the k bits and interleaves them prior to applying them to a second coder 104. The second coder produces an output that has more bits than its input, that is, it is a coder with rate that is less than 1. The coders 102,104 are typically recursive convolutional coders.
>
> Three different items are sent over the channel 150: the original k bits, first encoded bits 110, and second encoded bits 112. At the decoding end, two decoders are used: a first

> constituent decoder 160 and a second constituent decoder 162. Each receives both the original k bits, and one of the encoded portions 110, 112. Each decoder sends likelihood estimates of the decoded bits to the other decoders. The estimates are used to decode the uncoded information bits as corrupted by the noisy channel.

Id. at 1:38–53(emphasis omitted).

A coder 200, according to a first embodiment of the invention, is described with respect to Figure 2, reproduced below.

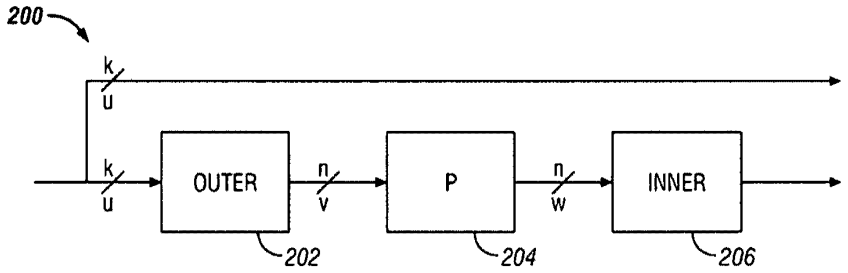

FIG. 2

Figure 2 of the '710 patent is a schematic diagram of coder 200. *Id.* at 2:16–17.

The specification states that "coder 200 may include an outer coder 202, an interleaver 204, and inner coder 206." *Id.* at 2:34–35. It further states as follows:

> The outer coder 202 receives uncoded data. The data may be partitioned into blocks of fixed size, say k bits. The outer coder may be an (n,k) binary linear block coder, where n>k. The coder accepts as input a block u of k data bits and produces an output block v of n data bits. The mathematical relationship between u and v is $v=T_0u$, where T_0 is an $n\times k$ matrix, and the rate[1] of the coder is k/n.

[1] The "rate" of an encoder refers to the ratio of the number of input bits to the number of resulting encoded output bits related to those input bits. *See* Pet. 9.

> The rate of the coder may be irregular, that is, the value of T_0 is not constant, and may differ for sub-blocks of bits in the data block. In an embodiment, the outer coder 202 is a repeater that repeats the k bits in a block a number of times q to produce a block with n bits, where n=qk. Since the repeater has an irregular output, different bits in the block may be repeated a different number of times. For example, a fraction of the bits in the block may be repeated two times, a fraction of bits may be repeated three times, and the remainder of bits may be repeated four times. These fractions define a degree sequence, or degree profile, of the code.
>
> The inner coder 206 may be a linear rate-1 coder, which means that then-bit output block x can be written as $x=T_I w$, where T_I is a nonsingular $n \times n$ matrix. The inner coder 210 can have a rate that is close to 1, e.g., within 50%, more preferably 10% and perhaps even more preferably within 1% of 1.

Id. at 2:41–64 (emphasis omitted). Codes characterized by a regular repeat of message bits into a resulting codeword are referred to as "regular repeat," whereas codes characterized by irregular repeat of message bits into a resulting codeword are referred to as "irregular repeat." The second ("inner") encoder 206 performs an "accumulate" function. Thus, the two-step encoding process illustrated in Figure 2, including a first encoding ("outer encoding") followed by a second encoding ("inner encoding"), results in either a "regular repeat accumulate" ("RRA") code or an "irregular repeat accumulate ("IRA") code, depending upon whether the repetition in the first encoding is regular or irregular.

Figure 4 of the '710 patent, reproduced below, shows an alternative embodiment in which the first encoding is carried out by a low density generator matrix.

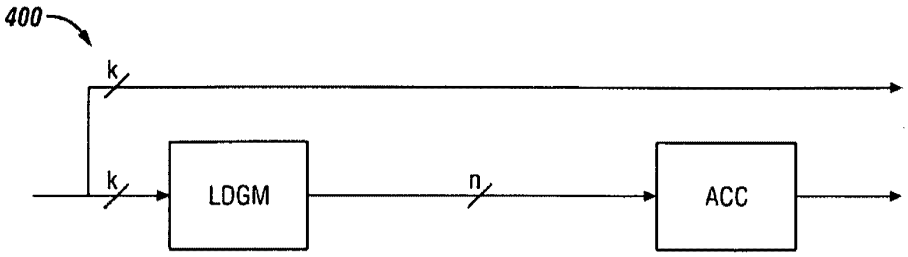

FIG. 4

Figure 4 of the '710 patent is a schematic of an irregular repeat and accumulate coder using a low density generator matrix (LDGM)[2] coder. *Id.* at 2:20–21, 3:24–25, 3:51–54. The LDGM coder "performs an irregular repeat of the k bits in the block, as shown in FIG. 4." *Id.* LDGM codes are a special class of low density parity check codes that allow for less encoding and decoding complexity. LDGM codes are systematic linear codes generated by a "sparse" generator matrix. No interleaver (as in the Figure 2 embodiment) is required in the Figure 4 embodiment because the LDGM provides scrambling otherwise provided by the interleaver.

C. Challenged Claims

Claims 1, 11, 15, and 25 of the '710 patent are independent. Claims 1 and 3 are illustrative of the claims at issue and are reproduced below:

1. A method of encoding a signal, comprising:

obtaining a block of data in the signal to be encoded;

partitioning said data block into a plurality of sub-blocks, each sub-block including a plurality of data elements;

[2] A "generator" matrix (typically referred to by "G") is used to create (generate) codewords. A parity check matrix (typically referred to by "H") is used to decode a received message.

> first encoding the data block to from a first encoded data block, said first encoding including repeating the data elements in different sub-blocks a different number of times;
>
> interleaving the repeated data elements in the first encoded data block; and
>
> second encoding said first encoded data block using an encoder that has a rate close to one.
>
> 3. The method of claim 1, wherein said first encoding is carried out by a first coder with a variable rate less than one, and said second encoding is carried out by a second coder with a rate substantially close to one.

Ex. 1001, 7:14–25, 7:28–31.

D. The Remaining Grounds of Unpatentability

The following grounds of unpatentability remain at issue in this case (Inst. Dec. 31; Paper 72, 2–3):

Reference(s)	Basis	Claims Challenged
Frey[3]	§ 102(a)	1 and 3
Frey and Divsalar[4]	§ 103(a)	1–8 and 11–14
Frey, Divsalar, and Luby97[5]	§ 103(a)	15 17, 19–22, and 24–33

[3] Brendan J. Frey and David J.C. MacKay, *Irregular Turbocodes*, PROCEEDINGS OF THE 37TH ALLERTON CONFERENCE ON COMMUNICATION, CONTROL, AND COMPUTING (1999) at 241–248 (Ex.1002, "Frey).
[4] Dariush Divsalar, et al., *Coding Theorems for "Turbo-Like" Codes*, PROCEEDINGS OF THE THIRTY-SIXTH ANNUAL ALLERTON CONFERENCE ON COMMUNICATION, CONTROL, AND COMPUTING, Sept. 23–25, 1998, at 201–209 (Ex. 1003, "Divsalar").
[5] Luby, M. et al., *Practical Loss-Resilient Codes*, PROCEEDINGS OF THE TWENTY-NINTH ANNUAL ACM SYMPOSIUM ON THEORY OF COMPUTING, May 4–6, 1997, at 150–159 (Ex. 1011, "Luby97").

II. ANALYSIS

A. Claim Interpretation

Because this *inter partes* review is based on a petition filed before November 13, 2018, we construe the claims by applying the broadest reasonable interpretation in light of the specification. 37 C.F.R. § 42.100(b) (2016); *see Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). In applying a broadest reasonable construction, claim terms generally are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Any special definition for a claim term must be set forth in the specification with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

1. "close to one" and "rate" (claims 1 and 3)

Petitioner argues that the broadest reasonable construction of "close to one" as recited in claims 1 and 3 is "within 50% of one." Pet. 24. Petitioner argues that this is consistent with the '710 patent specification, which states that the inner code 210 of Figure 1, "can have a rate that is close to one, e.g., within 50%, more preferably 10% and perhaps even more preferably within 1% of 1." Pet. 24–25 (quoting Ex. 1001, 2:62–64 and citing Ex. 1006, ¶¶ 102–103).

Patent Owner argues that the term "close to one" does not need to need to be construed (PO Resp. 19), but argues that the "term 'rate' in the context of an encoder would be 'the ratio of the number of input bits to the number of output bits'" (*id.* at 18 (citing Ex. 2004 ¶¶ 59–60)). Citing the testimony of Mr. Mitzenmacher, Patent Owner argues that "there is no

dispute that 'rate' should be construed as 'the ratio of the number of input bits to the number of output bits.'" PO Resp. 19; *see* Ex. 2033, 43:18–44:7; Ex. 2004 ¶¶ 59–60. Further, Patent Owner argues that the '710 patent explains that the rate of the coder is the number of input bits divided by the number of output bits. PO Resp. 18; Ex. 1001, 2:44–47, 2:59–61.

We agree with the parties determining that "close to one" as recited in claims 1 and 3 is construed as "within 50% of one."

With respect to "rate," Petitioner does not challenge Patent Owner's argument, which is supported by the '710 specification. See Pet. Reply 5 (discussing rate). Accordingly, we agree that "rate" is construed as "the ratio of the number of input bits to the number of output bits."

B. Frey's Status as Prior Art

Petitioner contends Frey qualifies as a prior art printed publication under 35 U.S.C. § 102(a) relative to the May 18, 2000, filing date of the provisional application to which the '710 patent claims priority. Pet. 5–6; *see also* Ex. 1001, [60]. Specifically, Petitioner asserts that Frey was "published in the Proceedings of the 37th Allerton Conference on Communication, Control and Computing" and that the "conference proceedings were published on or before March 20, 2000." *Id.* at 25 (citing Ex. 1015 (showing stamps from the Cornell University Library and the table of contents for the conference) and Ex. 1006 ¶ 63).

Patent Owner contends that Petitioner has not established that Frey is prior art under 35 U.S.C. § 102(a). PO Resp. 13–17. Specifically, Patent Owner argues that Petitioner is bound by its assertion in the Petition that March 20, 2000, is the publication date for Frey. PO Resp. 15 (citing

Pet. 25). Patent Owner also argues that the invention of the '710 patent was conceived prior to March 20, 2000, and reduced to practice with reasonable diligence. PO Resp. 14–17 (citing *Perfect Surgical Techniques, Inc. v. Olympus Am., Inc.*, 841 F.3d 1004, 1007 (Fed. Cir. 2016)). Patent Owner cites testimony from Dr. Hue Jin, a co-inventor and various contemporaneous records in support of its attempt to antedate the alleged March 20, 2000, publication date for Frey.

With respect to conception, Patent Owner argues that the declaration of Dr. Jin (Ex. 2020) with corroborating exhibits supports prior conception of the invention and removes Frey as prior art. Dr. Jin is a co-inventor and provides testimony and supporting documents that Patent Owner contends show that by early March 2000 the inventors "had developed the Irregular Repeat Accumulate code of the '710 patent, including an outer coder that could be generalized as a low-density generator matrix (LDGM), permitting elimination of an interleaver and focus on irregularity, and an inner coder comprising an accumulator." PO Resp. 15–16 (citing Ex. 2020 ¶¶ 5–7; Ex. 2022; Ex. 2031 ¶¶ 13–15). Specifically, Patent Owner argues that in early March 2000, Dr. Jin created and ran simulations using files and code that reflected the structure identical to the IRA code of Figure 3 in the '710 patent. PO Resp. 16 (Ex. 2020 ¶¶ 8–14). Moreover, Patent Owner avers that actual reduction to practice occurred on March 20, 2000, when a simulation ran using the irregular degree profile written on March 13, 2000. PO Resp. 16 (citing Ex. 2020 ¶¶ 8, 15–18). Patent Owner asserts that the inventors proceeded diligently to constructive reduction to practice on May 18, 2000, which is the filing date for the '710 patent. PO Resp. 16–17; Ex. 1001, [22].

In reply, Petitioner attempts to show that Frey was published even earlier—February 2000—based on testimony "from former co-chairs of the conference at which Frey was presented" regarding the shipment of conference proceedings. Pet. Reply 17 (citing Exs. 1032–1034). Petitioner also argues that Patent Owner's evidence does not corroborate the alleged date conception or demonstrate sufficient diligence. *Id.* at 18–22. Patent Owner's conception date, Petitioner argues, relies improperly on uncorroborated testimony from a co-inventor where corroboration beyond the inventor is necessary to avoid self-serving testimony. Pet. Reply 18 (*Singh v. Burke*, 317 F.3d 1334, 1340–41 (Fed. Cir. 2003)). Petitioner also argues that Patent Owner's documents and testimony fail to support Patent Owner's dates because (1) Exhibit 2022 is an unwitnessed excerpt from an inventor's notebook that fails to show a key feature of the invention (Pet. Reply 19); (2) the parameter files and software files cited as part of the pre-March 20, 2000, activity are undated or uncertain, at best, as to the date the files or software were run or updated (*id.* at 19–20 (discussing Exhibits 2025, 2027, 2029 (undated parameter files) and Exhibits 2023, 2024, 2026, and 2028 (simulation software files)). *See also* Pet. Reply 20 n.5 (arguing that the inventor's testimony regarding parameter files is the sole support for the dates for those files and that such testimony is not consistent or reliable).

In its sur-reply, Patent Owner asserts that Petitioner's shifting publication date is improper as untimely and prejudicial. PO Sur-Reply 2.

1. Printed Publication Analysis

We look to the underlying facts to make a legal determination as to whether a reference is a printed publication. *Suffolk Techs., LLC v. AOL Inc.*, 752 F.3d 1358, 1364 (Fed. Cir. 2014). The determination of whether a

given reference qualifies as a prior art "printed publication" involves a case-by-case inquiry into the facts and circumstances surrounding its disclosure to members of the public. *In re Klopfenstein*, 380 F.3d 1345, 1350 (Fed. Cir. 2004). The key inquiry is whether the reference was made "sufficiently accessible to the public interested in the art" before the critical date. *In re Cronyn*, 890 F.2d 1158, 1160 (Fed. Cir. 1989); *In re Wyer*, 655 F.2d 221, 226 (CCPA 1981). "A given reference is 'publicly accessible' upon a satisfactory showing that such document has been disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it." *Bruckelmyer v. Ground Heaters, Inc.*, 445 F.3d 1374, 1378 (Fed. Cir. 2006) (citation omitted).

Petitioner has put forth date stamp evidence that a copy of the conference proceedings including Frey was at least received in the Cornell University Library by March 20, 2000. Ex. 1015, 16. Petitioner also put forth a declaration of Pamela Stansbury, an employee in the Original Cataloging Unit of the Cornell University Library, who testifies that, based upon her review of library records and her knowledge of standard operating procedures, Frey was "publicly available at the Cornell University Library as of March 20, 2000." Ex. 1031 ¶ 4; *see also* Paper 22, 5 (Petitioner's motion to submit supplemental information, which includes a description of Exhibit 1031); Paper 32 (granting Petitioner's motion to submit supplemental information). Patent Owner does not dispute that Frey was publicly available as of March 20, 2000. *See* PO Resp. 15. Based on Petitioner's evidence, we determine that Frey qualifies as a prior art printed publication as of March 20, 2000.

We need not consider Petitioner's purported evidence of an even earlier publication date (*see* Pet. Reply 17–18), because we determine below that Patent Owner's evidence is insufficient to antedate Frey's March 20, 2000, publication date.

2. Patent Owner's Attempt to Antedate Frey

We now consider Patent Owner's arguments attempting to antedate Frey by showing an earlier conception date and diligent reduction to practice. Regarding the type of proof required to corroborate inventor testimony on conception and reduction to practice, the Federal Circuit has stated:

> It is well established that when a party seeks to prove conception via the oral testimony of a putative inventor, the party must proffer evidence corroborating that testimony. . . . There is no particular formula that an inventor must follow in providing corroboration of his testimony of conception. Rather, whether a putative inventor's testimony has been sufficiently corroborated is determined by a 'rule of reason' analysis, in which 'an evaluation of all pertinent evidence must be made so that a sound determination of the credibility of the inventor's story may be reached.' However, that 'rule of reason' analysis does not alter the requirement of corroboration of an inventor's testimony. Evidence of the inventive facts must not rest alone on the testimony of the inventor himself.

Singh, 317 F.3d 1240–41 (internal citations omitted) (quoting *Price v. Symsek*, 988 F.2d 1187, 1195 (Fed. Cir. 1993)). With respect to priority and antedating a reference, the Federal Circuit has stated the following regarding burdens and required documentary support:

> When the issue of priority concerns the antedating of a reference, the applicant is required to demonstrate, *with sufficient documentation*, that the applicant was in possession of the later-claimed invention before the effective date of the reference.

> *Demonstration of such priority requires documentary support, from which factual findings and inferences are drawn, in application of the rules and law of conception, reduction to practice, and diligence.* The purpose is not to determine priority of invention—the province of the interference practice—but to ascertain whether the applicant was in possession of the claimed invention sufficiently to overcome the teachings and effect of an earlier publication of otherwise invalidating weight.

In re Steed, 802 F.3d 1311, 1316 (Fed. Cir. 2015) (emphases added); *see also Perfect Surgical Techniques, Inc. v. Olympus America, Inc.*, 841 F.3d 1004, 1008 (Fed. Cir. 2016) (citing *Steed*). "The principles are legal, but the conclusions of law focus on the evidence, for which the Board's factual findings are reviewed for support by substantial evidence." *Steed*, 802 F.3d at 1316; *see also NFC Tech., LLC v. Matal*, 871 F.3d 1367, 1371 (Fed. Cir. 2017).

Upon review of the parties' evidence and argument, we are faced with conception evidence that is not corroborated and fails to show full possession of the entire invention. See PO Resp. 15–16 (Ex. 2020 ¶¶ 3–4; Ex, 2031 ¶¶ 13–15). The evidence Patent Owner cites are general directions to consider irregular outer codes (Ex. 2021) and an unwitnessed inventor notebook entry (Ex. 2022). Patent Owner does not provide sufficient corroboration for these exhibits or sufficient explanation that these documents show possession of the invention. *In re Steed*, 802 F.3d at 1316. Indeed, Patent Owner's arguments do not point to any particular date of conception, but merely states that it was "before" March 20, 2000, based on these uncorroborated documents (Ex. 2021; Ex. 2022). PO Resp. 15–16. When pressed to establish a date, Patent Owner points only to early March dates, but does not point to a date by which possession was established.

Tr. 37:9–38:12 (discussing conception and reduction to practice dates). Based on the full record before us, Patent Owner has not provided sufficient and persuasive corroborated evidence of conception prior to March 20, 2000, based on the Exhibits 2020, 2021 and 2022.

Patent Owner's antedating argument further posits that in early March, March 10 and March 20, 2000, simulations refelecting the structure of Figure 3 of the '710 patent were produced. PO Resp. 15–16. (citing Ex. 2020 ¶¶ 8–15). To evaluate this arugment, Patent Owner relies on inventor testimony interpreting uncorroborated parameter and software files . PO Resp. 15–16. (citing Ex. 2020 ¶¶ 8–15); *see, e.g.*, Ex. 2023; Pet. Reply 20 n.5. In particular, Patent Owner's arguments rely on the testimony of Dr. Jin to establish the dates of creation of parameter files and simulation programs along with the dates these programs would have been run based on Dr. Jin's regular practices regarding changelogs for the program files. PO Resp. 15–17; Ex. 2020 ¶¶ 3–19.

We agree with Petitioner that on their face, the parameter files about which Mr. Jin testifies are undated. Pet. Reply 19 (Exhibits 2025, 2027, 2029 (undated parameter files)). Dr. Jin testifies to his typical practices of noting significant changes in the logs and relies on that practice and file metadata to establish the date the simulations were run and the invention was reduced to practice. PO Resp. 16 (asserting that March 20, 2000 was when the undated degree profiles written on March 13, 2000, were run in the simulation); Ex. 2020 ¶¶ 8, 15–18. Yet the undated files do not corroborate Dr. Jin's testimony on the relevant dates.

Under the rule of reason, we require corroborating evidence sufficient to support Dr. Jin's testimony that early March, either March 10 or March

20, 2000, was the reduction to practice date. PO Resp. 16; *see* Tr. 38:4–11. Yet the documents put forth by Patent Owner to allegedly support Dr. Jin's testimony are not probative evidence on their own; they too rely on Dr. Jin's testimony for interpretation. *See, e.g.* Ex. 2020 ¶¶ 3–19 (discussing Ex. 2023–2029). We also note that Patent Owner has not submitted the metadata Dr. Jin relies on to establish the dates in his testimony. *See* Ex. 2020 ¶¶ 15–18. And, even if we were to credit the existence of the metadata, we find that Dr. Jin's testimony establishes that his practices regarding changelog dating for programs did not always reflect whether the contents of the files were altered after the change date. Pet. Reply 20 n.5 (citing Ex. 1063). Absent other corroborating evidence, Dr. Jin's testimony about metadata and about his usual practices is not sufficient to establish the date on which the simulation was run as the reduction to practice date. PO Resp. 16.

Upon review of the parties' evidence and argument, Patent Owner's evidence is not sufficient to establish conception in early March 2000 or an actual reduction to practice date of March 20, 2000, by a preponderance of the evidence. Although we agree that the evidence shows activity in the form of an email (Ex. 2021) and an inventor notebook entry (Ex. 2022), both of these documents require interpretation by the inventor relative to the reduction to practice inquiry and Patent Owner has not provided persuasive evidence showing possession of the invention of the '710 patent. Weighing the evidence from the co-inventor Dr. Jin in its entirety, we are not persuaded that the evidence sufficiently shows reduction to practice of the invention by March 20, 2000. Dr. Jin's testimony as an inventor in this instance lacks sufficient corroborating evidence. Ex. 2020 ¶¶ 3–19. On the

full record, Patent Owner's evidence is not sufficient to establish conception in early March 2000 or that March 20, 2000 is the date of actual reduction to practice.

Thus, on the full record, Patent Owner fails to establish sufficient evidence that the invention was conceived and reduced to practice before Frey's March 20, 2000, publication date. PO Resp. 15; Ex. 2020 ¶¶ 3–19. Accordingly, we determine that Frey qualifies as a prior art prior art printed publication under 35 U.S.C. § 102(a).

C. Level of Ordinary Skill in the Art

Petitioner cites Dr. Davis's testimony that "[a] person of ordinary skill in the art is a person with a Ph.D. in mathematics, electrical or computer engineering, or computer science with emphasis in signal processing, communications, or coding, or a master's degree in the above area with at least three years of work experience in this field at the time of the alleged invention." Pet. 23 (citing Ex. 1006, ¶ 95). Patent Owner expresses no position on the level of ordinary skill in the art, but its declarant, Dr. Mitzenmacher, applies the same standard advanced by Petitioner. Ex. 2004 ¶ 58.

We determine that Petitioner's proposed definition comports with the qualifications a person would have needed to understand and implement the teachings of the '710 patent and the prior art of record. Accordingly, we apply Petitioner's definition of the level of ordinary skill in the art.

D. Anticipation by Frey of Claim 1 and 3

Petitioner contends that Frey anticipates the limitations of independent claim 1 and dependent claim 3 of the '710 patent. Pet. 34–42 (citing

Ex. 1006 ¶¶ 106–126). Patent Owner disputes Petitioner's contentions. PO Resp. 20–30; PO Sur-Reply 2–4.

1. Frey (Ex. 1002)

Frey describes adding irregularity to turbocodes with systematic bits that participate in varying numbers of parity check equations. Ex. 1002, 1 (Abstract). Frey discloses how a turbocode is made irregular, showing a graphical representation in the fifth image of Figure 1, provided below.

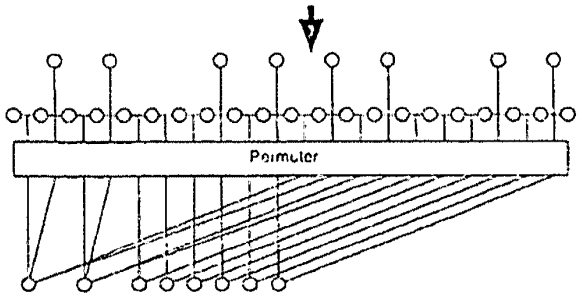

Figure 1, excerpted above, shows the systemic bits at the bottom with 2 or 4 lines going into the permuter. The fifth image of Figure 1 "shows how a turbocode can be made irregular by 'tying" some of the systematic bits together, i.e., by having some systematic bits replicated more than once." Ex. 1002, 3. Frey states that the fifth image of Figure 1 "illustrates one way the [] turbocode can be made irregular. Some of the systematic bits are 'tied' together, in effect causing some systematic bits to be replicated more than once." *Id.* at 2. Frey further discloses "that too [sic] keep the rate of the overall code fixed at 1/2, some extra parity bits must he punctured." *Id.*

In describing the decoding of irregular turbocodes, Frey provides a graphical model for the irregular turbocode shown in Figure 2, below.

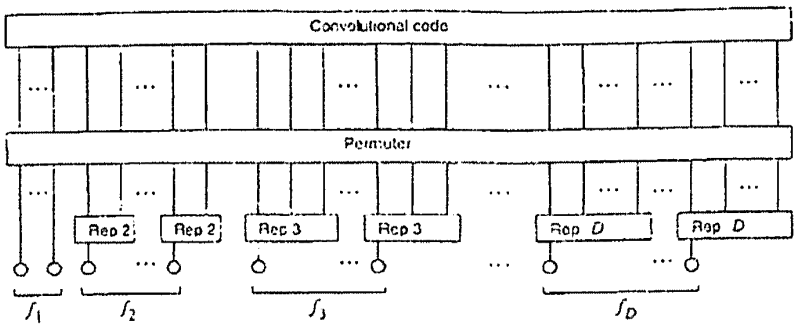

Figure 2: A general *irregular turbocode*. For $d = 1, \ldots, D$, fraction f_d of the codeword bits are repeated d times, permuted and connected to a convolutional code.

Figure 2 shows irregular turbocodes where f_d—the fraction of the codeword where each bit is repeated *d* times. Ex. 1002, 4. Frey discloses that "an irregular turbocode has the form shown [above] in Fig. 2, which is a type of 'trellis-constrained code'" where "f_d is the fraction of codeword bits that have degree *d* and *D* is the maximum degree." *Id.* at 2. Frey further discloses that "[e]ach codeword bit with degree *d* is repeated *d* times before being fed into the permuter. Several classes of permuter lead to linear-time encodable codes. In particular, if the bits in the convolutional code are partitioned into 'systematic bits' and 'parity bits', then by connecting each parity bit to a degree 1 codeword bit, we can encode in linear time." *Id.* at 2.

2. Analysis

To anticipate a patent claim under 35 U.S.C. § 102, "a reference must describe, either expressly or inherently, each and every claim limitation and enable one of skill in the art to practice an embodiment of the claimed invention without undue experimentation." *Am. Calcar, Inc. v. Am. Honda Motor Co.*, 651 F.3d 1318, 1341 (Fed. Cir. 2011) (citing *In re Gleave*, 560 F.3d 1331, 1334 (Fed. Cir. 2009)). When evaluating a prior art reference in the context of anticipation, the reference must be "considered together with

the knowledge of one of ordinary skill in the pertinent art." *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994) (citing *In re Samour*, 571 F.2d 559, 562 (CCPA 1978)). "[A] reference can anticipate a claim even if it 'd[oes] not expressly spell out' all the limitations arranged or combined as in the claim, if a person of skill in the art, reading the reference, would 'at once envisage' the claimed arrangement or combination." *Kennametal, Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376, 1381 (Fed. Cir. 2015) (quoting *In re Petering*, 49 CCPA 993, 301 F.2d 676, 681 (1962)). We analyze the instant ground with these principles in mind.

Claim 1 requires a second encoder that has a "rate close to one" as recited in claim 1 or a "rate substantially close to one" as recited in claim 3. Petitioner relies on the express disclosure in Frey that the second encoder has a rate of 2/3. Pet. 38–42 (citing Ex. 1002, 5); Pet. Reply 5–6. In the Petition, Petitioner relies on the equation and description disclosed in Frey which states that "[f]or a rate 1/2 turbocode, each constituent convolutional code should be rate 2/3 (which may, for example, be obtained by puncturing a lower-rate convolutional code.)" Ex. 1002, 2; Pet. 40; Ex. 1006 ¶ 121. Applying the equation in Frey, Petitioner argues that the convolution coder (second coder) yields a rate of 0.74, which is "close to one" as required by the claim. Pet. 40–41.

Patent Owner argues that Frey does not apply the term "rate" as properly construed, which refers to the number of input bits divided by the number of output bits. PO Resp. 18; Ex. 1001, 2:44-47, 2:59–61. Patent Owner further argues that when the proper construction of rate is applied to Frey's second coder, the convolution coder, it does not have a rate close to one. PO Resp. 24–27. Petitioner's evidence and analysis, Patent Owner

argues, rests on an equation in Frey that Dr. Davis acknowledged is in error. Ex. 2033, 13:19–14:3. Indeed, Patent Owner asserts that Frey's rate is accurate only if an "unconventional" definition of rate is applied to the second coder. PO Resp. 27 n.6. To obtain the rate in Frey requires treating the non-systemic code of the second coder in Frey as a systemic code. *Id.*

In reply, Petitioner argues that Patent Owner ignores the express statements in Frey that the convolution coder has a rate of 2/3 and then ignores the evidence regarding the second coder that would yield the 2/3 rate that Frey identifies. We are not persuaded by Petitioner's arguments.

First, we note that Petitioner's arguments on reply abandon the arguments and evidence of the Petition. Pet. Reply 5–6. This is not surprising, as Petitioner's expert declarant, Dr. Davis, acknowledged the error in the equation in Frey that is applied in the Petition and offered a corrected equation and analysis in his deposition. Ex. 2033, 13:19–14:3. Thus, Petitioner's declarant admits the calculations in the Petition are not correct. Despite this reversal, Petitioner offers no persuasive argument or explanation that the rate in the '710 patent is disclosed by Dr. Davis's corrected Frey equation and calculations or even the statements and rate equations in Frey. Pet. Reply 5–6.

Attempting to rebut Patent Owner's analysis of the convolution coder in Frey, Petitioner nakedly asserts that a person of ordinary skill in the art would have understood that Frey's second encoder outputs both systemic and parity bits, because that is the only way to achieve the 2/3 rate described in Frey. *Id.* Petitioner fails to cite any evidence for this conclusory statement regarding what a skilled artisan would have understood. Indeed, Petitioner's argument is undermined by Frey and Dr. Davis's testimony,

which both indicate that the convolution code step in Frey yields parity bits and not systemic bits as Petitioner alleges. *Compare* Ex. 2033, 128:8–10, 131:1–5; Ex. 1002, Figure 1, *with* Pet. 5–6. We are not persuaded by Petitioner's revised argument and evidence supporting the rate of the second encoder in Frey.

Petitioner fails to explain how a person of skill in the art would have understood that the output of the convolution coder in Frey yields a 2/3 rate under the construction of rate described in the '710 patent and adopted above. Pet. Reply 5–6. Indeed, Petitioner has not shown persuasively and by a preponderance of the evidence that the rate of the convolution coder in Frey yields a rate close to one under the construction of rate applicable to the '710 patent. Based on the full record, Petitioner has not shown by a preponderance of the evidence that Frey discloses that the second encoder has a rate close to one as required in claims 1 and 3.

Thus, on this record, we find that Petitioner has not shown has not presented sufficient information that Frey discloses the second encoder rate limitations of claims 1 and 3.

E. Obviousness based on Frey and Divsalar: Claims 1–8 and 11–14

Petitioner contends that claims 1–8 and 11–14 would have been obvious over the combination of Divsalar and Frey. Pet. 42–60 (citing Ex. 1006 ¶¶ 127–183). Patent Owner disputes Petitioner's contentions. PO Resp. 30–50.

1. Divsalar

Divsalar discloses "turbo-like" coding systems that are built from fixed convolutional codes interconnected with random interleavers,

including both parallel concatenated convolutional codes and serial concatenated convolutional codes as special cases. Ex. 1003, 1. With fixed component codes and interconnection topology, Divsalar demonstrates that as the block length approaches infinity, the ensemble (over all possible interleavers) maximum likelihood error probability approaches zero, if the ratio of energy per bit to noise power spectral density exceeds some threshold. *Id.*

The general class of concatenated coding systems is depicted in Figure 1 of Divsalar as follows:

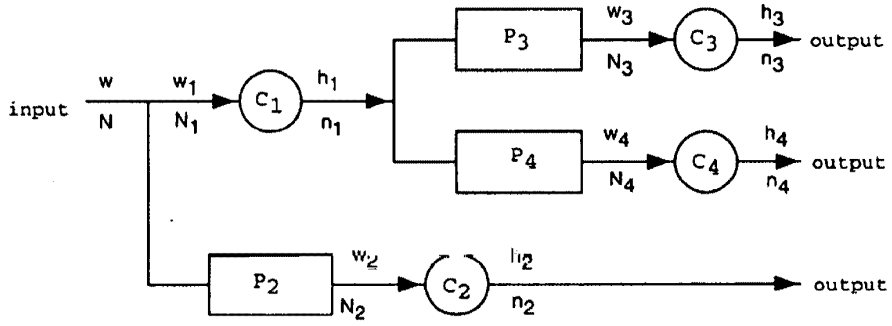

Figure 1. A "turbo-like" code with $s_I = \{1,2\}$, $s_O = \{2,3,4\}$, $\bar{s}_O = \{1\}$.

Figure 1 illustrates that encoders C_2, C_3, and C_4 are preceded by interleavers (permuters) P_2, P_3, and P_4, except C_1, which is connected to an input rather than an interleaver. *Id.* at 2–3. The overall structure must have no loops and, therefore, is called a "turbo-like" code. *Id.*

Divsalar further discloses that "turbo-like" codes are repeat and accumulate (RA) codes. *Id.* at 5. The general scheme is depicted in Figure 3 as follows:

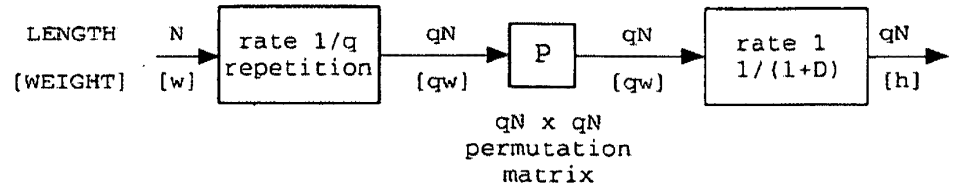

Figure 3. Encoder for a (qN, N) repeat and accumulate code. The numbers above the input-output lines indicate the length of the corresponding block, and those below the lines indicate the weight of the block.

Figure 3 illustrates that information block of length N is repeated q times, scrambled by interleaver of size qN, and then encoded by a rate 1 accumulator. *Id.* The accumulator can be viewed as a truncated rate-1 recursive convolutional encoder. *Id.* Figure 3 further illustrates a simple class of rate 1/q serially concatenated codes where the outer code is a q-fold repetition code and the inner code is a rate 1 convolutional code with a transfer function 1/(1+ D). *Id.* at 1, 5.

2. Analysis

A claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) where in evidence, so-called secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). We also recognize that prior art references must be "considered together

with the knowledge of one of ordinary skill in the pertinent art." *In re Paulsen*, 30 F.3d at 1480 (citing *In re Samour*, 571 F.2d 559, 562 (CCPA 1978)). We analyze Petitioner's obviousness grounds with the principles identified above in mind.

Petitioner contends that claims 1–8 and 11–14 would have been obvious over the combination of Divsalar and Frey. Pet. 42–60 (citing Ex. 1006 ¶¶ 127–183). With respect to the reasons to combine the references, Petitioner contends that Frey and Divsalar are directed to the same field of error-correcting codes (variations on turbocodes). *Id.* at 42–43 (citing Ex. 1006 ¶ 128). Petitioner argues that a person of ordinary skill in the art would have been motivated by Frey's teaching of better performance over classical turbo codes to apply irregularity to Divsalar's repeat accumulate codes. *Id.* at 43 (citing Ex. 1006 ¶ 129). Petitioner further asserts that a person of ordinary skill in the art would have understood that the components used in Frey and Divsalar could be substituted, requiring a trivial modification to the implementation of the Divsalar encoder to combine the references. *Id.* at 43–45 (citing Ex. 1006 ¶¶ 130–131). Petitioner also relies on a thesis by the co-inventor of the '710 patent (Pet. 45–47 (citing Ex. 1006 ¶ 132)) and an email from Dr. Frey to Dariush Divsalar (Pet. 44–45 (citing Ex. 1017, 52) in support of the combination of Divsalar and Frey.

Patent Owner argues that Petitioner's motivations to combine Divsalar and Frey are insufficient because (1) Frey teaches introducing irregularity leads to worse results; (2) Frey and Divsalar are not similar codes; (3) the proposed modifications to Frey are not trivial or simple changes; (4) Petitioner did not advance a sufficient obvious to try argument; and (5)

Petitioner did not show a reasonable expectation of success. PO Resp. 32–50. For the reasons discussed below, we agree with Patent Owner.

With respect to modification of Divsalar and Frey, the petition states that "[i]ncorporating the irregular repetition of Frey into the RA codes of Divsalar would have required only a trivial change." Pet. 44. Petitioner describes it as a "trivial modification for a person of ordinary skill to make to an existing RA coder." Pet. 45 (citing Ex. 1006 ¶ 131).

In response, Patent Owner argues that Frey acknowledges that finding a good profile for irregularity is not trivial. Ex. 1002, 5; PO Resp. 32. We agree. Indeed, Patent Owner argues that Frey's profiles only yielded one functional result that would not have been trivial to incorporate into Divsalar. PO Resp. 41. Furthermore, Petitioner fails to explain how an ordinarily skilled artisan would have incorporated Frey's irregular repetition into Dvisalar, beyond generic statements of adding irregularity. Pet. 45.

With respect to modification, we are not persuaded by Petitioner's citation to the thesis of a co-inventor of the '710 patent, Aamod Khandekar, to support the ease of modifying Divsalar with Frey. Pet. 45–47 (citing Ex. 1006 ¶ 132.). The Khandekar thesis is not prior art to the '710 patent because it was submitted in June 2002, more than two years after the '710 patent's priority date. Prelim. Resp 29–30. In addition, Petitioner provides no arguments or evidence that explain how the thesis supports its contention that a person of ordinary skill in the art would have modified or combined Frey and Divsalar at the time of the '710 patent. We do not find the thesis of a co-inventor of the '710 patent, which appears to postdate the '710 patent's priority date, to be timely corroborating evidence of the ease with which a person of ordinary skill in the art would have combined Frey

and Divsalar at the time of patenting. Accordingly, we give Petitioner's argument and evidence based on the Khandekar thesis no weight with respect to the motivation to combine or expectation of success in combining Divsalar and Frey.

Petitioner's vague and unsupported statements regarding the combination of references and their proposed modifications fail to establish or even address whether such modifications produce a reasonable expectation of success. PO Resp. 42. In contrast, Patent Owner presents evidence and argument that Frey teaches that finding an irregular degree profile is difficult and that such codes often lead to non-functioning results. *Id.* (citing Ex. 1002, 5–6; Ex. 2004 ¶ 102).

We are persuaded by Patent Owner's arguments that Petitioner failed to establish a reasonable expectation of success for the proposed modifications to Frey and Divsalar. Petitioner's argument in response acknowledges the missing expectation of success evidence by relying on the experimental nature of the field. Pet. Reply 9. Petitioner states that

> [a]s [Patent Owner] concedes, *rigorous mathematical analysis of codes is difficult, and, as a result, POSAs routinely developed codes by experimentation.* POR, 4. Encouraged by Frey's results, POSAs would have been motivated to use Frey's irregularity in Divsalar. Indeed, this is exactly what Dr. Frey suggested to Dr. Divsalar in an email dated December 8, 1999. Ex. 1035, App. A; Ex. 1064, 185:5–8. The Petition showed that POSAs would have had a reasonable expectation of success because it was trivial to modify Divsalar to make it irregular by repeating some of the information bits more than others, which meets the limitations of the claimed invention. Pet., 44–47. . . . Dr. Mitzenmacher agreed that simply repeating the first two bits in Divsalar "q+10" times and the rest "q" times would make the code irregular. Ex. 1062, 153:11-154:8.

Pet. Reply 9 (emphasis added). To buttress the argument that a skilled artisan would have had a reasonable expectation of success in the proposed modifications, Petitioner introduces new testimony and simulations from a new declarant, Dr. Frey, to confirm that using Frey's irregularity in Divsalar would not have been difficult and would have yielded a reasonable expectation of success. *Id.* at 10 (citing Ex. 1068).

Yet, even if we were to deem the testimony and simulation to be within the proper scope of a reply brief,[6] they do not support a reasonable expectation of success *at the time of the invention*. We agree with Patent Owner that "[i]t is completely irrelevant what Dr. Frey claims he could do in the year 2018 when armed with Caltech's patent disclosures and publications, [the inventor's] original coding work, contemporary resources, and some 18 years of post-filing date knowledge." PO Sur-Reply 6. Because this evidence is not tied to the state of the art at the time of the invention, it is not probative of anticipated success. *See Millennium Pharm., Inc. v. Sandoz Inc.*, 862 F.3d 1356, 1367 (Fed. Cir. 2017) (quoting *Interconnect Planning Corp. v. Feil*, 774 F.2d 1132, 1138 (Fed. Cir. 1985)) ("Those charged with determining compliance with 35 U.S.C. § 103 are required to place themselves in the minds of those of ordinary skill in the relevant art *at the time the invention was made*, to determine whether that which is now plainly at hand would have been obvious at such earlier time." (emphasis added)).

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[6] We need not reach this issue, because we do not rely on this evidence in a manner adverse to Patent Owner. *See infra* § III.A. (dismissing Patent Owner's Motion to Exclude as moot on the same basis).

As part of our obviousness analysis, we consider "the scope and content of the prior art." *See Graham*, 383 U.S. at 17–18. In this regard, we credit Patent Owner's testimony and evidence that an important aspect of the art in this case is the relative unpredictability of developing error-correction codes. *See* PO Resp. 4–5 (citing Ex. 2004 ¶¶ 37–60; Ex. 2033, 256:21–257:12) ("The field of error correction coding has historically been characterized by significant experimentation and unpredictable results. . . . Even when well-performing codes are identified, the reasons for the improved performance are often not understood.").

Petitioner embraces the unpredictability in the art and advancement through experimentation (Pet. Reply 9), arguing that Dr. Frey suggested the combination of Frey with Divsalar's encoder to Dr. Divsalar in an email dated December 8, 1999.[7] Ex. 1035; App. A; Ex. 1064, 185:5–8. We do not agree with Petitioner that the need to run experiments in an unpredictable field, such as error-correction coding, indicates anything about whether such experiments ultimately would have been successful at the time of the invention. Importantly, "[u]npredictability of results equates more with nonobviousness rather than obviousness, whereas that which is predictable is more likely to be obvious." *Honeywell Int'l Inc. v. Mexichem Amanco*

[7] Petitioner's reliance on the purported email between Frey and Divsalar, as evidenced by an expert report from Frey in a related district court litigation (Ex. 1017) is not adequately supported by persuasive and corroborating evidence sufficient to assess the content of these purported communications. Petitioner fails to provide an exhibit with sworn testimony in support of this alleged Frey to Divsalar email. Accordingly, we give Petitioner's arguments and evidence regarding the Frey email no weight with respect to the expectation of success in combining Divsalar and Frey.

Holding S.A., 865 F.3d 1348, 1356 (Fed. Cir. 2017). In the absence of any evidence rooted in the Petition that substantiates a reasonable expectation of success, Petitioner's reliance on a known need for experimentation is not sufficient to support its obviousness rationale.[8] *See Arctic Cat Inc. v. Bombardier Recreational Prod. Inc.*, 876 F.3d 1350, 1360–61 (Fed. Cir. 2017) ("[W]here a party argues a skilled artisan would have been motivated to combine references, it must show the artisan would have had a reasonable expectation of success from doing so." (internal quotation omitted)).

For these reasons, we are not persuaded that an ordinarily skilled artisan would have been motivated to combine the teachings of Frey and Divsalar in the manner suggested by Petitioner. Thus, we determine Petitioner has not shown by a preponderance of the evidence that claims 1–8 and 11–14 would have been obvious over the combination of Frey and Divsalar.

[8] Despite a bare statement that a skilled artisan would have found it obvious to try improving codes by adding irregularity (Pet. 48), Petitioner does not contend that its proposed combination should be analyzed under obvious-to-try case law. *Cf.* Tr., 14:1–6 (Petitioner acknowledging that it was not putting forth an obvious-to-try argument). Nor could Petitioner, because Petitioner does not develop an obvious-to-try theory. Specifically, Petitioner does not establish that the prior art directs which parameters to try and/or guides an inventor toward a particular solution. *See Bayer Schering Pharma AG v. Barr Labs., Inc.*, 575 F.3d 1341, 1347 (Fed. Cir. 2009).

F. Obviousness based on Frey, Divsalar, and Luby97: Claims 15—17, 19–22, and 24–33

Petitioner contends that claims 15–17, 19–22, and 24–33 would have been obvious over the combination of Divsalar, Frey, and Luby97. Pet. 61–72 (citing Ex. 1006 ¶¶ 188–250). Patent Owner disputes Petitioner's contentions. PO Resp. 50–52.

1. Luby97 (Ex. 1011)

Luby97 describes "randomized constructions of linear-time encodable and decodable codes that can transmit over lossy channels at rates extremely close to capacity." Ex. 1011, 150 (Abstract). Luby97 describes receiving data to be encoded in a stream of data symbols, such as bits, where the "*stream of data symbols* [] is partitioned and transmitted in logical units of blocks." *Id.* (emphasis added).

2. Analysis

Because Petitioner's obviousness analysis for claims 15–17, 19–22, and 24–33 rely on the same rationale for combining Frey and Divsalar discussed above, Petitioner's rationale for this ground also incorporates the same deficiencies. Thus for the reasons discussed above, we determine Petitioner has not shown by a preponderance of the evidence that claims 15–17, 19–22, and 24–33 would have been obvious over the combination of Divsalar, Frey, and Luby97.

Accordingly, upon review of full record, we are not persuaded that an ordinarily skilled artisan would have been motivated to combine the teachings of Frey and Divsalar with Luby97 in the manner suggested by Petitioner. Thus, we determine Petitioner has not shown by a preponderance

of the evidence that claims 15–17, 19–22, and 24–33 would have been obvious in view of Divsalar, Frey, and, Luby97.

III. MOTIONS

A. Patent Owner's Motion to Exclude

Patent Owner moves to exclude Exhibits 1013, 1029-1049, 1053, 1055, 1057–1061, 1065, 1067, 1068 and portions of Exhibits 1062 and 1064. Paper 57, 1. Patent Owner's motion is dismissed as moot with respect to these exhibits, as we do not rely on them in a manner adverse to Patent Owner.

B. Patent Owner's Motion for Sanctions

Patent Owner requests sanctions against Petitioner for allegedly failing to stay within the proper scope of cross-examination during the deposition of Dr. Mitzenmacher. Paper 50, 1. Specifically, Patent Owner details questioning of Dr. Mitzenmacher that allegedly "ventured into various topics beyond the scope of the witness' direct testimony." *Id.* at 7–9. For example, Patent Owner cites "extensive questioning regarding Tanner graphs and figures newly created by Petitioner's lawyers, but absent from any petition materials or the witness' direct testimony." *Id.* at 8. As sanctions, Patent Owner asks us to: (1) strike the out-of-scope testimony elicited by Petitioner; (2) hold the direct testimony of Dr. Mitzenmacher to be facts established in this proceeding; and (3) impose "reasonable compensatory expenses, including attorney fees, for costs reasonably related to excessive questioning and deposition time." *Id.* at 9–10.

Petitioner contends that "each question posed by Petitioner during Dr. Mitzenmacher's deposition pertained directly to topics and opinions in

his declaration." Paper 52, 5. Regarding the Tanner graphs and figures, Petitioner contends these were properly served upon Petitioner at Dr. Mitzenmacher's deposition in accordance with 37 C.F.R. § 42.53(f)(3). *Id.* at 6. According to Petitioner, Patent Owner's proposed sanctions are unwarranted, particularly because Patent Owner suffered no harm. *Id.* at 7–8.

The "Board may impose a sanction against a party for misconduct." 37 C.F.R. § 42.12(a); *see also* 35 U.S.C. § 316(a)(6) (requiring regulations prescribing sanctions). As the moving party, Patent Owner has the burden to persuade the Board that sanctions are warranted. *See* 37 C.F.R. § 42.20(c). In general, a motion for sanctions should address three factors: (i) whether a party has performed conduct that warrants sanctions; (ii) whether the moving party has suffered harm from that conduct; and (iii) whether the sanctions requested are proportionate to the harm suffered by the moving party. *See Square, Inc. v. Think Comput. Corp.*, Case CBM2014-00159, slip op. at 2 (PTAB Nov. 27, 2015) (Paper 48) (citing *Ecclesiastes 9:10-11-12, Inc. v. LMC Holding Co.*, 497 F.3d 1135, 1143 (10th Cir. 2007)).

Having reviewed the relevant portions of Dr. Mitzenmacher's deposition, we agree with Petitioner that sanctions are not warranted. Petitioner's attempts to elicit testimony regarding the Tanner graphs and figures, while inartful, did not rise to the level of sanctionable conduct because they were reasonably related to Dr. Mitzenmacher's direct testimony. Furthermore, we agree with Petitioner that Patent Owner suffered no harm, particularly in light of our Decision. For these reasons, we deny Patent Owner's motion for sanctions.

IV. CONCLUSION

For the foregoing reasons, Petitioner has not shown by a preponderance of the evidence that claims 1 and 3 of the '710 patent are anticipated by Frey pursuant to 35 U.S.C. § 102(b); claims 1–8 and 11–14 of the '710 patent would have been obvious over Divsalar and Frey; and claims 15–17, 19–22, and 24–33 of the '710 patent would have been obvious over Divsalar, Frey, and Luby97.

V. ORDER

Accordingly, it is:

ORDERED that claims 1–8, 11–17, 19–22, and 24–33 of the '710 patent are not held to be unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Exclude is *dismissed as moot*;

FURTHER ORDERED that Patent Owner's Motion for Sanctions is *denied*; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to this proceeding seeking judicial review of our decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

IPR2017-00210
Patent 7,116,710 B1

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MURGITROYD

2 February 2018

P163976.US.01/PHunter/Renewals

United States Patent & Trademark Office
Maintenance Division
United States

Dear Sirs,

BY FACSIMILE ONLY - TWO PAGES - 001 571 273 6500

Proprietor	California Institute of Technology	IP Title:	Serial concatenation of interleaved convolutional codes forming turbo-like codes
IP Type	Patent		
Country	United States		
Appn. No.	09/861102		
Pub/Grant No.	7116710	Short Title:	
Year	3rd Maintenance Fee	TM Category:	
Due Date	3 April 2018	Class(es):	

With regards to the above referenced US Patent our client is no longer Small Entity, therefore we would like to change this Patent to Large entity. I enclose the following;

1) Declaration of Entitlement to Large Entity Status for US Patent number 7116710 signed by Ms Hannah Dvorak-Carbone, Associate Director, Office of Technology Transfer, California Institute of Technology.

I would be grateful if you could process this as appropriate and confirm safe receipt as soon as possible.

Yours faithfully,
for Murgitroyd

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PATENT
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Current Date: December 8, 2017

Application No.: 09/861102

Filed.: May 18, 2001

Patent No.: 7116710

Issued.: October 3, 2006

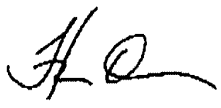
CHANGE OF ENTITY STATUS PURSUANT TO 37 C.F.R. §1.27 (g)(2)

Commissioner for Patents
Mail Stop M Correspondence
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This communication hereby notifies the United States Patent and Trademark Office that small entity status is no longer applicable for the above-identified patent.

Respectfully submitted,



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Paper 18
Entered: June 30, 2017

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

CALIFORNIA INSTITUTE OF TECHNOLOGY,
Patent Owner.

Case IPR2017-00210
Patent 7,116,710 B1

Before KEN B. BARRETT, TREVOR M. JEFFERSON, and JOHN A. HUDALLA, *Administrative Patent Judges*.

JEFFERSON, *Administrative Patent Judge*.

DECISION
Institution of *Inter Partes* Review
35 U.S.C. § 314(a) and *37 C.F.R. § 42.108*

I. INTRODUCTION

Petitioner, Apple, Inc. ("Apple"), filed a Petition (Paper 5, "Pet.") requesting an *inter partes* review of claims 1–8, 10–17, and 19–33 of U.S. Patent No. 7,116,710 B1 (Ex. 1001, "the '710 patent") pursuant to 35 U.S.C. §§ 311–319. Apple relies on the Declaration of James A. Davis, Ph.D. (Ex. 1006) with its Petition. Patent Owner, California Institute of Technology ("Caltech"), filed a Preliminary Response (Paper 17, "Prelim. Resp.") to the Petition.

We have jurisdiction under 37 C.F.R. § 42.4(a) and 35 U.S.C. § 314, which provides that an *inter partes* review may not be instituted unless the information presented in the Petition "shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." After considering the Petition and associated evidence, we conclude that Petitioner has demonstrated a reasonable likelihood that it would prevail in showing the unpatentability of claims 1–8, 11–17, 19–22, and 24–33 of the '710 patent.

A. Related Proceedings

The parties indicate that the '710 patent was involved in the following active case, *Cal. Inst. of Tech. v. Broadcom Ltd.*, No. 2:16-cv-03714 (C.D. Cal. filed May 26, 2016), and in concluded cases, *Cal. Inst. of Tech. v. Hughes Commc'ns, Inc.*, No. 2:15-cv-01108 (C.D. Cal. filed Feb. 17, 2015); and *Cal. Inst. of Tech. v. Hughes Commc'ns, Inc.*, 2:13-cv-07245 (C.D. Cal. filed Oct. 1, 2013). Pet. 3, Paper 8, 2–3.

The parties also identify co-pending cases IPR2017-00211 and IPR2017-00219, in which Apple has filed a petition for *inter partes* review

of the '710 patent. Pet. 3; Paper 8, 2–3. *Inter partes* review of the '710 patent was previously considered and denied in *Hughes Network Sys., LLC v. Cal. Inst. of Tech.*, IPR2015-00067 (PTAB April 27, 2015) (Paper 18) ("IPR2015-00067") and *Hughes Network Sys., LLC v. Cal. Inst. of Tech.*, IPR2015-00068 (PTAB April 27, 2015) ("IPR2015-00068"). Finally, patents related to the '710 patent were challenged in IPR2015-00059, IPR2015-00060, IPR2015-00061, and IPR2015-00081. Pet. 3.

B. The '710 Patent

The '710 patent describes the serial concatenation of interleaved convolutional codes forming turbo-like codes. Ex. 1001, Title. It explains some of the prior art with reference to its Fig. 1, reproduced below.

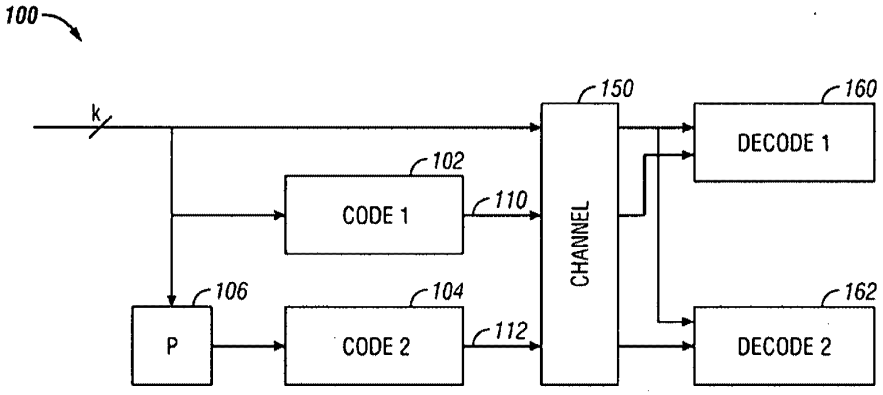

FIG. 1
(Prior Art)

Figure 1 is a schematic diagram of a prior "turbo code" system. *Id.* at 2:14–15. The '710 patent specification describes Figure 1 as follows:

> A standard turbo coder 100 is shown in FIG. 1. A block of k information bits is input directly to a first coder 102. A k bit interleaver 106 also receives the k bits and interleaves them prior to applying them to a second coder 104. The second coder produces an output that has more bits than its input, that

is, it is a coder with rate that is less than 1. The coders 102,104 are typically recursive convolutional coders.

Three different items are sent over the channel 150: the original k bits, first encoded bits 110, and second encoded bits 112. At the decoding end, two decoders are used: a first constituent decoder 160 and a second constituent decoder 162. Each receives both the original k bits, and one of the encoded portions 110, 112. Each decoder sends likelihood estimates of the decoded bits to the other decoders. The estimates are used to decode the uncoded information bits as corrupted by the noisy channel.

Id. at 1:38–53(emphasis omitted).

A coder 200, according to a first embodiment of the invention, is described with respect to Figure 2, reproduced below.

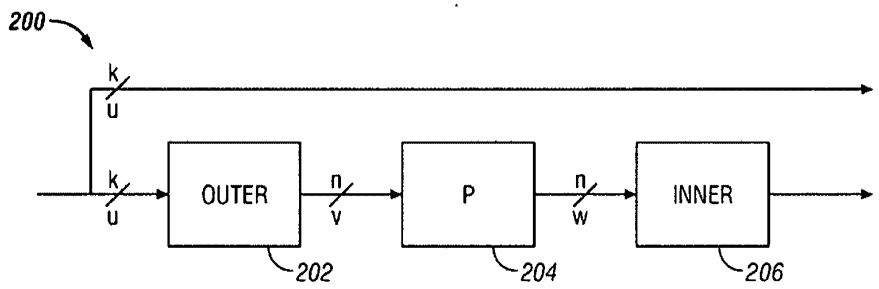

FIG. 2

Figure 2 of the '710 patent is a schematic diagram of coder 200. *Id.* at 2:16–17.

The specification states that "coder 200 may include an outer coder 202, an interleaver 204, and inner coder 206." *Id.* at 2:34–35. It further states as follows:

The outer coder 202 receives uncoded data. The data may be partitioned into blocks of fixed size, say k bits. The outer coder may be an (n,k) binary linear block coder, where n>k. The coder accepts as input a block u of k data bits and produces an output block v of n data bits. The mathematical

> relationship between u and v is $v=T_0u$, where T_0 is an $n\times k$ matrix, and the rate[1] of the coder is k/n.
>
> The rate of the coder may be irregular, that is, the value of T_0 is not constant, and may differ for sub-blocks of bits in the data block. In an embodiment, the outer coder 202 is a repeater that repeats the k bits in a block a number of times q to produce a block with n bits, where n=qk. Since the repeater has an irregular output, different bits in the block may be repeated a different number of times. For example, a fraction of the bits in the block may be repeated two times, a fraction of bits may be repeated three times, and the remainder of bits may be repeated four times. These fractions define a degree sequence, or degree profile, of the code.
>
> The inner coder 206 may be a linear rate-1 coder, which means that then-bit output block x can be written as $x=T_Iw$, where T_I is a nonsingular $n\times n$ matrix. The inner coder 210 can have a rate that is close to 1, e.g., within 50%, more preferably 10% and perhaps even more preferably within 1% of 1.

Id. at 2:41–64 (emphasis omitted). Codes characterized by a regular repeat of message bits into a resulting codeword are referred to as "regular repeat," whereas codes characterized by irregular repeat of message bits into a resulting codeword are referred to as "irregular repeat." The second ("inner") encoder 206 performs an "accumulate" function. Thus, the two-step encoding process illustrated in Figure 2, including a first encoding ("outer encoding") followed by a second encoding ("inner encoding"), results in either a "regular repeat accumulate" ("RRA") code or an "irregular

[1] The "rate" of an encoder refers to the ratio of the number of input bits to the number of resulting encoded output bits related to those input bits. *See* Pet. 9.

repeat accumulate ("IRA") code, depending upon whether the repetition in the first encoding is regular or irregular.

Figure 4 of the '710 patent, reproduced below, shows an alternative embodiment in which the first encoding is carried out by a low density generator matrix.

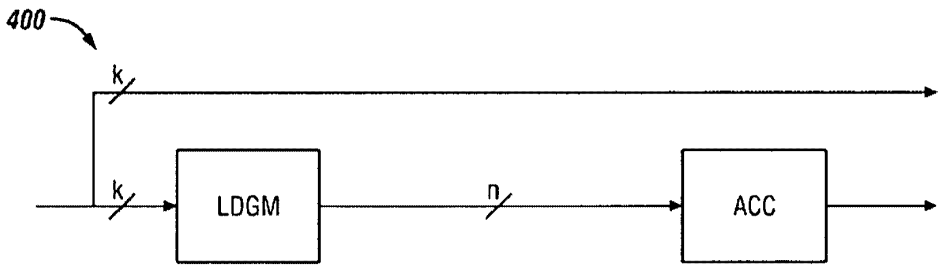

FIG. 4

Figure 4 of the '710 patent is a schematic of an irregular repeat and accumulate coder using a low density generator matrix (LDGM)[2] coder. *Id.* at 2:20–21, 3:24–25, 3:51–54. The LDGM coder "performs an irregular repeat of the k bits in the block, as shown in FIG. 4." *Id.* LDGM codes are a special class of low density parity check codes that allow for less encoding and decoding complexity. LDGM codes are systematic linear codes generated by a "sparse" generator matrix. No interleaver (as in the Figure 2 embodiment) is required in the Figure 4 embodiment because the LDGM provides scrambling otherwise provided by the interleaver.

[2] A "generator" matrix (typically referred to by "G") is used to create (generate) codewords. A parity check matrix (typically referred to by "H") is used to decode a received message.

C. Illustrative Claims

Apple challenges claims 1–8, 10–17, and 19–33 of the '710 patent, of which claims 1, 11, 15, and 25 are independent. Pet. 21. Claims 1, 3, 11, 15, and 25 are illustrative of the claims at issue and are reproduced below:

1. A method of encoding a signal, comprising:

obtaining a block of data in the signal to be encoded;

partitioning said data block into a plurality of sub-blocks, each sub-block including a plurality of data elements;

first encoding the data block to from a first encoded data block, said first encoding including repeating the data elements in different sub-blocks a different number of times;

interleaving the repeated data elements in the first encoded data block; and

second encoding said first encoded data block using an encoder that has a rate close to one.

3. The method of claim 1, wherein said first encoding is carried out by a first coder with a variable rate less than one, and said second encoding is carried out by a second coder with a rate substantially close to one.

11. A method of encoding a signal, comprising:

receiving a block of data in the signal to be encoded, the data block including a plurality of bits;

first encoding the data block such that each bit in the data block is repeated and two or more of said plurality of bits are repeated a different number of times in order to form a first encoded data block; and

second encoding the first encoded data block in such a way that bits in the first encoded data block are accumulated.

15. A coder comprising:

a first coder having an input configured to receive a stream of bits, said first coder operative to repeat said stream of bits irregularly and scramble the repeated bits; and

a second coder operative to further encode bits output from the first coder at a rate within 10% of one.

25. A coding system comprising:

a first coder having an input configured to receive a stream of bits, said first coder operative to repeat said stream of bits irregularly and scramble the repeated bits;

a second coder operative to further encode bits output from the first coder at a rate within 10% of one in order to form an encoded data stream; and

a decoder operative to receive the encoded data stream and decode the encoded data stream using an iterative decoding technique.

Ex. 1001, 7:14–25, 7:28–31, 7:49–589, 8:1–6, 8:32–41.

D. The Alleged Grounds of Unpatentability

The information presented in the Petition sets forth the grounds of unpatentability of claims 1–8, 10–17, and 19–33 of the '710 patent as follows (*see* Pet. 34–74):

Reference(s)	Basis	Claim(s) Challenged
Frey[3]	§ 102(a)	1 and 3

[3] Brendan J. Frey and David J.C. MacKay, *Irregular Turbocodes*, PROCEEDINGS OF THE 37TH ALLERTON CONFERENCE ON COMMUNICATION, CONTROL, AND COMPUTING (1999) at 241–248 (Ex.1002, "Frey).

Reference(s)	Basis	Claim(s) Challenged
Frey and Divsalar[4]	§ 103(a)	1–8 and 11–14
Frey, Divsalar, and Luby97[5]	§ 103(a)	15–17, 19–22, and 24–33
Frey, Divsalar, and Pfister Slides[6]	§ 103(a)	10
Frey, Divsalar, Luby97, and Pfister Slides	§ 103(a)	23

II. ANALYSIS

A. Claim Interpretation

We interpret claims of an unexpired patent using the broadest reasonable construction in light of the specification of the patent in which they appear. *See* 37 C.F.R. § 42.100(b); *Cuozzo Speed Techs. LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). In applying a broadest reasonable construction, claim terms generally are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Any special definition for a claim term must

[4] Dariush Divsalar, et al., *Coding Theorems for "Turbo-Like" Codes*, PROCEEDINGS OF THE THIRTY-SIXTH ANNUAL ALLERTON CONFERENCE ON COMMUNICATION, CONTROL, AND COMPUTING, Sept. 23–25, 1998, at 201–209 (Ex. 1003, "Divsalar").

[5] Luby, M. et al., *Practical Loss-Resilient Codes*, PROCEEDINGS OF THE TWENTY-NINTH ANNUAL ACM SYMPOSIUM ON THEORY OF COMPUTING, May 4–6, 1997, at 150–159 (Ex. 1011, "Luby97").

[6] Pfister, H., et al, *The Serial Concatenation of Rate-1 Codes Through Uniform Random Interleavers*, Presentation at Allerton Conference, Sept. 22–24, 1999 (Ex. 1005, "Pfister Slides").

be set forth in the specification with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

1. "close to one" (claims 1 and 3)

Apple argues that the broadest reasonable construction of "close to one" as recited in claims 1 and 3 is "within 50% of one." Pet. 24. Apple argues that this is consistent with the '710 patent specification, which states that the inner code 210 of Figure 1, "can have a rate that is close to one, e.g., within 50%, more preferably 10% and perhaps even more preferably within 1% of 1." Pet. 24–25 (quoting Ex. 1001, 2:62–64 and citing Ex. 1006, ¶¶ 102–103). Caltech does not provide an express claim construction.

For purposes of this Decision, we agree with Apple, determining that "close to one" as recited in claims 1 and 3 is construed as "within 50% of one."

B. Discretion to Institute Under 35 U.S.C. § 325(d)

"Congress did not mandate that an inter partes review must be instituted under certain conditions. Rather, by stating that the Director—and by extension, the Board—may not institute review unless certain conditions are met, Congress made institution discretionary." *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, Case IPR2013-00324, slip op. 4 (PTAB Nov. 21, 2013) (Paper 19). The Board's discretion is guided by 35 U.S.C. § 325(d), which provides, in part that:

> MULTIPLE PROCEEDINGS -- . . . In determining whether to institute or order a proceeding under this chapter, chapter 30, or chapter 31, the Director may take into account whether, and reject the petition or request because, the same or substantially

> the same prior art or arguments previously were presented to the Office.[7]

Accordingly, institution of an *inter partes* review is discretionary. *See, e.g.*, *NVIDIA Corp. v. Samsung Elec. Co.*, Case IPR2016-00134 (PTAB May 4, 2016) (Paper 9).

Caltech asserts that the instant petition presents substantially the same prior art and arguments presented to the Board in Case Nos. IPR2015-00067 and IPR2015-00068, both previously denied institution. Prelim. Resp. 2–6. Based on the facts and circumstances of this case, we decline to exercise our discretion under 35 U.S.C. § 325(d).

We begin by noting that Apple was not a party to the prior IPRs and was sued for infringement of the '710 patent by Caltech in May of 2016, which was after the decisions denying institution in IPR2015-00067 and IPR2015-00068. Pet. 3. Although not determinative, this factor weighs in favor of not exercising our discretion. In addition, Apple challenges additional claims not argued in IPR2015-00067 and IPR2015-00068. In IPR2015-00067, we did not reach the merits of the Petitioner's grounds for unpatentability with respect to Frey and Divsalar. Case IPR2015-00067, 3–5 (Paper 18); *see, e.g.*, Case IPR2015-00067, Paper 4 at 15–21 (challenging claim 1); Pet. 24–42 (challenging claims 1 and 3). Thus, although Frey and Divsalar were asserted in IPR2015-00067 and IPR2015-00068, the present case includes a different petitioner, challenging additional claims, and

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[7] Although this provision appears in Chapter 32 of the Patent Act, which is directed to post-grant reviews, by its terms it is applicable also to proceedings under Chapter 31, which covers *inter partes* review proceedings.

presenting arguments that were not addressed on their merits in IPR2015-00067. Accordingly, we decline to deny Apple's petition pursuant to the discretion in 35 U.S.C. § 325(d).

C. Printed Publication Prior Art and Apple's Expert Testimony

Caltech contends that Apple has not established that Frey, Divsalar, and the Pfister Slides qualify as prior art. Prelim. Resp. 6–17. We address each of these allegations in turn below.

1. Frey (Ex. 1002)

Apple asserts that Frey was "published in the Proceedings of the 37th Allerton Conference on Communication, Control and Computing" and that the "conference proceedings were published on or before March 20, 2000." Pet. 25 (citing Ex. 1015 (showing stamps from the Cornell University Library and the table of contents for the conference) and Ex. 1006 ¶ 63). Caltech asserts that the petition lacks sufficient evidence that Frey is actually a prior art printed publication as of the date Apple asserts, March 20, 2000. Prelim. Resp. 8.

In a prior petition filed by another petitioner (Hughes Communications Inc.) against the '710 patent, we found that the petitioner did not establish Frey as a prior art printed publication because the petitioner failed to provide any evidence or argument in support of their contention regarding the source of the printed publication or its distribution as part of the conference proceedings. IPR2015-00067 at 8–11 (Paper 18). In IPR2015-00067, we did not find the petitioner's reliance on the declaration of the co-authors, Dr. MacKay and Dr. Frey, to be persuasive as it did not address the purported publication date and distribution of the paper in the

Allerton conference proceedings as Petitioner alleged. *Id.*

In the present case, Apple offers no declaration and instead relies on the bare submission of a copy of the cover of the proceeding, table of contents of the proceeding, and library stamped pages from the proceeding all in support of their contention that proceeding is a prior art printed publication. Pet. 25.

Without conceding the admissibility of Apple's evidence in support of Frey, Caltech questions the legibility of the alleged library date stamp and the sufficiency of the unexplained and unsupported library stamp to meet Apple's burden. Prelim. Resp. 10–11.

We look to the underlying facts to make a legal determination as to whether a reference is a printed publication. *Suffolk Techs., LLC v. AOL Inc.*, 752 F.3d 1358, 1364 (Fed. Cir. 2014). The determination of whether a given reference qualifies as a prior art "printed publication" involves a case-by-case inquiry into the facts and circumstances surrounding its disclosure to members of the public. *In re Klopfenstein*, 380 F.3d 1345, 1350 (Fed. Cir. 2004). The key inquiry is whether the reference was made "sufficiently accessible to the public interested in the art" before the critical date. *In re Cronyn*, 890 F.2d 1158, 1160 (Fed. Cir. 1989); *In re Wyer*, 655 F.2d 221, 226 (CCPA 1981). "A given reference is 'publicly accessible' upon a satisfactory showing that such document has been disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it." *Bruckelmyer v. Ground Heaters, Inc.*, 445 F.3d 1374, 1378 (Fed. Cir. 2006) (citation omitted).

At this stage, we find Apple's support for the printed publication status of Frey to be sufficient to move forward to a trial. We note that the questions raised by Caltech's evidentiary arguments questioning Apple's exhibits are relevant inquiries, which, after development of the full record, will be evaluated in reaching a final decision regarding the printed publication and prior art status of Frey.

Based on the record at this stage and the information from Apple that purports to show that Frey was received at Cornell University Library as of March 20, 2000 (Ex. 1015, Ex. 1002), we find that Apple presents sufficient evidence at this stage of the proceeding to support Frey as a prior art printed publication. This Decision on Institution is *not* a final decision on the status of Frey as printed publication or prior art to the '710 patent.

2. Divsalar (Ex. 1003)

With respect to Divsalar, Apple relies on the Board's prior final written decision in a related case that found that Divsalar qualifies as prior art under 35 U.S.C. § 102(b) because the balance of evidence appeared to show that it was published before the effective filing date of the '710 patent. Pet. 28 (citing *Hughes Network Sys. v. Cal. Inst. of Tech.*, Case IPR2015-00059, slip op 13–22 (PTAB April 21, 2016) (Paper 42)) ("IPR2015-00059 FWD"). In the present case, Apple relies on the same declaration from a librarian prepared for use in Case IPR2015-00059 as evidence that Divsalar was publicly available by April 30, 1999, in the University of Texas library. *See* Ex. 1012 (Declaration of Fradenburgh) ¶ 7.

Caltech argues that Apple "misapprehends the scope of the Board's prior decision in IPR2015-00059," which did not find Divsalar to be a prior art printed publication based solely on the Fradenburgh Declaration (Ex.

1012). Prelim. Resp. 13. We agree with Caltech that our previous determination regarding the prior art status of Divsalar was made under the particular factual and procedural circumstances of that case. Specifically, our Final Written Decision in IPR2015-00059 relied, in part, on Caltech's waiver of its objection to the Fradenburgh declaration and the failure to move to strike the declaration. *See* IPR2015-00059 FWD at 31 (denying Caltech's motion to strike Ms. Fradenburgh's testimony on the basis of no timely evidentiary objection); Prelim. Resp. 13. Furthermore, our findings in IPR2015-00059 relied on additional evidence, properly before the Board, in support of Divsalar as a prior art printed publication.

Based on the evidence at this stage of the proceeding, Divisalar appears to be part of conference proceedings related to the 37th Allerton Conference held September 23–25, 1998. Ex. 1003, 1. The Fradenburgh declaration provides some evidence that Divsalar was available to the public on April 30, 1999." *See* Ex. 1012, 2. Although we find that Apple presents sufficient evidence at this stage of the proceeding to meet the burden that Divsalar is a prior art printed publication for purposes of this Decision, we expect that Apple's evidence in support of Divsalar's prior art status will be more completely evaluated in the context of a trial based on the complete record in this case.

3. Pfister Slides (Ex. 1005)

Apple contends that Paul Siegel presented the Pfister Slides at the Allerton Conference in September 1999. Pet. 32 (citing Declaration of Paul Siegel, Ex. 1020, 3). Caltech correctly argues that Apple's Petition is devoid of any explanation or argument as to why or how the Pfister Slides qualify as prior art. Prelim. Resp. 13–14. Indeed, Apple's petition makes no

attempt to show how the Pfister Slides qualify as a "printed publication" under 35 U.S.C. § 311(b), which limits IPRs to challenges based on patents and printed publications.

With respect to slide presentations, Federal Circuit case law and a prior opinion from our Board have found that the mere presentation of slides at a professional conference is not *per se* a prior art printed publication. *Klopfenstein*, 380 F.3d at 1349 n.4; *Temporal Power Ltd. v. Beacon Power, LLC*, Case IPR2015-00146, slip op. at 8–11 (PTAB April 27, 2015) (Paper 10).

In the present case, Apple cites to a specific page of Mr. Siegel's declaration that does not support its conclusion that the Pfister Slides were presented and qualify as a printed publication. Pet. 32 (citing Ex. 1020, 3). Mr. Siegel's declaration in its entirety does not address the factors cited in *In re Klopfenstein* as to whether the slides in question qualify as a printed publication. *See* Ex. 1020. Apple's petition and Mr. Siegel's declaration merely support the assertion that a presentation took place, but fail to provide sufficient evidence or argument regarding whether the Pfister Slides were published or how the Pfister Slides were made accessible to the relevant public, among other issues raised by slide presentations. *See, e.g., Klopfenstein*, 380 F.3d at 1350 (addressing slide presentation); *Temporal Power Ltd.*, IPR2015-00146 at 8–11.

With respect to the Pfister Slides, Apple fails to meet the burden imposed under § 314(a) to establish in its Petition a reasonable likelihood of success, which includes, among other things, making a threshold showing that the Pfister Slides are a prior art printed publication. Based on Apple's Petition and supporting evidence, we find that it has not met that burden

with the Pfister Slides. Accordingly, we find that Apple has not demonstrated a likelihood of showing that grounds based on the Pfister Slides render the challenged claims unpatentable.

4. Apple's Expert Testimony

Caltech argues that we should accord the declaration testimony of Dr. Davis (Ex. 1006) little or no weight because it appears to be copied from the expert report of Dr. Frey (Ex. 1017), which was produced as part of related litigation. Prelim. Resp. 17–18 (citing Ex. 1006 ¶¶ 22–46; Ex. 1017 ¶¶ 35–53, 55, 57–60, 63). Caltech further argues that testimony of Dr. Davis fails to cite sufficient references and evidence in support of the proffered testimony and repeats the petition's argument. Prelim. Resp. 17–18.

Caltech's argument and evidence at this stage of our inquiry do not provide a sufficient basis to disregard Dr. Davis's testimony in its entirety or accord it little weight. Dr. Davis's testimony in *inter partes* review is subject cross-examination and will be afforded its due weight subject to rebuttal evidence and argument. Accordingly, we do not discount Dr. Davis's testimony for purposes of this Decision.

D. Anticipation by Frey of Claim 1 and 3

Apple contends that Frey anticipates the limitations of independent claim 1 and dependent claim 3 of the '710 patent. Pet. 34–42 (citing Ex. 1006 ¶¶ 106–126).

1. Frey (Ex. 1002)

Frey describes adding irregularity to turbocodes with systematic bits that participate in varying numbers of parity check equations. Ex. 1002, 1

(Abstract). Frey discloses how a turbocode is made irregular, showing a graphical representation in the fifth image of Figure 1, provided below.

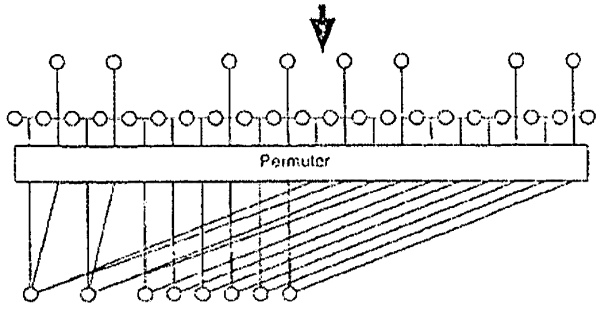

Figure 1, excerpted above, shows the systemic bits at the bottom with 2 or 4 lines going into the permuter. The fifth image of Figure 1 "shows how a turbocode can be made irregular by 'tying" some of the systematic bits together, i.e., by having some systematic bits replicated more than once." Ex. 1002, 3. Frey states that the fifth image of Figure 1 "illustrates one way the [] turbocode can be made irregular. Some of the systematic bits are 'tied' together, in effect causing some systematic bits to be replicated more than once." *Id.* at 2. Frey further discloses "that too [sic] keep the rate of the overall code fixed at 1/2, some extra parity bits must he punctured." *Id.*

In describing the decoding of irregular turbocodes, Frey provides a graphical model for the irregular turbocode shown in Figure 2, below.

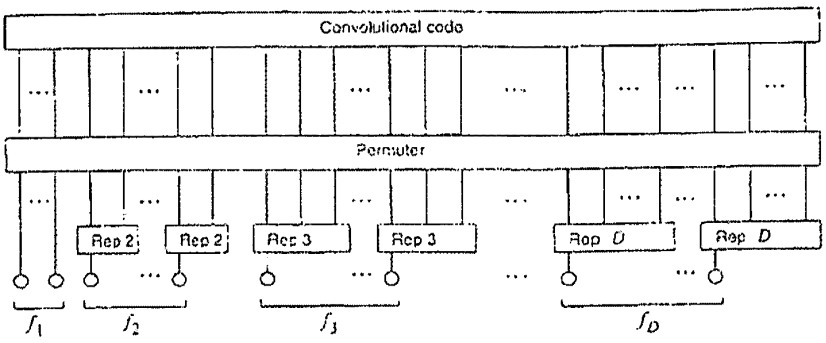

Figure 2: A general *irregular turbocode*. For $d = 1, \ldots, D$, fraction f_d of the codeword bits are repeated d times, permuted and connected to a convolutional code.

Figure 2 shows irregular turbocodes where f_d —the fraction of the codeword where each bit is repeated *d* times. Ex. 1002, 4. Frey discloses that "an irregular turbocode has the form shown [above] in Fig. 2, which is a type of 'trellis-constrained code'" where "f_d is the fraction of codeword bits that have degree *d* and *D* is the maximum degree." *Id.* at 2. Frey further discloses that "[e]ach codeword bit with degree *d* is repeated *d* times before being fed into the permuter. Several classes of permuter lead to linear-time encodable codes. In particular, if the bits in the convolutional code are partitioned into 'systematic bits' and 'parity bits', then by connecting each parity bit to a degree 1 codeword bit, we can encode in linear time." *Id.* at 2.

2. Analysis

For claim 1, Apple contends that Frey discloses "a method of encoding a signal" (Pet. 34–35), "obtaining a block of data in the signal to be encoded" (*id.* at 35–36), and "partitioning said data block into a plurality of sub-blocks, each sub-block including a plurality of data elements" (*id.* at 36–37).

Apple argues that Figure 2 of Frey shows that "Frey partitions the information bits into groups, where the bits in each group have the same

degree (i.e., bits within the same subgroup are all repeated the same number of times)." *Id.* at 36. Apple asserts that

> groups of information bits [shown in Frey, Figure 2] labeled f_2, f_3,..., f_D represent sub-blocks into which the data block is partitioned. Thus, the bits that are repeated twice (f_2) constitute one sub-block, the bits that are repeated three times (f_3) constitute a second sub-block, and so on. Each of these sub-blocks contains a plurality of bits (or "data elements"), as required by the claim. (Ex. 1006, ¶113.)

Pet. 37.

Caltech argues that Apple misreads Frey, which only discloses individual systematic bits shown in Figure 1. *See* Prelim. Resp. 20. These bits are copied at different rates to produce sets of bits that are permuted. *Id.* Caltech contends that Frey discloses individual bit operations and *not* partitioning into blocks of data, and sub-blocks as recited in claim 1. *Id.* Apple, Caltech argues, cites Figure 2 of Frey without sufficient explanation for how the labels f_2, f_3, . . . f_D represent sub-blocks into which the data block is partitioned. *Id.* At 21 (citing Pet. 37). Caltech asserts that Figure 2 of Frey is an *individual* bit copying process described in Figure 1. *Id.* Thus, Caltech contends, "[r]ather than describing partitioning of data in to sub-blocks including a plurality of data elements, Frey, including the limited provisions cited in the petition, teaches merely repeating its systemic bits on an individual basis." *Id.* at 22.

Caltech also argues that in the grounds based on the combination of Frey and Divsalar, Apple's argument for Frey teaching the limitations of claim 1 acknowledges that Apple considers Frey to *inherently* teach the partitioning limitations of claim 1. *Id.* at 20 n.8 (citing Pet. 52). Apple's argument applying Frey to claim 1 in the obviousness grounds is that

irregular coding schemes such as those taught in Frey "*de facto* partition information bits into sub-blocks" whenever they encode bits a different number of times. Pet. 52 (citing Ex. 1006 ¶ 147 and stating "in particular that an encoding method that meets the 'different number of times' limitation of claim 1 necessarily meets the 'partitioning' limitation").

On the record before us, Apple has presented sufficient evidence that Frey discloses partitioning the information into blocks and sub-blocks. Neither party has sought a construction of "partition" or "block" as used in independent claim 1 (and in dependent claim 16). At this stage of the proceeding, Caltech's argument that Frey is directed to bit-based individual repeating and not the partitioning of data in sub-blocks and blocks does not undercut Apple's evidence and argument that a person of ordinary skill in the art would understand Frey to disclose partitioning of blocks into sub-blocks under an ordinary meaning as recited in the claims. Pet. 20–21, 52; Ex. 1002, 2–4; Ex. 1006 ¶¶ 111–115, 147. Thus, on this record, we find that Apple has presented sufficient information that Frey discloses the partitioning limitations of claims 1 and 3.

Apple has adequately shown, at this stage of the proceeding, that Frey discloses each of the limitations of the challenged claims; specifically the encoding of a block of data limitation (Pet. 34–35), partitioning and encoding different sub-blocks a different number of times, and interleaving limitations (Pet. 36–39), and the second encoder with a rate close to 1 limitation (Pet. 39–41) of claim 1, and rate limitations on the first coder with a variable rate, and second coder with a rate substantially close to one of dependent claim 3 (Pet. 41–42). Based on the record, Apple has provided sufficient evidence and argument showing that there is a reasonable

likelihood that Apple would prevail in demonstrating the unpatentability of claims 1 and 3 as anticipated by Frey.

E. Obviousness based on Frey and Divsalar: Claims 1–8 and 11–14

Apple contends that claims 1–8 and 11–14 are obvious over the combination of Divsalar and Frey. Pet. 42–60 (citing Ex. 1006 ¶¶ 127–183).

1. Divsalar

Divsalar discloses "turbo-like" coding systems that are built from fixed convolutional codes interconnected with random interleavers, including both parallel concatenated convolutional codes and serial concatenated convolutional codes as special cases. Ex. 1003, 1. With fixed component codes and interconnection topology, Divsalar demonstrates that as the block length approaches infinity, the ensemble (over all possible interleavers) maximum likelihood error probability approaches zero, if the ratio of energy per bit to noise power spectral density exceeds some threshold. *Id.*

The general class of concatenated coding systems is depicted in Figure 1 of Divsalar as follows:

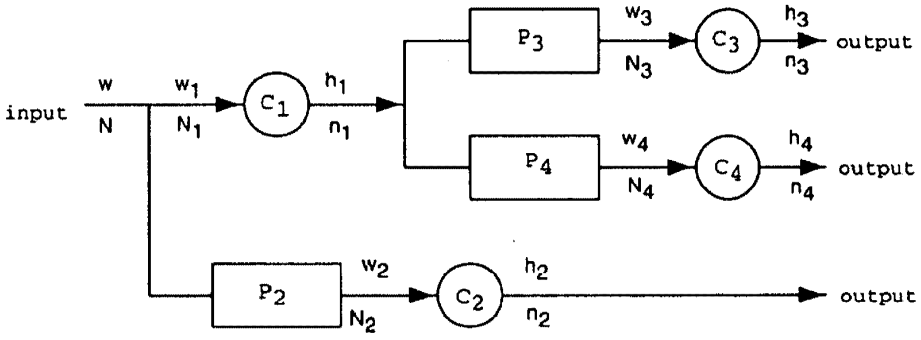

Figure 1. A "turbo-like" code with $s_I = \{1,2\}$, $s_O = \{2,3,4\}$, $\bar{s}_O = \{1\}$.

Figure 1 illustrates that encoders C_2, C_3, and C_4 are preceded by interleavers (permuters) P_2, P_3, and P_4, except C_1, which is connected to an input rather than an interleaver. *Id.* at 2–3. The overall structure must have no loops and, therefore, is called a "turbo-like" code. *Id.*

Divsalar further discloses that "turbo-like" codes are repeat and accumulate (RA) codes. *Id.* at 5. The general scheme is depicted in Figure 3 as follows:

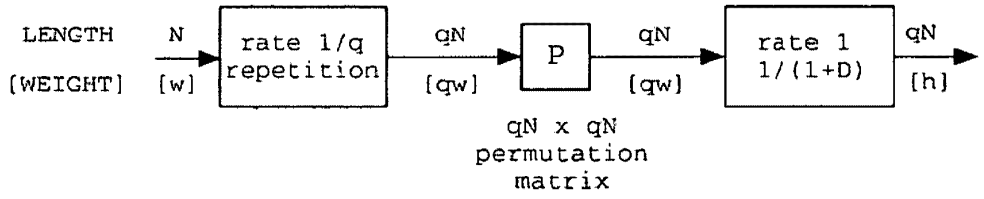

Figure 3. Encoder for a (qN, N) repeat and accumulate code. The numbers above the input-output lines indicate the length of the corresponding block, and those below the lines indicate the weight of the block.

Figure 3 illustrates that information block of length N is repeated q times, scrambled by interleaver of size qN, and then encoded by a rate 1 accumulator. *Id.* The accumulator can be viewed as a truncated rate-1 recursive convolutional encoder. *Id.* Figure 3 further illustrates a simple class of rate 1/q serially concatenated codes where the outer code is a q-fold repetition code and the inner code is a rate 1 convolutional code with a transfer function 1/(1+ D). *Id.* at 1, 5.

2. Analysis

Apple contends that claims 1–8 and 11–14 are obvious over the combination of Divsalar and Frey and provide an articulated reasoning with rational underpinning in support of the combination of Divsalar and Frey. Pet. 42–60 (citing Ex. 1006 ¶¶ 127–183). Apple contends that Frey and

Divsalar are directed to the same field of error-correcting codes (variations on turbocodes). *Id.* at 42–43 (citing Ex. 1006 ¶ 128). Apple argues that a person of ordinary skill in the art (*see id.* at 23 (setting forth Apple's unchallenged level of skill in the art at issue)), would be motivated by Frey's teaching of better performance over classical turbo codes to apply irregularity to Divsalar's repeat accumulate codes. *Id.* at 43 (citing Ex. 1006 ¶ 129). Apple further asserts that a person of ordinary skill in the art would understand that the components used in Frey and Divsalar could be substituted, requiring a trivial modification to the implementation of the Divsalar encoder to combine the references. *Id.* at 43–44 (citing Ex. 1006 ¶¶ 130–131). Apple also relies on a thesis by the co-inventor of the '710 patent (Pet. 46–47 (citing Ex. 1006 ¶ 132)) and an email from Dr. Frey to Dariush Divsalar (Pet. 44–45 (citing Ex. 1017, 52) in support of the combination of Divsalar and Frey.

Caltech argues that "the manner of combination of Frey and Divsalar and the function expected by a person of ordinary skill are left substantially unexplained" in Apple's petition. Prelim. Resp. 30. Furthermore, Caltech contends that a person of ordinary skill in the art, based on the disclosures of Frey and Divsalar, would understand that the combination of the references would fail to function according to its intended purpose with a second encoder having a rate equal to 1. *Id.* at 30–32.

Based on the record evidence discussed above, Apple has presented sufficient evidence and argument at this stage supporting an articulated reasoning with rational underpinning for the combination of Divsalar and Frey. In particular, Apple has provided evidence that a person of ordinary

skill in the art would understand Frey to disclose applying irregularity to improve the performance of encoders such as the one disclosed in Divsalar.

Caltech contends that the additional evidence offered by Apple (an email from Dr. Frey and a thesis from a co-inventor of the '710 patent) is flawed and relies on hearsay in support of the motivation to combine the Frey and Divsalar references. Prelim. Resp. 33–35. We agree with Caltech.

First, Apple's reliance on the purported email between Frey and Divsalar, as evidenced by an expert report from Frey in a related district court litigation (Ex. 1017), is not adequately supported by persuasive and corroborating evidence sufficient to put the content of these purported communications before this panel. Apple has failed to provide an exhibit with sworn testimony in support of this purported email between the authors of the Frey and Divsalar references. In addition to the hearsay from the unsworn expert report of Dr. Frey and unsubstantiated email from Frey to Divsalar that Caltech identifies (Prelim. Resp. 33–35), Apple's evidence fails to properly present the evidence of this purported email communication in a manner that allows it or its alleged corroborating statements to be considered on the merits. Accordingly, we give Apple's arguments and evidence regarding the Frey email no weight with respect to the motivation to combine Divsalar and Frey.

In addition, we were not persuaded by Apple's citation to the thesis of a co-inventor of the '710 patent, Aamod Khandekar, to support the ease of modifying Divsalar with Frey. Pet. 46–47 (citing Ex. 1006 ¶ 132.). As Caltech asserts, the Khandekar thesis does not appear to be prior art to the '710 patent as it was submitted in June 2002, more than two years after the '710 patent's priority date. Prelim. Resp 29–30. Apple provides no

arguments or evidence that explains how the thesis supports its contention about how or why a person of ordinary skill in the art would modify or combine Frey and Divsalar at the time of the '710 patent. Indeed, Apple has not explained adequately why the thesis of a co-inventor of the '710 patent, which appears to postdate the '710 patent's priority date, is timely corroborating evidence of the ease of combining Frey and Divsalar by a person of ordinary skill in the art at the time of patenting. Like the Frey email discussed above, we give Apple's argument and evidence based on the Khandekar thesis no weight with respect to the motivation to combine Divsalar and Frey.

Although we give no weight to Apple's arguments regarding the alleged Frey email and Khandekar thesis, we nonetheless determine, on this record, that Apple has provided sufficient argument and evidence in support of the motivation to combine Divsalar and Frey.

With respect to the limitations of claims 1–8 and 11–14 of the '710 patent, Apple contends that Divsalar teaches each of the encoding limitations of claims 1–8 and 11–14, and relies on Frey to teach irregularity as it appears in the challenged claims. Pet. 49–60. For example, with respect to independent claims 1 and 11, Apple cites Divsalar as teaching the obtaining and encoding a block of data, interleaving the repeated data elements, and second encoding of claims 1 and 11. Pet. 49–53, 57–60. Apple turns to Frey to teach the irregular repeating limitations requiring different bits to be repeated a different number of times. *Id.*

With respect to the partitioning limitation of claim 1, Caltech asserts that, for the same reasons discussed above with respect to Frey anticipating claims 1 and 3, Frey fails to teach the partitioning limitations of claim 1 and

related dependent claims 2–8. Prelim. Resp. 23–29. Apple contends that the partitioning of claim 1 is disclosed by the irregular repeating disclosed in Frey and provides declarant testimony in support of its contention. Pet. 50–51 (citing Ex. 1006 ¶ 147). For the same reasons discussed above with respect to Frey, we find that Apple has presented sufficient evidence that Frey discloses the partitioning limitations of claim 1.

For dependent claims 2–8, which depend from independent claim 1, Apple provides citations to the prior art and declaration testimony to support the contention that Frey and Divsalar teach the limitations. Pet. 49–57 (citing Ex. 1006 ¶¶ 151–170). For example, Apple provides testimony that the coders of Frey are implemented with low-density generator matrices recited in dependent claim 7. *Id.* at 56–57; Ex. 1006 ¶¶ 162–167. Although Caltech argues that this evidence is not sufficient as the disclosures in Frey and Divsalar do not expressly recite a low-density generator matrix, at issue is whether Apple is likely to prevail in showing that the references teach the limitation to a person of ordinary skill in the art, and not whether the reference expressly uses the term low-density generator matrix.

Accordingly, we find that Apple has presented sufficient argument and evidence to support the finding that it will prevail in showing that Frey and Divsalar teach the low-density generator matrix limitation of claim 7. Upon review of Apple's petition and supporting evidence and Caltech's preliminary response, we further find that Apple provides sufficient evidence and argument that Frey and Divsalar teach the limitations of dependent claims 2–8.

With respect to claims 11–14, which do not recite the partitioning limitations of claims 1–8, Apple relies on the arguments regarding Frey

teaching irregularity and Divsalar teaching the second encoding using an accumulator. *Id.* at 57–59. Based on the record at this stage of Apple's challenge to the claims of the '710 patent, Apple provides sufficient evidence and argument that it is likely to prevail in showing that Frey and Divsalar in combination teach the limitations of claims 11–14. *Id.* at 57–60.

Based on the foregoing, we find that Apple demonstrates a reasonable likelihood of prevailing in its challenge of claims 1–8 and 11–14 based on Frey and Divsalar.

F. Obviousness based on Frey, Divsalar, and Luby97: Claims 15—17, 19–22, and 24–33

Apple contends that claims 15–17, 19–22, and 24–33 are obvious over the combination of Divsalar, Frey, and Luby97. Pet. 42–60 (citing Ex. 1006 ¶¶ 127–183).

3. Luby97 (Ex. 1011)

Luby97 describes "randomized constructions of linear-time encodable and decodable codes that can transmit over lossy channels at rates extremely close to capacity." Ex. 1011, 150 (Abstract). Luby97 describes receiving data to be encoded in a stream of data symbols, such as bits, where the "*stream of data symbols* [] is partitioned and transmitted in logical units of blocks." *Id.* (emphasis added).

4. Analysis

Apple provides articulated reasoning to support its contention that a person of ordinary skill in the art would be motivated to combine Divsalar and Luby97 as both relate to error correcting codes, where Luby97 introduces a stream of data symbols or bits as the blocks of data to encode to

the encoders of Divsalar. Pet. 61–62 (citing Ex. 1006 ¶¶ 185–187). Apple argues that a person of ordinary skill in the art would understand the practice of encoding information in a real-time stream as disclosed in Luby97 in combination with Divsalar and/or Divsalar and Frey. *Id.*

Caltech argues that Apple's reasoning to combine Luby97, Divsalar, and Frey is conclusory and lacks sufficient details as to how and why one of ordinary skill in the art would combine the Luby97 with Divsalar and/or Divsalar and Frey. Prelim. Resp. 36–37.

On the present record, we find that Apple has presented sufficient evidence that it is likely to prevail in showing that a person of ordinary skill in the art (Pet. 23) would have been motivated to modify Divsalar in combination with Frey to encode a stream of bits in blocks as taught in Luby97. As discussed above, Apple has provided sufficient argument and evidence regarding the level of skill in the art (*id.* at 23) and testimony in support of the manner and expectations of success in the combination of the cited references. *Id.* at 61–62 (citing Ex. 1006 ¶¶ 185–187)

With respect to the claims, Apple provides argument and citations to the references and their declarant in support of their contention that independent claims 15 and 25 are obvious in view of Divsalar, Frey, and, Luby97. *Id.* at 62–63, 65–68 (citing Ex. 1006 ¶¶ 188–202, 218–224). Caltech contends that Apple fails to disclose specific claim limitations in the challenged claims and instead rely on analysis of claim 1, and does not address the differences between challenged claim 15 and claim 1. Prelim. Resp. 37–38; *see* Pet. 62. Caltech further argues that Apple fails to address these additional or different limitations in claims 15–17, 19–22, and 24–33 with respect to Divsalar and Frey, or explain adequately how these claims

differ from the related claims in the grounds discussed above. Prelim. Resp. 37–40.

Based on the record before us, Apple has presented sufficient evidence addressing the limitations of the claims in light of the relative breadth and differences between independent claims 1 and 11 and independent claims 15 and 25. Accordingly, upon review of Apple's evidence and argument on this record, Apple provides sufficient evidence and argument that demonstrates a likelihood of Apple prevailing in showing that claims 15–17, 19–22, and 24–33 would have been obvious in view of Divsalar, Frey, and, Luby97.

G. Obviousness based, in part, on the Pfister Slides

Apple's argument for dependent claims 10 and 23, which place an additional limitation on the second coder, namely that it utilize two accumulators, relies on the Pfister Slides (Ex. 1005) to teach this additional limitation. Pet. 73–74. As discussed above, Apple failed to show a likelihood in prevailing by showing that Pfister Slides are a prior art printed publication to the '710 patent. Accordingly, we do not institute trial on the grounds that claim 10 would have been obvious over Divsalar, Frey, and the Pfister Slides, and that claim 23 would have been obvious over Divsalar, Frey, Luby97, and the Pfister Slides.

III. CONCLUSION

For the foregoing reasons, we are persuaded that Petitioner has met its burden of showing a reasonable likelihood of prevailing in demonstrating that claims 1–8, 11–17, 19–22, and 24–33 of the '710 patent are unpatentable.

At this stage of the proceeding, we have not made a final determination as to any factual or legal determination with respect to patentability of these challenged claims.

IV. ORDER

Accordingly, it is:

ORDERED that pursuant to 35 U.S.C. § 314, an *inter partes* review is hereby instituted as to claims 1–8, 11–17, 19–22, and 24–33 of the '710 patent on the following grounds of unpatentability raised in the Petition:

Claims 1 and 3 of the '710 patent as anticipated by Frey pursuant to 35 U.S.C. § 102(b);

Claims 1–8 and 11–14 of the '710 patent as obvious over Divsalar and Frey;

Claims 15–17, 19–22, and 24–33 of the '710 patent as obvious over Divsalar, Frey, and Luby97;

FURTHER ORDERED that *inter partes* review is commenced on the entry date of this Order, and pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial; and

FURTHER ORDERED that the trial is limited to the grounds of unpatentability listed above, and no other grounds of unpatentability are authorized for *inter partes* review.

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Paper 17
Entered: June 30, 2017

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

CALIFORNIA INSTITUTE OF TECHNOLOGY,
Patent Owner.

Case IPR2017-00219
Patent 7,116,710 B1

Before KEN B. BARRETT, TREVOR M. JEFFERSON, and JOHN A. HUDALLA, *Administrative Patent Judges*.

JEFFERSON, *Administrative Patent Judge*.

DECISION
Institution of *Inter Partes* Review
35 U.S.C. § 314(a) and *37 C.F.R. § 42.108*

I. INTRODUCTION

Petitioner, Apple, Inc. ("Apple"), filed a Petition (Paper 5, "Pet.") requesting an *inter partes* review of claims 1–8, 10–17, and 19–33 of U.S. Patent No. 7,116,710 B1 (Ex. 1201, "the '710 patent") pursuant to 35 U.S.C. §§ 311–319. Apple relies on the Declaration of James A. Davis, Ph.D. (Ex. 1206) with its Petition. Patent Owner, California Institute of Technology ("Caltech"), filed a Preliminary Response (Paper 16, "Prelim. Resp.") to the Petition. Caltech relies on the Declaration of Dr. R. Michael Tanner (Ex. 2001) filed with its Preliminary Response.

We have jurisdiction under 37 C.F.R. § 42.4(a) and 35 U.S.C. § 314, which provides that an *inter partes* review may not be instituted unless the information presented in the Petition "shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." After considering the Petition and associated evidence, we conclude that Apple has demonstrated a reasonable likelihood that it would prevail in showing the unpatentability of claims 1–8, 11–17, 19–22, and 24–33 of the '710 patent.

A. Related Proceedings

The parties indicate that the '710 patent was involved in the following active case, *Cal. Inst. of Tech. v. Broadcom Ltd.*, No. 2:16-cv-03714 (C.D. Cal. filed May 26, 2016), and in concluded cases, *Cal. Inst. of Tech. v. Hughes Commc'ns, Inc.*, No. 2:15-cv-01108 (C.D. Cal. filed Feb. 17, 2015); and *Cal. Inst. of Tech. v. Hughes Commc'ns, Inc.*, 2:13-cv-07245 (C.D. Cal. filed Oct. 1, 2013). Pet. 3, Paper 8, 2–3.

The parties also identify co-pending cases IPR2017-00210 and IPR2017-00211, in which Apple has filed a petition for *inter partes* review of the '710 patent. Pet. 3; Paper 8, 2–3. *Inter partes* review of the '710 patent was previously considered and denied in *Hughes Network Sys. v. Cal. Inst. of Tech.*, Case IPR2015-00067 (PTAB April 27, 2015) (Paper 18) ("IPR2015-00067") and *Hughes Network Sys. v. Cal. Inst. of Tech.*, Case IPR2015-00068 (PTAB April 27, 2015) (Paper 18) ("IPR2015-00068"). Finally, certain patents related to the '710 patent were challenged in IPR2015-00059, IPR2015-00060, IPR2015-00061, and IPR2015-00081. Pet. 3. A Final Written Decision cancelling claims 1 and 2 of U.S. Patent No. 7,916,781 B2 was issued in *Hughes Network Sys. v. Cal. Inst. of Tech.*, Case IPR2015-00059 (PTAB April 21, 2016) (Paper 42).

B. The '710 Patent

The '710 patent describes the serial concatenation of interleaved convolutional codes forming turbo-like codes. Ex. 1201, Title. It explains some of the prior art with reference to its Fig. 1, reproduced below.

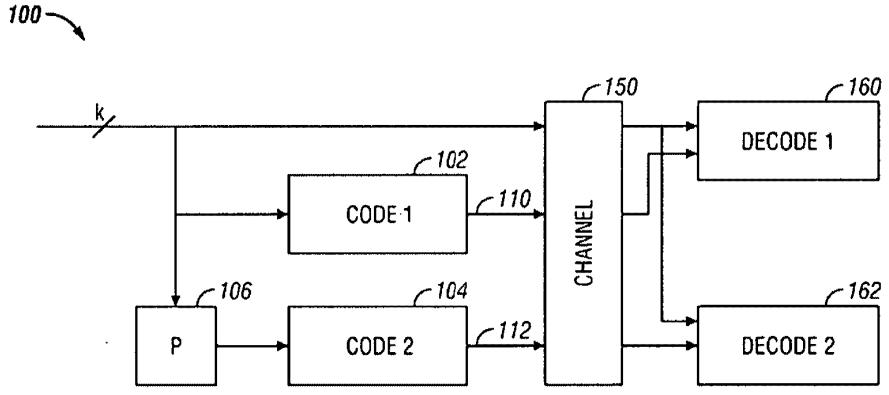

FIG. 1
(Prior Art)

Figure 1 is a schematic diagram of a prior "turbo code" system. *Id.* at 2:14–15. The '710 patent specification describes Figure 1 as follows:

> A standard turbo coder 100 is shown in FIG. 1. A block of k information bits is input directly to a first coder 102. A k bit interleaver 106 also receives the k bits and interleaves them prior to applying them to a second coder 104. The second coder produces an output that has more bits than its input, that is, it is a coder with rate that is less than 1. The coders 102,104 are typically recursive convolutional coders.
>
> Three different items are sent over the channel 150: the original k bits, first encoded bits 110, and second encoded bits 112. At the decoding end, two decoders are used: a first constituent decoder 160 and a second constituent decoder 162. Each receives both the original k bits, and one of the encoded portions 110, 112. Each decoder sends likelihood estimates of the decoded bits to the other decoders. The estimates are used to decode the uncoded information bits as corrupted by the noisy channel.

Id. at 1:38–53 (emphasis omitted).

A coder 200, according to a first embodiment of the invention, is described with respect to Figure 2, reproduced below.

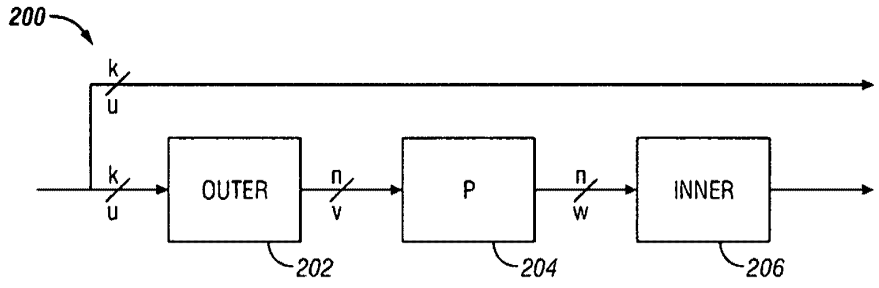

FIG. 2

Figure 2 of the '710 patent is a schematic diagram of coder 200. *Id.* at 2:16–17.

The specification states that "coder 200 may include an outer coder 202, an interleaver 204, and inner coder 206." *Id.* at 2:34–35. It further states as follows.

> The outer coder 202 receives uncoded data. The data may be partitioned into blocks of fixed size, say k bits. The outer coder may be an (n,k) binary linear block coder, where n>k. The coder accepts as input a block u of k data bits and produces an output block v of n data bits. The mathematical relationship between u and v is $v=T_0u$, where T_0 is an $n\times k$ matrix, and the rate[1] of the coder is k/n.
>
> The rate of the coder may be irregular, that is, the value of T_0 is not constant, and may differ for sub-blocks of bits in the data block. In an embodiment, the outer coder 202 is a repeater that repeats the k bits in a block a number of times q to produce a block with n bits, where n=qk. Since the repeater has an irregular output, different bits in the block may be repeated a different number of times. For example, a fraction of the bits in the block may be repeated two times, a fraction of bits may be repeated three times, and the remainder of bits may be repeated four times. These fractions define a degree sequence, or degree profile, of the code.
>
> The inner coder 206 may be a linear rate-1 coder, which means that then-bit output block x can be written as $x=T_Iw$, where T_I is a nonsingular $n\times n$ matrix. The inner coder 210 can have a rate that is close to 1, e.g., within 50%, more preferably 10% and perhaps even more preferably within 1% of 1.

Id. at 2:41–64 (emphasis omitted). Codes characterized by a regular repeat of message bits into a resulting codeword are referred to as "regular repeat,"

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[1] The "rate" of an encoder refers to the ratio of the number of input bits to the number of resulting encoded output bits related to those input bits. *See* Pet. 9.

whereas codes characterized by irregular repeat of message bits into a resulting codeword are referred to as "irregular repeat." The second ("inner") encoder 206 performs an "accumulate" function. Thus, the two step encoding process illustrated in Figure 2, including a first encoding ("outer encoding") followed by a second encoding ("inner encoding"), results in either a "regular repeat accumulate" ("RRA") code or an "irregular repeat accumulate ("IRA") code, depending upon whether the repetition in the first encoding is regular or irregular.

Figure 4 of the '710 patent, reproduced below, shows an alternative embodiment in which the first encoding is carried out by a low density generator matrix.

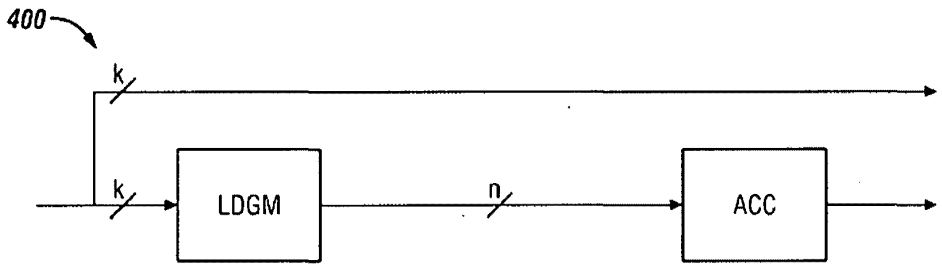

FIG. 4

Figure 4 of the '710 patent is a schematic of an irregular repeat and accumulate coder using a low density generator matrix (LDGM)[2] coder. *Id.* at 2:20–21, 3:25. The LDGM coder "performs an irregular repeat of the k bits in the block, as shown in FIG. 4." *Id.* at 3:52–54. LDGM codes are a special class of low density parity check codes that allow for less encoding

[2] A "generator" matrix (typically referred to by "G") is used to create (generate) codewords. A parity check matrix (typically referred to by "H") is used to decode a received message.

and decoding complexity. LDGM codes are systematic linear codes generated by a "sparse" generator matrix. No interleaver (as in the Figure 2 embodiment) is required in the Figure 4 embodiment because the LDGM provides scrambling otherwise provided by the interleaver.

C. Illustrative Claims

Apple challenges claims 1–8, 10–17, and 19–33 of the '710 patent, of which claims 1, 11, 15, and 25 are independent. Pet. 21. Claims 1, 3, 11, 15, and 25 are illustrative of the claims at issue and are reproduced below:

1. A method of encoding a signal, comprising:

obtaining a block of data in the signal to be encoded;

partitioning said data block into a plurality of sub-blocks, each sub-block including a plurality of data elements;

first encoding the data block to from a first encoded data block, said first encoding including repeating the data elements in different sub-blocks a different number of times;

interleaving the repeated data elements in the first encoded data block; and

second encoding said first encoded data block using an encoder that has a rate close to one.

3. The method of claim 1, wherein said first encoding is carried out by a first coder with a variable rate less than one, and said second encoding is carried out by a second coder with a rate substantially close to one.

11. A method of encoding a signal, comprising:

receiving a block of data in the signal to be encoded, the data block including a plurality of bits;

first encoding the data block such that each bit in the data block is repeated and two or more of said plurality of bits are

repeated a different number of times in order to form a first encoded data block; and

second encoding the first encoded data block in such a way that bits in the first encoded data block are accumulated.

15. A coder comprising:

a first coder having an input configured to receive a stream of bits, said first coder operative to repeat said stream of bits irregularly and scramble the repeated bits; and

a second coder operative to further encode bits output from the first coder at a rate within 10% of one.

25. A coding system comprising:

a first coder having an input configured to receive a stream of bits, said first coder operative to repeat said stream of bits irregularly and scramble the repeated bits;

a second coder operative to further encode bits output from the first coder at a rate within 10% of one in order to form an encoded data stream; and

a decoder operative to receive the encoded data stream and decode the encoded data stream using an iterative decoding technique.

Ex. 1201, 7:14–25, 7:28–32, 7:51–69, 8:1–6, 8:32–41.

D. The Alleged Grounds of Unpatentability

The information presented in the Petition sets forth the grounds of unpatentability of claims 1–8, 10–17, and 19–33 of the '710 patent as follows (*see* Pet. 34–71):

Reference(s)	Basis	Claim(s) Challenged
Divsalar[3] and Luby[4]	§ 103(a)	1–8 and 11–14
Divsalar, Luby, and Luby97[5]	§ 103(a)	15–17, 19–22, and 24–33
Divsalar, Luby, and Pfister Slides[6]	§ 103(a)	10
Divsalar, Luby, Luby97, and Pfister Slides	§ 103(a)	23

II. ANALYSIS

A. Claim Interpretation

We interpret claims of an unexpired patent using the broadest reasonable construction in light of the specification of the patent in which they appear. *See* 37 C.F.R. § 42.100(b); *Cuozzo Speed Techs. LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). In applying a broadest reasonable construction, claim terms generally are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *See In re Translogic Tech., Inc.*, 504 F.3d

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[3] Dariush Divsalar, et al., *Coding Theorems for "Turbo-Like" Codes*, PROCEEDINGS OF THE THIRTY-SIXTH ANNUAL ALLERTON CONFERENCE ON COMMUNICATION, CONTROL, AND COMPUTING, Sept. 23–25, 1998, at 201–209 (Ex. 1203, "Divsalar").

[4] "Luby, M., et al, *Analysis of Low Density Codes and Improved Designs Using Irregular Graphs*, PROCEEDINGS OF THE THIRTIETH ANNUAL ACM SYMPOSIUM ON THEORY OF COMPUTING, May 23–26, 1997, at 249–258 (Ex. 1204, "Luby").

[5] Luby, M. et al., *Practical Loss-Resilient Codes*, PROCEEDINGS OF THE TWENTY-NINTH ANNUAL ACM SYMPOSIUM ON THEORY OF COMPUTING, May 4–6, 1997, at 150–159 (Ex. 1211, "Luby97").

[6] Pfister, H., et al, *The Serial Concatenation of Rate-1 Codes Through Uniform Random Interleavers*, Presentation at Allerton Conference, Sept. 22–24, 1999 (Ex. 1205, "Pfister Slides").

1249, 1257 (Fed. Cir. 2007). Any special definition for a claim term must be set forth in the specification with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

1. "close to one" (claims 1 and 3)

Apple argues that the broadest reasonable construction of "close to one" as recited in claims 1 and 3 is "within 50% of one." Pet. 24–25. Apple argues that this is consistent with the '710 patent specification, which states that the inner code 210 of Figure 1, "can have a rate that is close to one, e.g., within 50%, more preferably 10% and perhaps even more preferably within 1% of 1." Pet. 24–25 (quoting Ex. 1201, 2:62–64 and citing Ex. 1206 ¶¶ 102–103). Caltech does not provide an express claim construction.

For purposes of this Decision, we agree with Apple, determining that "close to one" as recited in claims 1 and 3 is construed as "within 50% of one."

B. Discretion to Institute Under 35 U.S.C. § 325(d)

"Congress did not mandate that an inter partes review must be instituted under certain conditions. Rather, by stating that the Director—and by extension, the Board—may not institute review unless certain conditions are met, Congress made institution discretionary." *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, Case IPR2013-00324, slip op. 4 (PTAB Nov. 21, 2013) (Paper 19). The Board's discretion is guided by 35 U.S.C. § 325(d), which provides, in part that:

> MULTIPLE PROCEEDINGS -- . . . In determining whether to institute or order a proceeding under this chapter, chapter 30, or chapter 31, the Director may take into account whether, and reject the petition or request because, the same or substantially

> the same prior art or arguments previously were presented to the Office.[7]

Accordingly, institution of an *inter partes* review is discretionary. *See, e.g.*, *NVIDIA Corp. v. Samsung Elec. Co.*, Case IPR2016-00134 (PTAB May 4, 2016) (Paper 9).

Caltech asserts that the instant petition presents substantially the same prior art and arguments presented to the Board in Case Nos. IPR2015-00067 and IPR2015-00068, both previously denied institution. Prelim. Resp. 3–6. Based on the facts and circumstances of this case, we decline to exercise our discretion under 35 U.S.C. § 325(d).

We begin by noting that Apple was not a party to the prior IPRs and was sued for infringement of the '710 patent by Caltech in May of 2016, which was after the decisions denying institution in IPR2015-00067 and IPR2015-00068. Pet. 3. Although not determinative, this factor weighs in favor of not exercising our discretion. Caltech argues that Apple recycles substantially the same prior art and arguments IPR2015-00067 and IPR2015-00068, which presented grounds based on Divsalar and U.S. Patent No. 6,081,909 issued to Luby. Prelim. Resp. 5–6. Although the present petitions differ in prior art, e.g., replacing a patent issued to Luby in IPR2015-00068 with the Luby reference in the present case, and different claims are challenged, Caltech argues that these changes are immaterial and fall within § 325(d). Prelim. Resp. 5–6.

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[7] Although this provision appears in Chapter 32 of the Patent Act, which is directed to post-grant reviews, by its terms it is applicable also to proceedings under Chapter 31, which covers *inter partes* review proceedings.

Although similar art and arguments were asserted in IPR2015-00067 and IPR2015-00068, we are persuaded that the present case brought by Apple, a different petitioner, challenging additional claims, and presenting arguments not fully addressed in the prior IPRs does warrant denial of the petition pursuant to § 325(d). Accordingly, we decline to deny Apple's petition pursuant to the discretion in 35 U.S.C. § 325(d).

C. Printed Publication Prior Art

Caltech contends that Apple has not established that Frey, Divsalar, and the Pfister Slides are prior art. Prelim. Resp. 6–17. We address each of these allegations in turn below.

1. Divsalar (Ex. 1203)

With respect to Divsalar, Apple relies on the Board's prior final written decision in IPR2015-00059 that found that Divsalar qualifies as prior art under 35 U.S.C. § 102(b) because the balance of evidence appeared to show that it was published before the effective filing date of the '710 patent. Pet. 25–26 (citing *Hughes Network Sys. v. Cal. Inst. of Tech.*, Case IPR2015-00059, slip op 13–22 (PTAB April 21, 2016) (Paper 42) ("IPR2015-00059 FWD")). Apple also cites to Exhibit 1215 as "explaining that Divsalar was available to the public by March 30, 1999." *Id.* Nonetheless, Exhibit 1215 is a table of contents for conference proceedings that do not contain any reference to Divsalar. Ex. 1215. To the extent Apple erred and intended to cite Exhibit 1212 (*see* Prelim. Resp. 9), the Declaration of Fradenburgh, Apple relies on the same declaration from a librarian prepared for use in IPR2015-00059, as evidence that Divsalar was

publicly available by *April* 30, 1999, in the University of Texas library. *See* Ex. 1212 ¶ 7; *see also* IPR2015-00059 FWD at 13–22.

Caltech argues that Apple "misapprehends the scope of the Board's prior decision in IPR2015-00059," which did not find Divsalar to be a prior art printed publication based solely on the Fradenburgh Declaration (Ex. 1212). Prelim. Resp. 9. We agree with Caltech that our previous determination regarding the prior art status of Divsalar was made under the particular factual and procedural circumstances of that case. IPR2015-00059 FWD at 13–22. In particular, our Final Written Decision in IPR2015-00059 relied, in part, on Caltech's waiver of its objection to the Fradenburgh declaration and subsequent failure to move to strike the declaration. *See* IPR2015-00059 FWD at 31 (denying Caltech's motion to strike Ms. Fradenburgh's testimony on the basis of no timely evidentiary objection); Prelim. Resp. 9. Furthermore, our findings in IPR2015-00059 relied on additional evidence, properly before the Board, in support of Divsalar as a prior art printed publication.

Based on the evidence at this stage of the proceeding, Divisalar appears to be part of conference proceedings related to the 36th Allerton Conference held September 23–25, 1998. Ex. 1203, 1. The Fradenburgh declaration provides some evidence that Divsalar was available to the public on April 30, 1999." *See* Exhibit 1212, 2. Although we find that Apple presents sufficient evidence at this stage of the proceeding to meet the burden that Divsalar is a prior art printed publication for purposes of this Decision, we expect that Apple's evidence in support of Divsalar's prior art status will be more completely evaluated in the context of a trial based on the complete record in this case.

2. Pfister Slides (Ex. 1205)

Apple contends that Paul Siegel presented the Pfister Slides at the Allerton Conference in September 1999. Pet. 32 (citing Declaration of Paul Siegel, Ex. 1220, 3). Caltech correctly argues that Apple's Petition is devoid of any explanation or argument as to why or how the Pfister Slides qualify as prior art. Prelim. Resp. 13–14. Indeed, Apple's petition makes no attempt to show how the Pfister Slides qualify as a "printed publication" under 35 U.S.C. § 311(b), which limits IPRs to challenges based on patents and printed publications.

Under 35 U.S.C. § 311(b), IPR challenges are limited to patents and printed publications. We look to the underlying facts to make a legal determination as to whether a reference is a printed publication. *Suffolk Techs., LLC v. AOL Inc.*, 752 F.3d 1358, 1364 (Fed. Cir. 2014). The determination of whether a given reference qualifies as a prior art "printed publication" involves a case-by-case inquiry into the facts and circumstances surrounding its disclosure to members of the public. *In re Klopfenstein*, 380 F.3d 1345, 1350 (Fed. Cir. 2004). The key inquiry is whether the reference was made "sufficiently accessible to the public interested in the art" before the critical date. *In re Cronyn*, 890 F.2d 1158, 1160 (Fed. Cir. 1989); *In re Wyer*, 655 F.2d 221, 226 (CCPA 1981). "A given reference is 'publicly accessible' upon a satisfactory showing that such document has been disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it." *Bruckelmyer v. Ground Heaters, Inc.*, 445 F.3d 1374, 1378 (Fed. Cir. 2006) (citation omitted). With respect to slide presentations, Federal Circuit case law and a prior opinion from our

Board have found that the mere presentation of slides at a professional conference is not *per se* a prior art printed publication. *Klopfenstein*, 380 F.3d at 1349 n.4; *Temporal Power Ltd. v. Beacon Power, LLC*, Case IPR2015-00146, slip op. at 8–11 (PTAB April 27, 2015) (Paper 10).

In the present case, Apple's evidence and argument in support of Pfister is insufficient to establish that the Pfister Slides qualify as a prior art printed publication. Pet. 32 (citing Ex. 1220 at 3). *See, e.g., In re Klopfenstein*, 380 F.3d at 1350 (addressing slide presentation); *Temporal Power Ltd.*, IPR2015-00146 at 8–11. Despite Professor Siegel's testimony that he presented the Pfister Slides at the Allerton Conference (*see* Ex. 1220, 3), Apple makes no attempt to explain the manner in which the Pfister Slides were published or how the Pfister Slides were made accessible to the relevant public. Thus, Apple fails to meet the burden imposed under § 314(a) to establish in its Petition a reasonable likelihood of success, which includes, among other things, making a threshold showing that the Pfister Slides are a prior art printed publication. Accordingly, we find that Apple has not demonstrated a likelihood of showing that grounds based on the Pfister Slides render the challenged claims unpatentable.

D. Obviousness based on Luby and Divsalar: Claims 1–8 and 11–14

Apple contends that claims 1–8 and 11–14 are obvious over the combination of Divsalar and Frey. Pet. 42–60 (citing Ex. 1206 ¶¶ 399–456).

1. Divsalar

Divsalar discloses "turbo-like" coding systems that are built from fixed convolutional codes interconnected with random interleavers, including both parallel concatenated convolutional codes and serial

concatenated convolutional codes as special cases. Ex. 1203, 1. With fixed component codes and interconnection topology, Divsalar demonstrates that as the block length approaches infinity, the ensemble (over all possible interleavers) maximum likelihood error probability approaches zero, if the ratio of energy per bit to noise power spectral density exceeds some threshold. *Id.*

The general class of concatenated coding systems is depicted in Figure 1 of Divsalar as follows:

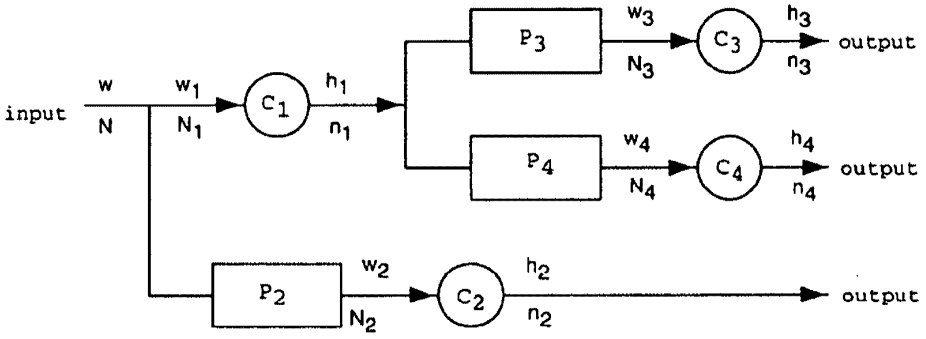

Figure 1. A "turbo-like" code with $s_I = \{1,2\}$, $s_O = \{2,3,4\}$, $\bar{s}_O = \{1\}$.

Figure 1 illustrates that encoders C_2, C_3, and C_4 are preceded by interleavers (permuters) P_2, P_3, and P_4, except C_1, which is connected to an input rather than an interleaver. *Id.* at 2–3. The overall structure must have no loops and, therefore, is called a "turbo-like" code. *Id.*

Divsalar further discloses that "turbo-like" codes are repeat and accumulate (RA) codes. *Id.* at 5. The general scheme is depicted in Figure 3 as follows:

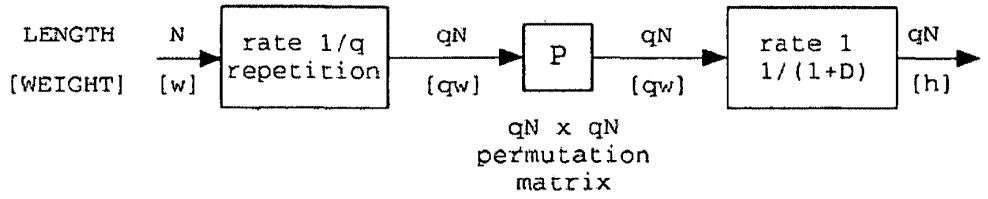

Figure 3. Encoder for a (qN, N) repeat and accumulate code. The numbers above the input-output lines indicate the length of the corresponding block, and those below the lines indicate the weight of the block.

Figure 3 illustrates that information block of length N is repeated q times, scrambled by interleaver of size qN, and then encoded by a rate 1 accumulator. *Id.* The accumulator can be viewed as a truncated rate-1 recursive convolutional encoder. *Id.* Figure 3 further illustrates a simple class of rate 1/q serially concatenated codes where the outer code is a q-fold repetition code and the inner code is a rate 1 convolutional code with a transfer function 1/(1+ D). *Id.* at 1, 5.

2. Luby

Luby discloses derivation of irregular random graphs that improve upon the performance of Gallager's low-density parity-check (LDPC) codes, and finds that irregular codes described in the paper resulted in codes with improved error correcting capabilities. Ex. 1204, 257. Luby discloses that irregular codes are represented by random irregular bipartite graphs, while regular codes are represented using regular graphs derived from Gallager codes based on sparse bipartite graphs. *Id.* at 249.

Luby discloses that irregular codes are those represented by bipartite graphs in which different message nodes have different degrees (*i.e.*, where different message nodes are connected to different numbers of check nodes). Luby. *Id.* at 257. Luby further states that message nodes with high degree

tend to correct their value quickly and then provide good information for check nodes. *Id.* at 253.

3. Analysis

Apple contends that claims 1–8 and 11–14 are obvious over the combination of Divsalar and Luby and provide an articulated reasoning with rational underpinning in support of the combination of Divsalar and Luby. Pet. 34–55 (citing Ex. 1206 ¶¶ 127–456). Apple contends that Luby was a significant advance in error-correcting codes using irregularity to design codes that were superior to regular codes. *Id.* at 34–35. Apple cites Frey,[8] which credits Luby for providing motivation to study irregular codes, in particular citing Luby's advancements regarding irregular Gallager codes. *Id.* at 35 (citing Ex. 1202, 1 (discussing reference [1])). Apple notes that Luby is expressly discussed as motivation to incorporate irregularity into turbo-like codes, and identifies the codes in Divsalar as such turbo-like codes. *Id.* (citing Ex. 1206 ¶ 401). Apple argues that a person of ordinary skill following Frey "would have understood that incorporating irregularity into RA codes would be even more likely to produce favorable results. *Id.* at 36 (citing Ex. 1206 ¶ 403). Apple relies on the Khandekar thesis (Ex. 1218), a thesis written by a co-inventor of the '710 patent, to support the rationale to combine Divsalar and Luby. Pet. 35. Finally, Apple argues that a person of ordinary skill in the art would have combined Luby and Divsalar "for research" purposes to "study irregularity." *Id.* at 36.

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[8] Brendan J. Frey and David J.C. MacKay, *Irregular Turbocodes*, PROCEEDINGS OF THE 37TH ALLERTON CONFERENCE ON COMMUNICATION, CONTROL, AND COMPUTING (1999) at 241–248 (Ex. 1202, "Frey).

Caltech argues that Apple's argument for the combination "fails for being based on a fundamental misapprehension of the difference between 'irregular graphing' of Luby and irregular repetition of information bits prior to interleaving, as recited in the [challenged] claims." Prelim. Resp. 31–33. In addition, Caltech argues that Apple relies on non-prior art references, Frey (Ex. 1202) and the Khandekar thesis (Ex. 1218), to support the rationale to combine Divsalar and Luby. Prelim. Resp. 32–35; *see* Pet. 35. Caltech also contends that Apple's argument that Luby and Divsalar could be combined to research and study irregularity by applying them to RA codes is unsupported hindsight analysis. Prelim. Resp. 35–36.

We agree with Caltech that Apple's arguments and evidence regarding the Khandekar thesis (Ex. 1218) and its arguments regarding combining the references for research purposes are unavailing. *See* Pet. 36 (citing Ex. 1206 ¶ 404). Apple provides no arguments or evidence that explains how the thesis supports its contention about how or why a person of ordinary skill in the art would modify or combine Luby and Divsalar at the time of the '710 patent. Indeed, Apple has not explained adequately why the thesis of a co-inventor of the '710 patent, which appears to postdate the '710 patent's priority date, is timely corroborating evidence of the application of Luby's teachings to Divsalar by a person of ordinary skill in the art at the time of patenting. Similarly, Apple's argument and evidence regarding research motivating the combination is not supported adequately by the declarant testimony (Ex. 1206 ¶ 405).

Although we give no weight to Apple's arguments regarding the researching of irregularity and the Khandekar thesis as motivations to combine, we nonetheless determine, on this record, that Apple has presented

sufficient evidence and argument that modifying Divsalar using the irregularity in the Tanner graphs disclosed in Luby would have been within the skill of a person of ordinary skill in the art and an easy modification. Pet. 23 (level of ordinary skill), 37–41 (ease of implementation).

With respect to the limitations of independent claims 1 and 11 of the '710 patent, Apple contends that Divsalar teaches each of the encoding limitations, and relies on Luby to teach irregularity as it appears in the challenged claims. Pet. 41–55. Apple cites Figure 3 of Divsalar, noting the repeat, interleave, and accumulate steps used in the RA coder. Pet. 43–44 (citing Ex. 1206 ¶¶ 416–418). With respect to the partitioning step of claim 1, Apple argues that Luby describes introducing irregularity by varying the degree of the message nodes in the Tanner graph. Pet. 46–47. Apple provides testimony and analysis that the irregular repeater of Luby adapted to Divsalar would *de facto* partition information into sub-blocks of bits with different degrees of repetition. Pet. 46–47. For claim 11, which does not recite partitioning, Apple relies on Luby in combination with Divsalar to teach that the information bits can be repeated a different number of time. Pet. 53–54.

Caltech argues that Apple's evidence that irregular repeating necessarily or *de facto* yields partitioning as recited in claim 1 is not supported by the record. Prelim. Resp. 14–15. On this record, we find that Apple has presented sufficient information to demonstrate a likelihood of showing that the irregular repeat teaches partitioning the data into blocks and sub-blocks based on the degree of repetition. Pet. 46–47.

With respect to Luby teaching irregular repetition, Caltech, relying on the Declaration of Dr. Tanner (Ex. 2001), argues that Apple's petition and

supporting declarant misunderstand the teachings of Luby. Prelim. Resp. 19–31. Caltech offers testimonial evidence from Dr. Tanner that Luby's irregular graphing, which relies on Tanner graphing, does *not* teach irregular repeating, as Luby discloses repeating info bits and check bits. *Id.* at 19–31. Caltech, relying on Dr. Tanner, contends that irregular graphs such as those in Luby can be generated by regular repetition information. *Id.* at 28–29 (citing Ex. 2001 ¶ 31). Because the graphed "irregular codes" as described in Luby can be represented by regular repeating information bit graphs, Caltech contends that Luby does not teach irregular repeating or expressly disclose such repeating. *Id.* at 26, 28–29. Specifically, Caltech asserts "Luby's disclosure of codes with irregular graphs includes codes with regular repetition of information bits, so Luby does not expressly disclose irregular repetition of information bits." *Id.* at 30.

The testimony from Dr. Davis on behalf of Apple and Dr. Tanner on behalf of Caltech indicate contradictory views of Luby that are not mutually exclusive based on the present record. For purposes of deciding whether to institute *inter partes* review, such "such testimonial evidence will be viewed in the light most favorable to the petitioner solely for purposes of deciding whether to institute inter partes review." 37 C.F.R. § 42.108(c). In this light, we find that Apple has presented sufficient evidence that it would prevail in showing the Luby teaches irregular repeating information bits, even though the irregular repeating messaging bits in Luby may include check nodes and information bits. *See* Pet. 28–31; Prelim. Resp. 23–31.

For dependent claims 2–8 and 12–14, Apple provides citations to the prior art and Dr. Davis to support its contention that Divsalar and Luby teach the limitations of the challenged claims. Pet 48–52 (Ex. 1206 ¶¶ 428–444),

54–55 (citing Ex. 1206 ¶¶ 452–456). Upon review of the evidence and argument, we find that Apple demonstrates a reasonable likelihood of showing that Luby and Divsalar teach the limitations of claims 1–8 and 11–14.

E. Obviousness based on Divsalar, Luby, and Luby97: Claims 15—17, 19–22, and 24–33

Apple contends that claims 15–17, 19–22, and 24–33 are obvious over the combination of Divsalar, Luby, and Luby97. Pet. 55–69 (citing Ex. 1206 ¶¶ 457–503).

1. Luby97 (Ex. 1211)

Luby97 describes randomized constructions of linear-time encodable and decodable codes that can transmit over lossy channels at rates extremely close to capacity." Ex. 1211, Abstract. Luby97 describes receiving data to be encoded in a stream of data symbols, such as bits, where the "*stream of data symbols* [] is partitioned and transmitted in logical units of blocks." *Id.* at 150 (emphasis added).

2. Analysis

Apple provides articulated reasoning to support its contention that a person of ordinary skill in the art would be motivated to combine Divsalar, and Luby97 as both relate to error correcting codes, where Luby97 introduces a stream of data symbols or bits as the blocks of data to encode to the encoders of Divsalar. Pet. 55–56 (citing Ex. 1206 ¶¶ 457–460). Apple argues that a person of ordinary skill in the art would understand using the teaching of streaming in Luby97 to make an encoder capable of receiving and processing streams as opposed to blocks. *Id.* at 56.

Caltech argues that Apple's reasoning to combine Luby97, Divsalar, and Luby is conclusory and lacks sufficient details regarding how to incorporate Luby's teachings of a stream of bits into Divsalar and Luby. Prelim. Resp. 38–39.

On the present record, we find that Apple has presented sufficient evidence that it is likely to prevail in showing that a person of ordinary skill in the art (Pet. 23) would have been motivated to modify Divsalar in combination with Luby to encode a stream of bits in blocks as taught in Luby97.

With respect to the claims, Apple provides argument and citations to the references and their declarant in support of their contention that independent claims 15 and 25 are obvious in view of Divsalar, Luby, and, Luby97. *Id.* at 57–58, 60–62 (citing Ex. 1006 ¶¶ 461–466, 474–482). Caltech contends that Apple's arguments fail to disclose specific claim limitations in the challenged claims and instead rely on the analysis for claim 1 regarding Divsalar and Luby. Thus, Caltech argues, Apple fails to address the differences between challenged claim 15 and claim 1. Prelim. Resp. 39–40. Caltech makes a similar argument with respect to claim 25. *Id.* at 41. Caltech further argues that the combination of Divsalar, Luby, and Luby97 fails to teach partitioning, to the extent Apple relies on the arguments presented for claim 1 discussed above. *Id.* at 40 (discussing claims 16 and 17 which recite a partitioning limitation). Finally, Caltech also argues that Apple fails to show that the cited prior art teaches a low-density generator matrix coder as recited in claim 20. *Id.*

On the present record, Apple identifies sufficient evidence and argument regarding claims 15–17, 19–22, and 24–33 to meet their burden of

demonstrating a likelihood of success in showing that the challenged claims are obvious in view of Divsalar, Luby, and, Luby97. Apple provides citations to the references and testimony that provide sufficient evidence at this stage of the proceeding that address the limitations of the claims in light of the relative breadth of the claims and differences between independent claims 1 and 11 and independent claims 15 and 25.

Accordingly, upon review of Apple's evidence and argument on this record, Apple provides sufficient evidence and argument that demonstrates a likelihood of Apple prevailing in showing that claims 15–17, 19–22, and 24–33 would have been obvious in view of Divsalar, Luby, and, Luby97.

F. Obviousness based, in part, on Pfister Slides

Apple's argument for dependent claims 10 and 23, which place an additional limitation on the second coder, namely that it utilize two accumulators, rely on the Pfister Slides (Ex. 1205) to teach this additional limitation. Pet. 69–71. As discussed above, Apple failed to show a likelihood in prevailing by showing that Pfister Slides are a prior art printed publication to the '710 patent. Accordingly, we do not institute trial on the grounds that claim 10 would have been obvious over Divsalar, Luby, and the Pfister Slides, and that claim 23 would have been obvious over Divsalar, Luby, Luby97, and the Pfister Slides.

III. CONCLUSION

For the foregoing reasons, we are persuaded that Petitioner has met its burden of showing a reasonable likelihood of prevailing in demonstrating that claims 1–8, 11–17, 19–22, and 24–33 of the '710 patent are unpatentable.

At this stage of the proceeding, we have not made a final determination as to any factual or legal determination with respect to patentability of these challenged claims.

IV. ORDER

Accordingly, it is:

ORDERED that pursuant to 35 U.S.C. § 314, an *inter partes* review is hereby instituted as to claims 1–8, 11–17, 19–22, and 24–33 of the '710 patent on the following grounds of unpatentability raised in the Petition:

Claims 1–8 and 11–14 of the '710 patent as obvious over Divsalar and Luby;

Claims 15–17, 19–22, and 24–33 of the '710 patent as obvious over Divsalar, Luby, and Luby97;

FURTHER ORDERED that *inter partes* review is commenced on the entry date of this Order, and pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial; and

FURTHER ORDERED that the trial is limited to the grounds of unpatentability listed above, and no other grounds of unpatentability are authorized for *inter partes* review.

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ORIGINAL

AO 120 (Rev. 08/10)

TO: Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Central District of California on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO. CV13-07245	DATE FILED 10/01/2013	U.S. DISTRICT COURT Central District of California
PLAINTIFF The California Institute of Technology		DEFENDANT Hughes Communications, Inc., Hughes Network Systems, LLC, DISH Network Corporation, DISH Network L.L.C., dishNET Satellite Broadband L.L.C.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	7,116,710	10/3/2006	California Institute of Technology
2	7,421,032	9/2/2008	California Institute of Technology
3	7,916,781	3/29/2011	California Institute of Technology
4	8,284,833	10/9/2012	California Institute of Technology
5			

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT
see attached Order of Dismissal

2013 OCT -1 AM 10:21
CLERK U.S. DISTRICT COURT
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LOS ANGELES
BY

FILED

CLERK	(BY) DEPUTY CLERK	DATE
KIRY K. GRAY		5/31/16

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

JS-6

UNITED STATES DISTRICT COURT

CENTRAL DISTRICT OF CALIFORNIA

CALIFORNIA INSTITUTE OF TECHNOLOGY, a California corporation,

Plaintiff,

vs.

HUGHES COMMUNICATIONS, INC., a Delaware corporation, HUGHES NETWORK SYSTEMS, LLC, a Delaware limited liability company, DISH NETWORK CORPORATION, a Nevada corporation, DISH NETWORK L.L.C., a Colorado limited liability company, and DISHNET SATELLITE BROADBAND L.L.C., a Colorado limited liability company,

Defendants.

CASE NO. 2:13-CV-7245 MRP-JEM

[~~PROPOSED~~] ORDER OF DISMISSAL

CAME ON THIS DAY for consideration of the Joint Stipulated Motion for Dismissal with Prejudice of all claims, defenses, and counterclaims asserted between Caltech and Defendants, and the Court being of the opinion that said motion should be GRANTED, it is hereby ORDERED, ADJUDGED AND DECREED that all claims, defenses, and counterclaims in this action asserted in this suit between Caltech and Defendants are hereby dismissed with prejudice.

It is further ORDERED that all attorneys' fees and costs are to be borne by the party that incurred them. .

IT IS SO ORDERED.

DATED: May 27, 2016

Honorable George H. King
Chief United States District Court Judge

AO 120 (Rev. 08/10)

TO:	Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Central District of California on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:16-cv-3714	5/26/2016	Central District of California

PLAINTIFF	DEFENDANT
California Institute of Technology	Broadcom Limited, Broadcom Corporation, Avago Technologies Limited, Apple Inc.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	7,116,710	10/3/2006	California Institute of Technology
2	7,421,032	9/2/2008	California Institute of Technology
3	7,916,781	3/29/2011	California Institute of Technology
4	8,284,833	10/9/2012	California Institute of Technology
5			

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

AO 120 (Rev. 08/10)

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☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:15-cv-01108	2/17/2015	Central District of California

PLAINTIFF	DEFENDANT
The California Institute of Technology	Hughes Communications, Inc., Hughes Network Systems, LLC, DISH Network Corporation, DISH Network L.L.C., and dishNET Satellite Broadband, L.L.C.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	7,116,710	10/3/2006	California Institute of Technology
2	7,421,032	9/2/2008	California Institute of Technology
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In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
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1		
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DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

Trials@uspto.gov
571-272-7822

Paper 18
Entered: April 27, 2015

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HUGHES NETWORK SYSTEMS, LLC and
HUGHES COMMUNICATIONS, INC.,
Petitioner,

v.

CALIFORNIA INSTITUTE OF TECHNOLOGY,
Patent Owner.

Case IPR2015-00067
Patent 7,116,710 B1

Before KALYAN K. DESHPANDE, GLENN J. PERRY, and TREVOR M. JEFFERSON, *Administrative Patent Judges.*

JEFFERSON, *Administrative Patent Judge.*

DECISION
Denying Institution of *Inter Partes* Review
37 C.F.R. § 42.108

I. INTRODUCTION

Hughes Network Systems, LLC and Hughes Communications, Inc. (collectively, "Petitioner") filed a Corrected Petition requesting an *inter partes* review of claims 1, 3, 4, 5, 6, 15, 16, 20, 21, and 22 of U.S. Patent No. 7,116,710 B1 (Ex. 1001, "the '710 patent"). Paper 4 ("Pet."). California Institute of Technology ("Patent Owner") timely filed a Preliminary Response. Paper 13 ("Prelim. Resp."). We have jurisdiction under 35 U.S.C. § 314(a), which provides that an *inter partes* review may not be instituted "unless . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." After considering the Petition, the Preliminary Response, and associated evidence, we conclude that Petitioner has not demonstrated a reasonable likelihood that it would prevail in showing unpatentability of all the challenged claims. Thus, we deny institution of an *inter partes* review of claims 1, 3, 4, 5, 6, 15, 16, 20, 21, and 22 of the '710 patent.

A. Related Proceedings

Petitioner indicates that the '710 patent is the subject of the proceedings in *California Institute of Technology v. Hughes Communications, Inc.*, No. 13-cv-07245 (C.D. Cal.). Pet. 1–2.

The '710 patent is also the subject of IPR2015-00068. Additionally, Petitioner indicates that the '710 patent is related to U.S. Patent No. 7,421,032, U.S. Patent No. 7,916,781, and U.S. Patent No. 8,284,833, which are the subject of IPR2015-00059, IPR2015-00060, IPR2015-00061, and IPR2015-00081. Paper 7, 1–2.

B. The '710 Patent

The '710 patent describes the serial concatenation of interleaved convolutional codes forming turbo-like codes. Ex. 1001, Title. It explains some of the prior art with reference to its Fig. 1, reproduced below.

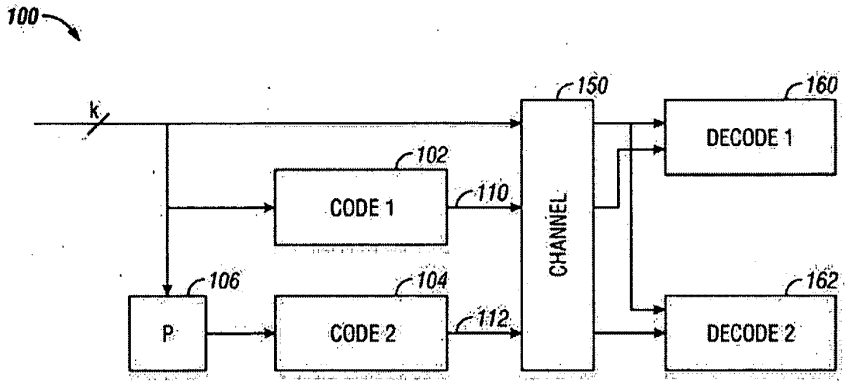

FIG. 1
(Prior Art)

Figure 1 is a schematic diagram of a prior "turbo code" system. *Id.* at 2:14–15. The '710 patent specification describes Figure 1 as follows:

> A standard turbo coder 100 is shown in FIG. 1. A block of k information bits is input directly to a first coder 102. A k bit interleaver 106 also receives the k bits and interleaves them prior to applying them to a second coder 104. The second coder produces an output that has more bits than its input, that is, it is a coder with rate that is less than 1. The coders 102,104 are typically recursive convolutional coders.
>
> Three different items are sent over the channel 150: the original k bits, first encoded bits 110, and second encoded bits 112. At the decoding end, two decoders are used: a first constituent decoder 160 and a second constituent decoder 162. Each receives both the original k bits, and one of the encoded portions 110, 112. Each decoder sends likelihood estimates of the decoded bits to the other decoders. The estimates are used to decode the uncoded information bits as corrupted by the noisy channel.

Id. at 1:38–53(emphasis omitted).

A coder 200, according to a first embodiment of the invention, is described with respect to Figure 2, reproduced below.

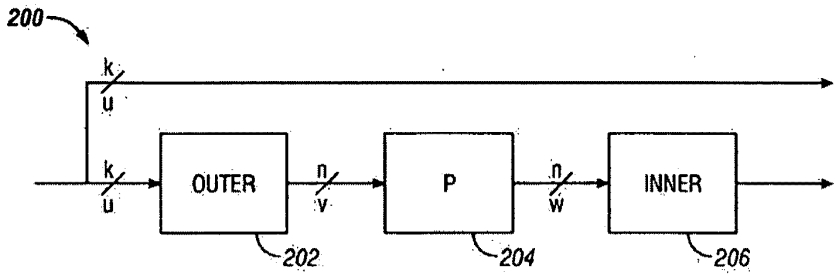

FIG. 2

Figure 2 of the '710 patent is a schematic diagram of coder 200. *Id.* at2:16–17.

The specification states that "coder 200 may include an outer coder 202, an interleaver 204, and inner coder 206." *Id.* at 2:34–35. It further states as follows.

> The outer coder 202 receives uncoded data. The data may be partitioned into blocks of fixed size, say k bits. The outer coder may be an (n,k) binary linear block coder, where n>k. The coder accepts as input a block u of k data bits and produces an output block v of n data bits. The mathematical relationship between u and v is $v=T_0u$, where T_0 is an n x k matrix, and the rate[1] of the coder is k/n.
>
> The rate of the coder may be irregular, that is, the value of T_0 is not constant, and may differ for sub-blocks of bits in the data block. In an embodiment, the outer coder 202 is a repeater that repeats the k bits in a block a number of times q to produce a block with n bits, where n=qk. Since the repeater has an irregular output, different bits in the block may be repeated a

[1] The "rate" of an encoder refers to the ratio of the number of input bits to the number of resulting encoded output bits related to those input bits. *See* Ex. 1010 ¶ 19.

> different number of times. For example, a fraction of the bits in the block may be repeated two times, a fraction of bits may be repeated three times, and the remainder of bits may be repeated four times. These fractions define a degree sequence, or degree profile, of the code.
>
> The inner coder 206 may be a linear rate-1 coder, which means that then-bit output block x can be written as $x=T_I w$, where T_I is a nonsingular n x n matrix. The inner coder 210 can have a rate that is close to 1, e.g., within 50%, more preferably 10% and perhaps even more preferably within 1% of 1.

Id. at 2:41–64 (emphasis omitted and footnote added). Codes characterized by a regular repeat of message bits into a resulting codeword are referred to as "regular repeat," whereas codes characterized by irregular repeat of message bits into a resulting codeword are referred to as "irregular repeat." The second ("inner") encoder 206 performs an "accumulate" function. Thus, the two step encoding process illustrated in Fig. 2, including a first encoding ("outer encoding") followed by a second encoding ("inner encoding"), results in either a "regular repeat accumulate" ("RRA") code or an "irregular repeat accumulate ("IRA") code, depending upon whether the repetition in the first encoding is regular or irregular.

Figure 4 of the '710 patent, reproduced below, shows an alternative embodiment in which the first encoding is carried out by a low density generator matrix.

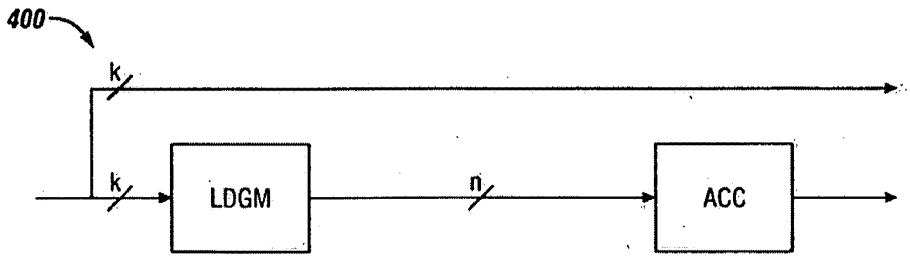

FIG. 4

Figure 4 of the '710 patent is a schematic of an irregular repeat and accumulate coder using a Low density generator matrix (LDGM)[2] coder. *Id.* at 2:20–21, 3:25. The LDGM coder "performs an irregular repeat of the k bits in the block, as shown in FIG. 4." *Id.* at 3:52–54. LDGM codes are a special class of low density parity check codes that allow for less encoding and decoding complexity. LDGM codes are systematic linear codes generated by a "sparse" generator matrix. No interleaver (as in the Figure 2 embodiment) is required in the Figure 4 embodiment because the LDGM provides scrambling otherwise provided by the interleaver.

C. Illustrative Claim

Petitioner challenges claims 1, 3, 4, 5, 6, 15, 16, 20, 21, and 22 of the '710 patent. Pet. 3–4. Claim 1 is illustrative of the claims at issue and is reproduced below:

> 1. A method of encoding a signal, comprising:
> obtaining a block of data in the signal to be encoded;

[2] A "generator" matrix (typically referred to by "G") is used to create (generate) codewords. A parity check matrix (typically referred to by "H") is used to decode a received message.

partitioning said data block into a plurality of sub-blocks, each sub-block including a plurality of data elements;

first encoding the data block to from a first encoded data block, said first encoding including repeating the data elements in different sub-blocks a different number of times;

interleaving the repeated data elements in the first encoded data block; and

second encoding said first encoded data block using an encoder that has a rate close to one.

D. The Alleged Grounds of Unpatentability

The information presented in the Petition sets forth proposed grounds of unpatentability of claims 1, 2, 4, 6, 8, 9, 10, 11, and 13 of the '710 patent as follows (*see* Pet. 15–50):

Reference(s)	Basis	Claim(s) Challenged
Frey[3]	§ 102(a)	1
Frey and Divsalar[4]	§ 103(a)	1, 3, 4, 5, 6, 15, 16, 21, and 22
Frey, Divsalar, and Hall[5]	§ 103(a)	15, 16, 21, and 22
Frey, Divsalar, and Ping[6]	§ 103(a)	20
Frey, Divsalar, Ping, and Hall	§ 103(a)	20

[3] Brendan J. Frey and David J.C. MacKay, *Irregular Turbocodes*, PROCEEDINGS OF THE 37TH ALLERTON CONFERENCE ON COMMUNICATION, CONTROL, AND COMPUTING (1999) at 1–7 (Ex.1012, "Frey).

[4] Dariush Divsalar, et al., *Coding Theorems for "Turbo-Like" Codes*, THIRTY-SIXTH ANNUAL ALLERTON CONFERENCE ON COMMUNICATION, CONTROL, AND COMPUTING, Sept. 23–25, 1998, at 201–209 (Ex. 1011, "Divsalar").

[5] Eric K. Hall, et al., *Stream-Oriented Turbo Codes*, 48TH IEEE VEHICULAR TECHNOLOGY CONFERENCE 1998 at 71-75 (Ex. 1013, "Hall").

[6] L. Ping, et al., *Low Density Parity Check Codes with Semi-Random Parity Check Matrix*, 35 ELECTRONIC LETTERS 38–39, 1999 (Ex. 1014, "Ping").

II. ANALYSIS[7]

A. Grounds based, in part, on Frey

Petitioner contends that claim 1 is unpatentable under 35 U.S.C. § 102(a) over Frey (Pet. 15–21) and that each of the challenged claims 1, 3, 4, 5, 6, 15, 16, 20, 21, and 22 are unpatentable under 35 U.S.C. § 103(a) as obvious over Frey in combination with other asserted prior art (Pet. 21–50). Thus, whether Frey is a prior art printed publication is a dispositive issue in this proceeding.

1. Frey (Ex. 1014)

Petitioner describes Frey as disclosing "a generalized two-step irregular code involving (1) a permutation and (2) a convolution." Pet. 10 (citing Ex. 1014 at 3–4; Figs. 1 and 2). Petitioner states that Frey was published at least by May 11, 2000 without direct citation, citing only the Declaration of David J.C. Mackay, Ex. 1060 ¶¶ 40–49 for indirect support. Pet. 2. Petitioner's list of Exhibits parenthetically notes that Frey was also "published no later than October 8, 1999 at the website of D.J.C. MacKay." Pet. iii.

Patent Owner challenges the availability of Frey as a printed publication as of the asserted date of May 11, 2000. Prelim. Resp. 21–24. Patent Owner argues that Petitioner makes no attempt to explain or support the contention that Frey was "published at least by May 11, 2000" other than the reference to the declaration of D.J.C. MacKay. *Id.* at 22. Patent Owner

[7] Patent Owner argues that, as a threshold matter, the Petition should be dismissed because Petitioner fails to identify all real parties in interest. Prelim. Resp. 3. Because we have determined that Petitioner has not demonstrated a reasonable likelihood of prevailing, we need not address the real parties in interest issue in this Decision.

contends that Petitioner has also failed to show that Frey was publicly accessible as of the asserted date. *Id.* (citing *In re Wyer*, 655 F.2d 221, 227 (CCPA 1981)).

Patent Owner states that the petition lacks any "discussion of the dissemination of Frey, such that a person of ordinary skill exercising reasonable diligence would have located this document as of the date alleged. Nor does the petition discuss whether Frey was sufficiently accessible to members of the public interested and ordinarily skilled in the art before the critical date. *In re Cronyn*, 890 F.2d 1158, 1160 (Fed. Cir. 1989)." Prelim. Resp. 23.

"Whether an anticipatory document qualifies as a 'printed publication' under § 102 is a legal conclusion based on underlying factual determinations." *SRI Int'l, Inc. v. Internet Sec. Sys., Inc.*, 511 F.3d 1186, 1192 (Fed .Cir. 2008) (citation omitted); *see In re Klopfenstein*, 380 F.3d 1345, 1347 (Fed. Cir. 2004) ("Where no facts are in dispute, the question of whether a reference represents a 'printed publication' is a question of law.") In the present case, Petitioner has provided insufficient evidence and supporting argument that Frey, Ex. 1012, is a printed publication that was disseminated and sufficiently accessible to members of the public.[8]

[8] "Because there are many ways in which a reference may be disseminated to the interested public, 'public accessibility' has been called the *touchstone* in determining whether a reference constitutes a 'printed publication' bar under 35 U.S.C.§ 102(b)." *SRI Int'l, Inc.*, 511 F.3d at 1194 (quoting *In re Hall*, 781 F.2d 897, 898–99 (Fed. Cir. 1986)). "A given reference is 'publicly accessible' upon a satisfactory showing that such document has been disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it." *Id.* (quoting *Bruckelmyer v. Ground*

Although Petitioner's asserted date for publication of Frey appears to rely on the Allerton Conference, the Declaration of Dr. David J.C. MacKay—a co-author (with Frey) of the paper—discusses only publication of Frey via the MacKay website (Ex. 1060 ¶ 44). Indeed, the paragraphs of MacKay's testimony cited by Petitioner do not state that the Frey reference was published as part of the Allerton Conference, but merely indicates that it was submitted for publication. Ex. 1060 ¶ 43. We also note that although the first page of the Frey reference indicates that it was prepared for the 37th Allerton Conference in 1999 (Ex. 1012, 1), the pages of Exhibit 1012 do not indicate that it was taken from an Allerton Conference published proceeding as apparent from Divsalar (Ex. 1011). *Compare* Frey, Ex. 1012 *with* Divsalar, Ex 1011.

The silence of the Petition on whether the paper was published as part of the Allerton Conference proceedings and whether such a publication was received or shelved by a library is telling. Petitioner's sole reference to the MacKay declaration (Pet. 2, citing Ex. 1060 ¶¶ 40–49) does not provide sufficient support for the contention that Frey was published to the interested public as of May 11, 2000. Furthermore, the Petition provides insufficient testimony, evidence or argument with respect to the public accessibility of the MacKay website.

Heaters, Inc., 445 F.3d 1374, 1378 (Fed. Cir. 2006)); *see In re Cronyn*, 890 F.2d at 1160 ("[D]issemination and public accessibility are the keys to the legal determination whether a prior art reference was 'published.'" (quoting *Constant v. Advanced Micro-Devices, Inc.*, 848 F.2d 1560, 1568 (Fed. Cir. 1988), *cert. denied*, 488 U.S. 892 (1988))).

Based on the record before us, Petitioner provides insufficient evidence by declaration or document to establish the public accessibility of Frey. *Cf. In re Hall*, 781 F.2d at 899 (examining affidavit in support of public availability of thesis). Petitioner's naked assertion that Frey was published (Pet. 2) is not supported sufficiently by the record.

Because each of Petitioner's asserted grounds of unpatentability is based, in part, on Frey (Pet. 3–4), and Petitioner has not met its burden of establishing that Frey is a "printed publication" and, thus, satisfies the statutory requirement of 35 U.S.C. § 311(b), Petitioner has not shown a reasonable likelihood of prevailing on the asserted grounds.

III. CONCLUSION

For the foregoing reasons, we determine that the information presented in the Petition does not establish a reasonable likelihood that Petitioner would prevail in establishing the unpatentability of: (1) claim 1 as anticipated by Frey; (2) claims 1, 3, 4, 5, 6, 15, 16, 20, 21, and 22 as obvious over Frey, Divsalar and Hall; (3) claims 15, 16, 211, and 22 as obvious over Frey, Divsalar and Hall; (4) claim 20 as obvious over Frey, Divsalar, and Ping; and (5) claim 20 as obvious over Frey, Divsalar, Ping, and Hall.

IV. ORDER

Accordingly, it is

ORDERED that pursuant to 35 U.S.C. § 314, an *inter partes* review is hereby denied as to all grounds raised in the Petition for the reasons stated above and no trial is instituted.

For PETITIONER:

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571-272-7822

Paper 18
Entered: April 27, 2015

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HUGHES NETWORK SYSTEMS, LLC and
HUGHES COMMUNICATIONS, INC.,
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CALIFORNIA INSTITUTE OF TECHNOLOGY,
Patent Owner.

Case IPR2015-00068
Patent 7,116,710 B1

Before KALYAN K. DESHPANDE, GLENN J. PERRY, and TREVOR M. JEFFERSON, *Administrative Patent Judges*.

JEFFERSON, *Administrative Patent Judge*.

DECISION
Denying Institution of *Inter Partes* Review
37 C.F.R. § 42.108

I. INTRODUCTION

Hughes Network Systems, LLC and Hughes Communications, Inc. (collectively, "Petitioner") filed a Corrected Petition requesting an *inter partes* review of claims 1, 3, 4, 5, 6, 15, 16, 20, 21, and 22 of U.S. Patent No. 7,116,710 B1 (Ex. 1001, "the '710 patent"). Paper 4 ("Pet."). California Institute of Technology ("Patent Owner") timely filed a Preliminary Response. Paper 13 ("Prelim. Resp."). We have jurisdiction under 35 U.S.C. § 314(a), which provides that an *inter partes* review may not be instituted "unless . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." After considering the Petition, the Preliminary Response, and associated evidence, we conclude that Petitioner has not demonstrated a reasonable likelihood that it would prevail in showing unpatentability of all the challenged claims. Thus, we deny institution of an *inter partes* review of claims 1, 3, 4, 5, 6, 15, 16, 20, 21, and 22 of the '710 patent.

A. Related Proceedings

Petitioner indicates that the '710 patent is the subject of the proceedings in *California Institute of Technology v. Hughes Communications, Inc. et al.*, No. 13-cv-07245 (C.D. Cal.). Pet. 1–2.

The '710 patent is also the subject of IPR2015-00067. Additionally, Petitioner indicates that the '710 patent is related to U.S. Patent No. 7,421,032, U.S. Patent No. 7,916,781, and U.S. Patent No. 8,284,833, which are the subject of IPR2015-00059, IPR2015-00060, IPR2015-00061, and IPR2015-00081. Paper 7, 1–2.

B. The '710 Patent

The '710 patent describes the serial concatenation of interleaved convolutional codes forming turbo-like codes. Ex. 1001, Title. It explains some of the prior art with reference to its Figure 1, reproduced below.

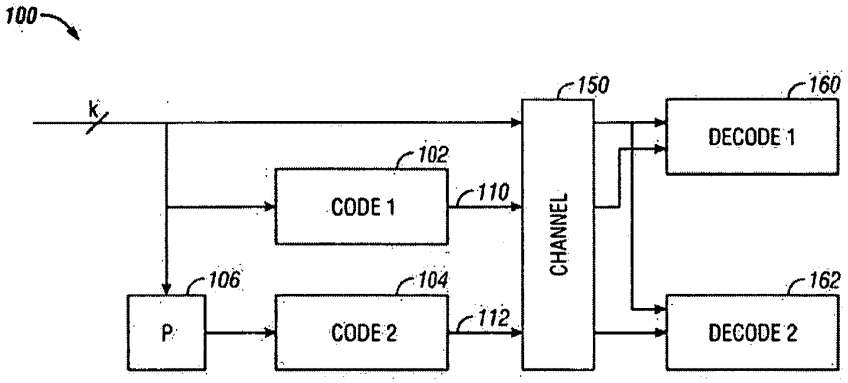

FIG. 1
(Prior Art)

Figure 1 is a schematic diagram of a prior "turbo code" system. *Id.* at 2:14–15. The '710 patent Specification describes Figure 1 as follows:

> A standard turbo coder 100 is shown in FIG. 1. A block of k information bits is input directly to a first coder 102. A k bit interleaver 106 also receives the k bits and interleaves them prior to applying them to a second coder 104. The second coder produces an output that has more bits than its input, that is, it is a coder with rate that is less than 1. The coders 102,104 are typically recursive convolutional coders.
>
> Three different items are sent over the channel 150: the original k bits, first encoded bits 110, and second encoded bits 112. At the decoding end, two decoders are used: a first constituent decoder 160 and a second constituent decoder 162. Each receives both the original k bits, and one of the encoded portions 110, 112. Each decoder sends likelihood estimates of the decoded bits to the other decoders. The estimates are used to decode the uncoded information bits as corrupted by the noisy channel.

Id. at 1:38–53 (emphasis omitted).

A coder 200, according to a first embodiment of the invention, is described with respect to Figure 2, reproduced below.

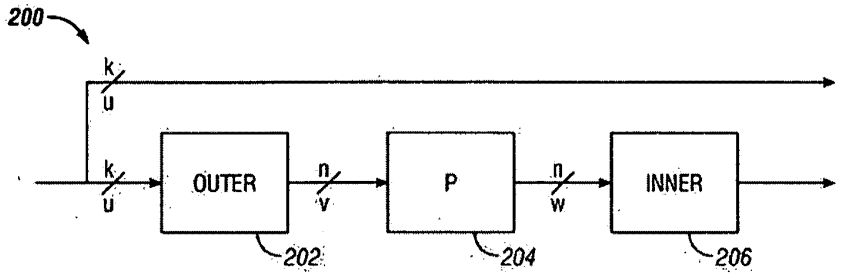

FIG. 2

Figure 2 of the '710 patent is a schematic diagram of coder 200. *Id.* at2:16–17.

The Specification states that "coder 200 may include an outer coder 202, an interleaver 204, and inner coder 206." *Id.* at 2:34–35 (emphasis omitted). It further states as follows.

> The outer coder 202 receives the uncoded data. The data may be partitioned into blocks of fixed size, say k bits. The outer coder may be an (n,k) binary linear block coder, where n>k. The coder accepts as input a block u of k data bits and produces an output block v of n data bits. The mathematical relationship between u and v is $v=T_0u$, where T_0 is an n x k matrix, and the rate[1] of the coder is k/n.
>
> The rate of the coder may be irregular, that is, the value of T_0 is not constant, and may differ for sub-blocks of bits in the data block. In an embodiment, the outer coder 202 is a repeater that repeats the k bits in a block a number of times q to produce a block with n bits, where n=qk. Since the repeater has an irregular output, different bits in the block may be repeated a

[1] The "rate" of an encoder refers to the ratio of the number of input bits to the number of resulting encoded output bits related to those input bits. *See* Ex. 1010 ¶ 19.

> different number of times. For example, a fraction of the bits in the block may be repeated two times, a fraction of bits may be repeated three times, and the remainder of bits may be repeated four times. These fractions define a degree sequence or degree profile, of the code.
>
> The inner coder 206 may be a linear rate-1 coder, which means that the n-bit output block x can be written as $x=T_I w$, where T_I is a nonsingular n x n matrix. The inner coder 210 can have a rate that is close to 1, e.g., within 50%, more preferably 10% and perhaps even more preferably within 1% of 1.

Id. at 2:41–64 (emphasis omitted and footnote added). Codes characterized by a regular repeat of message bits into a resulting codeword are referred to as "regular repeat," whereas codes characterized by irregular repeat of message bits into a resulting codeword are referred to as "irregular repeat." The second ("inner") encoder 206 performs an "accumulate" function. Thus, the two step encoding process illustrated in Figure 2, including a first encoding ("outer encoding") followed by a second encoding ("inner encoding"), results in either a "regular repeat accumulate" ("RRA") code or an "irregular repeat accumulate ("IRA") code, depending upon whether the repetition in the first encoding is regular or irregular.

Figure 4 of the '710 patent, reproduced below, shows an alternative embodiment in which the first encoding is carried out by a low density generator matrix.

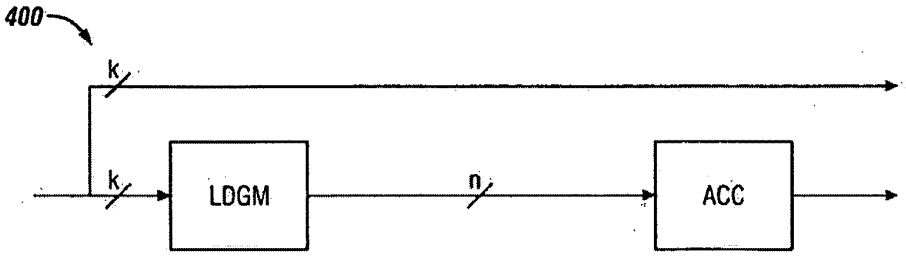

FIG. 4

Figure 4 of the '710 patent is a schematic of an irregular repeat and accumulate coder using a Low density generator matrix (LDGM)[2] coder. *Id.* at 2:20–21, 3:25. The LDGM coder "performs an irregular repeat of the k bits in the block, as shown in FIG. 4." *Id.* at 3:52–54. LDGM codes are a special class of low density parity check codes that allow for less encoding and decoding complexity. LDGM codes are systematic linear codes generated by a "sparse" generator matrix. No interleaver (as in the Figure 2 embodiment) is required in the Figure 4 embodiment because the LDGM provides scrambling otherwise provided by the interleaver.

C. Illustrative Claim

Petitioner challenges claims 1, 3, 4, 5, 6, 15, 16, 20, 21, and 22 of the '710 patent. Pet. 3–4. Claim 1 is illustrative of the claims at issue and is reproduced below:

> 1. A method of encoding a signal, comprising:
> obtaining a block of data in the signal to be encoded;

[2] A "generator" matrix (typically referred to by "G") is used to create (generate) codewords. A parity check matrix (typically referred to by "H") is used to decode a received message.

> partitioning said data block into a plurality of sub-blocks, each sub-block including a plurality of data elements;
>
> first encoding the data block to from a first encoded data block, said first encoding including repeating the data elements in different sub-blocks a different number of times;
>
> interleaving the repeated data elements in the first encoded data block; and
>
> second encoding said first encoded data block using an encoder that has a rate close to one.

D. The Alleged Grounds of Unpatentability

The information presented in the Petition sets forth proposed grounds of unpatentability of claims 1, 3, 4, 5, 6, 15, 16, 21, and 223 of the '710 patent as follows (*see* Pet. 14–43):

References	Basis	Claim(s) Challenged
Divsalar[3] and Luby[4]	§ 103(a)	1, 3, 4, 5, 6, 15, 16, 21, and 22
Divsalar, Luby, and Hall[5]	§ 103(a)	15, 16, 21, and 22
Divsalar, Luby, and Ping[6]	§ 103(a)	20
Divsalar, Luby, Ping, and Hall	§ 103(a)	20

[3] Dariush Divsalar, et al., *Coding Theorems for "Turbo-Like" Codes*, THIRTY-SIXTH ANNUAL ALLERTON CONFERENCE ON COMMUNICATION, CONTROL, AND COMPUTING, Sept. 23–25, 1998, at 201–209 (Ex. 1011, "Divsalar").

[4] U.S. Patent No. 6,081,909, issued June 27, 2000 (Ex. 1016, "Luby").

[5] Eric K. Hall, et al., *Stream-Oriented Turbo Codes*, 48TH IEEE VEHICULAR TECHNOLOGY CONFERENCE 1998 at 71-75 (Ex. 1013, "Hall").

[6] L. Ping, et al., *Low Density Parity Check Codes with Semi-Random Parity Check Matrix*, 35 ELECTRONIC LETTERS 38–39, 1999 (Ex. 1014, "Ping").

II. ANALYSIS[7]

A. Claim Construction

The Board will interpret claims of an unexpired patent using the broadest reasonable construction in light of the specification of the patent in which they appear. *See* 37 C.F.R. § 42.100(b); Office Patent Trial Practice Guide, 77 Fed. Reg. 48756, 48766 (Aug. 14, 2012). Under the broadest reasonable construction standard, claim terms are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech. Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007).

Petitioner discusses several claim terms and the District Court's construction of those terms, but does not offer proposed constructions. Pet. 12–14. We determine that no claim construction is necessary for the purposes of this decision.

B. Divsalar (Ex. 1011) and Luby (Ex. 1016)

Petitioner contends that claims 1, 3, 4, 5, 6, 15, 16, 21, and 22 are unpatentable under 35 U.S.C. § 103(a) over Divsalar and Luby (Pet. 14–33) and that each of the remaining challenged claims 15, 16, 20, 21, and 22 are unpatentable under 35 U.S.C. § 103(a) as obvious over Divsalar and Luby in combination with other asserted prior art (Pet. 34–43).

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[7] Patent Owner argues that, as a threshold matter, the Petition should be dismissed because Petitioner fails to identify all real parties in interest. Prelim. Resp. 3. Because we have determined that Petitioner has not demonstrated a reasonable likelihood of prevailing, we need not address the real parties in interest issue in this Decision.

1. Divsalar (Ex. 1011) as a Printed Publication

Petitioner states that Divsalar was "published no later than April 30, 1999 at the University of Texas library." Pet. iii; *see also* Pet. 2 (stating that Divsalar was "published at least by April 30, 1999 and available as prior art under 35 U.S.C. § 102(b)"). In support, Petitioner proffers the declaration testimony of a Univ. of Texas librarian (Ex. 1064) including an acquisition record pasted into an email. According to Petitioner's expert, Dr. Henry D. Pfister, The Allerton Conference is generally regarded as one of the main conferences in the field of information theory and communications. Ex. 1010 ¶ 28.

Patent Owner argues that Petitioner has not established that Divsalar is a printed publication within the meaning of § 311(b). Prelim. Resp. 21–23. Patent Owner states that the acquisition record of the University of Texas library does not state that the paper was actually shelved or otherwise displayed and accessible to those of "ordinary skill." Prelim. Resp. 22–23.

According to the Divsalar cover page, it was presented at the Allerton Conference held on September 23–25, 1998. The acquisition record of the University of Texas indicating acquisition in April, 1999 lends credence to the actual presentation and publication of the paper at the September 1998 Allerton Conference and dissemination of the paper to the interested public. *See* Ex. 1064 (Declaration of Robin Fradenburgh) 4–6. Given Dr. Pfister's testimony that the Allerton Conference is the premier conference for information theorists, we find sufficient evidence to establish Divsalar as a printed publication within the meaning of the AIA statute.[8]

[8] We also note that Divsalar is listed as being of record among the "References Cited" in U.S. Patent No. 7,916,781 (the '781 patent) that is the

Accordingly, we are persuaded by Petitioner and the supporting evidence that Divsalar is prior art for the purposes of this Decision. Patent Owner may rebut Petitioner's contentions and supporting evidence with evidence that Divsalar was not presented and published at the Allerton Conference.

2. Divsalar (Ex. 1011)

Divsalar discloses "turbo-like" coding systems that are built from fixed convolutional codes interconnected with random interleavers, including both parallel concatenated convolutional codes and serial concatenated convolutional codes as special cases. Ex. 1011, 3. With fixed component codes and interconnection topology, Divsalar demonstrates that as the block length approaches infinity, the ensemble (over all possible interleaves) maximum likelihood error probability approaches zero, if the ratio of energy per bit to noise power spectral density exceeds some threshold. *Id.*

The general class of concatenated coding systems is depicted in Figure 1 of Divsalar as follows:

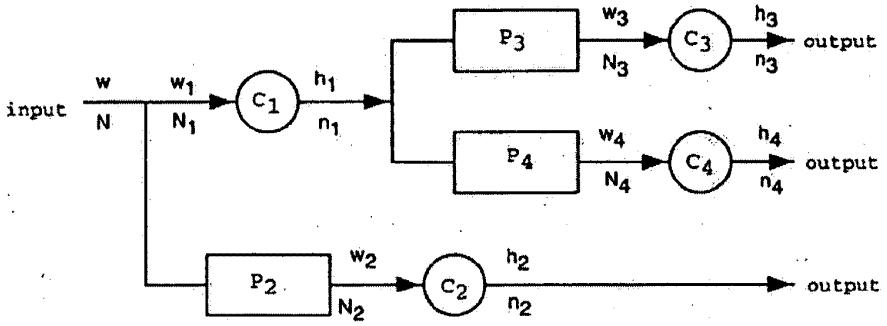

Figure 1. A "turbo-like" code with $s_I = \{1,2\}$, $s_O = \{2,3,4\}$, $\bar{s}_O = \{1\}$.

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subject of IPR2015-00059. It was cited by the Applicant in an IDS apparently filed with the application on June 30, 2008.

Figure 1 illustrates that encoders C2, C3, and C4 are preceded by interleavers (permuters) P2, P3, and P4, except C1, which is connected to an input rather than an interleaver. *Id.* at 4–5. The overall structure must have no loops and, therefore, is called a "turbo-like" code. *Id.*

Divsalar further discloses that "turbo-like" codes are repeat and accumulate (RA) codes. *Id.* at 7. The general scheme is depicted in Figure 3 as follows:

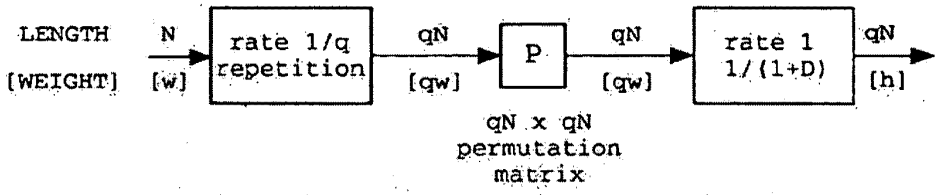

Figure 3. Encoder for a (qN, N) repeat and accumulate code. The numbers above the input-output lines indicate the length of the corresponding block, and those below the lines indicate the weight of the block.

Figure 3 illustrates that information block of length N is repeated q times, scrambled by interleaver of size qN, and then encoded by a rate 1 accumulator. *Id.* The accumulator can be viewed as a truncated rate-1 recursive convolutional encoder. *Id.* Figure 3 further illustrates a simple class of rate 1/q serially concatenated codes where the outer code is a q-fold repetition code and the inner code is a rate 1 convolutional code with a transfer function 1/(1+ D). *Id.* at 3, 7.

3. Luby (Ex. 1016)

Luby discloses a technique for creating loss resilient and error correcting codes having irregular graphing between the message data and the redundant data. Ex. 1016, 1:5–9. Luby teaches a technique for creating encoded messages, which when decoded, facilitate recover and/or correcting

of message data that has been lost or corrupted during transmission or storage. *Id.* at 2:56–60.

4. Analysis – Divsalar and Luby (independent claims 1 and 15)

Independent claim 1 recite encoding that required "repeating the data elements in different sub-blocks a different number of times." In addition irregular repeating, claim 1 further recites partitioning the data block into sub-blocks.

Although Divsalar teaches obtaining a block of data (Pet. 14), Petitioner admits that "*Divsalar* teaches a method that includes repeating each input bit the same number of []times" and not an irregular or different number of times. Pet. 16 (citing Ex. 1011 at 5; Ex. 1010 ¶ 118); *see also* Pet. 24 (stating that Divsalar "does not 'repeat said stream of bits *irregularly*,' as required by claim 15"). Petitioner relies on Luby to teach the irregular repeating recited in claims 1 and 15. Pet. 24–25. According to Petitioner, this is demonstrated by Luby's Figure 17, reproduced below.

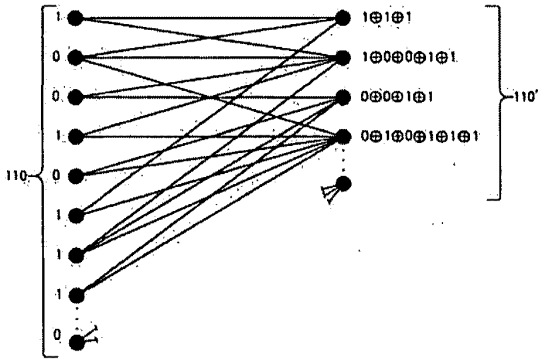

FIG. 17

Figure 17 depicts an irregular graphing of the edges between node layers in an error correcting cascading encoding structure. Ex. 1016, 5:42–46. According to Petitioner, the circles (nodes) in the left column represent

information bits to be encoded and the circles (nodes) in the right column represent parity bits computed from the information bits. Pet. 17 (citing Ex. 1010 ¶ 119). Each parity bit on the right is computed by summing together (modulo 2) all of the information bits connected to that parity bits by an edge. *Id.*

According to Petitioner, if d_i is the degree (or the number of adjacent edges) of the i-th information bit, then some information bits are connected to two parity bits (i.e., have a degree of two) and other information bits are connected to three parity bits (i.e., have a degree of three). *Id.* Petitioner argues that a person of ordinary skill in the art would understand that Luby's assignment of a first group to a degree of two and a second group of input bits to a degree of three is "partitioning said data block into a plurality of sub-blocks, each sub-block including a plurality of elements," as recited in claim 1. Pet. 17; *see also* Pet. 24. Petitioner contends that in Figure 17 of the Luby, "the input bits with a degree of two are one sub-block and the input bits with a degree of three are a second sub-block" of at least two input bits. *Id.*

With respect to the parity bits of Figure 17 of Luby, Petitioner argues that "the parity bits are computed by first repeating the i-th information bit d_i times and then interleaving the repeated bits based on the edge connection in the graph." Pet. 17–18 (citing Ex. 1010 ¶ 146). "Next, each parity bit with degree d is computed as the modulo-2 sum of d repeated bits." *Id.* Petitioner contends that Luby teaches "partitioning said data block into a plurality of sub-blocks, each sub-block including a plurality of data elements" because some bits have different degrees, either two or three. *Id.*

Based on the record before us, we agree with Patent Owner that Petitioner has not sufficiently shown that Luby discloses "partitioning said data block into a plurality of sub-blocks, each sub-block including a plurality of data elements," as recited in claim 1. Prelim. Resp. 26. In addition, the Petition fails to adequately show how the combination of Luby and Divsalar teach "said first encoding including repeating the data elements in different sub-blocks a different number of times" as recited in claim 1.

Petitioner has neither provided sufficient citation to evidence, nor adequately explained how one of ordinary skill in the art applies irregular graphing of the edges between node layers as disclosed in Luby to partition the block of data in Divsalar into "a plurality of sub-blocks, each sub-block including a plurality of data elements," as recited in claim 1. Indeed, the Petition claim chart does not adequately explain how parity bits are computed based on the edge graphing disclosed in Luby.[9]

With respect to claim 15, Petitioner has failed to provide sufficient evidence and testimony to support the combination of the Luby and Divsalar. Although Luby discusses that "sparse graph codes" can be improved by use of "'irregular graphing'" (Pet. 24–25 (citing Ex. 1016, Fig. 17; 11:23–49)), Petitioner has not shown that the irregular graphing of Luby

[9] Even assuming that Petitioner intended to cite Dr. Pfister's declaration testimony on information bits and parity bits in Figure 17 to explain the teaching of Luby (*see* Prelim. Resp. 29), we are not persuaded. The Pfister declaration states that Figure 17 of Luby describes the functional relationship between the information bits and the parity bits without any reference to Luby. Ex. 1010 ¶ 120. Petitioner failed to cite this testimony, which does not adequately show how Figure 17 of Luby teaches one of ordinary skill in the art the partitioning and irregular encoding of sub-blocks limitations recited in claim 1.

combined with the regular repeat codes of block of length N in Divsalar teaches the limitations of claim 15.

In sum, Petitioner has not provided sufficient evidence or argument to support the contention that "irregular graphing" of Luby teaches the irregular stream of bits as required in claim 15. In addition, we note that Petitioner provides only conclusory statements that Divsalar has inputs configured to receive a stream of bits as recited in claim 15. Pet. 24.

On the record before us, we are not persuaded by Petitioner's contentions that Luby in combination with Divsalar teaches irregular repeating as required in independent claims 1 and 15. Petitioner's arguments and evidence with respect to claim limitations for partitioning and assignment and irregular encoding in claim 1 and the limitation for an irregular stream of bits in claim 15 are presented confusingly and are not persuasive. *See* Pet. 15–18; 23–25. Petitioner relies on the same arguments presented for independent claims 1 and 15 to support the unpatentability of dependent claims 3, 4, 5, 6, 16, 21, and 22. Pet. 14–33.

For the reasons stated above, we conclude that on this record Petitioner has not demonstrated a reasonable likelihood that Petitioner would prevail in showing that claims 1, 3, 4, 5, 6, 15, 16, 21, and 22 are unpatentable as obvious over Divsalar and Luby.

5. *Analysis—Remaining Grounds based, in part, on Divsalar and Luby (claims 15, 16, 20, 21, and 22)*

Petitioner relies on the same arguments presented for claim 15 with respect to Divsalar and Luby (Pet. 23–25) in the grounds of unpatentability asserted for claims 15, 16, 21, and 22 based on obviousness over Divsalar, Luby and Hall (Pet. 35–36); and the grounds of unpatentability asserted for

claim 20 based on (i) Divsalar, Luby, and Ping and (ii) Divsalar, Luby, Ping and Hall (Pet. 37–43).

For the reasons discussed above, we conclude that on this record Petitioner has not demonstrated a reasonable likelihood that Petitioner would prevail in showing that claims 15, 16, 21, and 22 are unpatentable for obviousness over Divsalar, Luby, and Hall; claim 20 is unpatentable for obviousness over Divsalar, Luby, and Ping; and claim 20 is unpatentable for obviousness over Divsalar, Luby, Ping, and Hall.

III. CONCLUSION

For the foregoing reasons, we determine that the information presented in the Petition does not establish a reasonable likelihood that Petitioner would prevail in establishing the unpatentability of: (1) claims 1, 3, 4, 5, 6, 15, 16, 21, and 22 as obvious over Divsalar and Luby; (2) claims 15, 16, 21, and 22 as obvious over Divsalar, Luby, and Hall; (4) claim 20 as obvious over Divsalar, Luby, and Ping; and (5) claim 20 as obvious over Divsalar, Luby, Ping, and Hall.

IV. ORDER

Accordingly, it is

ORDERED that pursuant to 35 U.S.C. § 314, an *inter partes* review is hereby denied as to all grounds raised in the Petition for the reasons stated above and no trial is instituted.

Case IPR2015-00068
Patent 7,116,710 B1

For PETITIONER:

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ORIGINAL

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Central District of California on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO. CV13-07245	DATE FILED 10/01/2013	U.S. DISTRICT COURT Central District of California
PLAINTIFF The California Institute of Technology		DEFENDANT Hughes Communications, Inc., Hughes Network Systems, LLC, DISH Network Corporation, DISH Network L.L.C., dishNET Satellite Broadband L.L.C.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	7,116,710	[illegible]/2006	California Institute of Technology
2	7,421,032	9/2/2008	California Institute of Technology
3	7,916,781	3/29/2011	California Institute of Technology
4	8,284,833	10/9/2012	California Institute of Technology
5			

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

FILED
2013 OCT -1 AM 10:21
CLERK U.S. DISTRICT COURT
CENTRAL DIST. OF CALIF.
LOS ANGELES
BY

CLERK	(BY) DEPUTY CLERK	DATE

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Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/861,102	05/18/2001	Hui Jin	06618-637001 / CIT3220

CONFIRMATION NO. 6026

20985
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POWER OF ATTORNEY NOTICE

OC000000050416739

Date Mailed: 10/17/2011

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 08/10/2011.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

/hchristian/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/861,102	05/18/2001	Hui Jin	06618-637001 / CIT3220

CONFIRMATION NO. 6026

29690
CALIFORNIA INSTITUTE OF TECHNOLOGY
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PASADENA, CA 91125

POA ACCEPTANCE LETTER

OC000000050416791

Date Mailed: 10/17/2011

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 08/10/2011.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/hchristian/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

PTO/SB/96 (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: Robert J McEliece, Hui Jin, Aamod Khandekar

Application No./Patent No.: ~~09/891,102~~ D9186102 Filed/Issue Date: 5/18/2001

Titled: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

California Institute of Technology , a University
(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.

states that it is:

1. ☐ the assignee of the entire right, title, and interest in;

2. ☐ an assignee of less than the entire right, title, and interest in
(The extent (by percentage) of its ownership interest is _____ %); or

3. ☒ the assignee of an undivided interest in the entirety of (a complete assignment from one of the joint inventors was made)

the patent application/patent identified above, by virtue of either:

A. ☒ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 012225, Frame 0885, or for which a copy therefore is attached.

OR

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____
The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

2. From: _____ To: _____
The document was recorded in the United States Patent and Trademark Office at
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3. From: _____ To: _____
The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☒ As required by 37 CFR 3.73(b)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (*i.e.*, a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Fred Farina/	7/21/2011
Signature	Date
Fred Farina	Chief Innovation Officer, OTT
Printed or Typed Name	Title

PTO/SB/81 (01-09)
Approved for use through 11/30/2011. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

POWER OF ATTORNEY OR REVOCATION OF POWER OF ATTORNEY WITH A NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

Application Number	09/861,102
Filing Date	May 18, 2001
First Named Inventor	Robert J. McEliece
Title	Serial Concatenation of Interleaved...
Art Unit	
Examiner Name	
Attorney Docket Number	CIT 3220

I hereby revoke all previous powers of attorney given in the above-identified application.

☐ A Power of Attorney is submitted herewith.

OR

☒ I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith: **29690**

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

Practitioner(s) Name	Registration Number

Please recognize or change the correspondence address for the above-identified application to:

☒ The address associated with the above-mentioned Customer Number.

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the:

☐ Applicant/Inventor.

OR

☒ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) (Form PTO/SB/96) submitted herewith or filed on _____.

SIGNATURE of Applicant or Assignee of Record

Signature	/Fred Farina/	Date	June 1, 2011
Name	Fred Farina	Telephone	(626) 395-3058
Title and Company	Chief Innovation Officer, California Institute of Technology		

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☒ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Electronic Acknowledgement Receipt

EFS ID:	10709064
Application Number:	09861102
International Application Number:	
Confirmation Number:	6026
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Customer Number:	20985
Filer:	Hannah Dvorak-Carbone/Deborah Lewis
Filer Authorized By:	Hannah Dvorak-Carbone
Attorney Docket Number:	06618-637001 / CIT3220
Receipt Date:	10-AUG-2011
Filing Date:	18-MAY-2001
Time Stamp:	17:12:39
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	CIT-3220-POA.pdf	32361 dbf67ad178da19f7290c059acc20faac9b6436a3	no	1

Warnings:	
Information:	

2	Oath or Declaration filed	CIT-3220-Cert.pdf	432301 429f27798732804f514ac665da29c840b93d e1f8	no	2

Warnings:	
Information:	
Total Files Size (in bytes):	464662

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/96 (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

STATEMENT UNDER 37 CFR 3.73(b)

Applicant/Patent Owner: Robert J McEliece, Hui Jin, Aamod Khandekar

Application No./Patent No.: ~~09/861,102~~ 09861102 Filed/Issue Date: 5/18/2001

Titled:
SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

California Institute of Technology , a University
(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.

states that it is:

1. ☐ the assignee of the entire right, title, and interest in;

2. ☐ an assignee of less than the entire right, title, and interest in
(The extent (by percentage) of its ownership interest is _____ %); or

3. ☒ the assignee of an undivided interest in the entirety of (a complete assignment from one of the joint inventors was made)

the patent application/patent identified above, by virtue of either:

A. ☒ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 012225, Frame 0885, or for which a copy therefore is attached.

OR

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____
The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

2. From: _____ To: _____
The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

3. From: _____ To: _____
The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☒ As required by 37 CFR 3.73(b)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (*i.e.*, a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Fred Farina/ 7/21/2011
Signature Date

Fred Farina Chief Innovation Officer, OTL
Printed or Typed Name Title

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/861,102	05/18/2001	Hui Jin	06618-637001 / CIT3220

CONFIRMATION NO. 6026

20985
FISH & RICHARDSON P.C. (SD)
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

MISCELLANEOUS NOTICE

OC000000048336094

Date Mailed: 06/23/2011

A communication which cannot be delivered in electronic form has been mailed to the applicant.

Doc Code: N572

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
09/861,102	05/18/2001	Hui Jin	06618-637001 / CIT3220

CONFIRMATION NO. 6026

OC000000048336094

20985
FISH & RICHARDSON P.C. (SD)
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

Cc: CALIFORNIA INSTITUTE OF TECHNOLOGY
1200 E.CALIFORNIA BLVD.
M/C 201-85
PASADENA, CA 91125

Date Mailed: 06/22/11

DENIAL OF REQUEST FOR POWER OF ATTORNEY

The request for Power of Attorney filed 06/14/11 is acknowledged. However, the request cannot be granted at this time for the reason stated below.

- ☐ The Power of Attorney you provided did not comply with the new Power of Attorney rules that became effective on June 25, 2004. See 37 CFR 1.32.
- ☐ The revocation is not signed by the applicant, the assignee of the entire interest, or one particular principal attorney having the authority to revoke.
- ☑ The Power of Attorney is from an assignee and the Certificate required by 37 CFR 3.73(b) has not been received.
- ☐ The person signing for the assignee has omitted their empowerment to sign on behalf of the assignee.
- ☐ The inventor(s) is without authority to appoint attorneys since the assignee has intervened as provided by 37 CFR 3.71.
- ☐ The signature(s) of _____, a co-inventor in this application, has been omitted. The Power of Attorney will be entered upon receipt of confirmation signed by said co-inventor(s).
- ☐ The person(s) appointed in the Power of Attorney is not registered to practice before the U.S. Patent and Trademark Office.

Questions relating to this Notice should be directed to the Application Assistance Unit.

H. S

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

PTO/SB/81 (01-09)
Approved for use through 11/30/2011. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

POWER OF ATTORNEY OR REVOCATION OF POWER OF ATTORNEY WITH A NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

Application Number	09/861,102
Filing Date	May 18, 2001
First Named Inventor	Robert J. McEliece
Title	Serial Concatenation of Interleaved...
Art Unit	
Examiner Name	
Attorney Docket Number	CIT 3220

I hereby revoke all previous powers of attorney given in the above-identified application.

☐ A Power of Attorney is submitted herewith.

OR

☒ I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith: **29690**

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

Practitioner(s) Name	Registration Number

Please recognize or change the correspondence address for the above-identified application to:

☒ The address associated with the above-mentioned Customer Number.

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the:

☐ Applicant/Inventor.

OR

☒ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) (Form PTO/SB/96) submitted herewith or filed on _____.

SIGNATURE of Applicant or Assignee of Record

Signature	/Fred Farina/	Date	June 1, 2011
Name	Fred Farina	Telephone	(626) 395-3058
Title and Company	Chief Innovation Officer, California Institute of Technology		

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☒ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt	
EFS ID:	10303579
Application Number:	09861102
International Application Number:	
Confirmation Number:	6026
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Customer Number:	20985
Filer:	Hannah Dvorak-Carbone/Melinda Bakarbessy
Filer Authorized By:	Hannah Dvorak-Carbone
Attorney Docket Number:	06618-637001 / CIT3220
Receipt Date:	14-JUN-2011
Filing Date:	18-MAY-2001
Time Stamp:	18:14:00
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	CIT-3220.pdf	1467257 7c1a282f02e30bef795c01e21854e6a5d158a7cb	no	2
Warnings:					
Information:					

Total Files Size (in bytes):	1467257

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,116,710 B1
APPLICATION NO. : 09/861102
DATED : October 3, 2006
INVENTOR(S) : Hui Jin, Aamod Khandekar and Robert J. McEliece

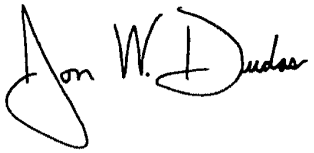
It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

At column **1**, line **8**, please amend the paragraph as follows:

This application claims the priority [[to]] of U.S. Provisional Application Ser. No. 60/205,095, filed on May 18, 2000, and [[to]] is a continuation-in-part of U.S. application Ser. No. 09/922,852, filed on Aug. 18, 2000 and entitled Interleaved Serial Concatenation Forming Turbo-Like Codes.

Signed and Sealed this

Twenty-second Day of July, 2008



JON W. DUDAS
Director of the United States Patent and Trademark Office

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	: Hui Jin et al.	Art Unit	: 2611
Patent No.	: 7,116,710	Examiner	: Dac V. Ha
Issue Date	: October 3, 2006		
Serial No.	: 09/861,102		
Filed	: May 18, 2001		
Title	: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES		

Attn.: Certificate of Corrections Branch
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL OF REQUEST FOR CERTIFICATE OF CORRECTION

Applicant hereby requests that a certificate of correction be issued for the above patent in accordance with the attached request.

One or more of the errors sought to be corrected were made by applicant, and a check for $100 is enclosed to cover the required fee of 37 C.F.R. § 1.20(a).

Please apply any charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

Date: May 23, 2008

/John F. Conroy, Reg. # 45,485/
John F. Conroy
Reg. No. 45,485

Fish & Richardson P.C.
12390 El Camino Real
San Diego, California 92130
Telephone: (858) 678-5070
Facsimile: (877) 769-7945

Staple Here Only

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. .: 7,116,710
APPLICATION NO .: 09/861,102
DATED .: OCTOBER 3, 2006
INVENTOR(S) .: HUI JIN, AAMOD KHANDEKAR AND ROBERT J. MCELIECE

It is certified that an error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

At column **1**, line **8**, please amend the paragraph as follows:

This application claims the priority [[to]] of U.S. Provisional Application Ser. No. 60/205,095, filed on May 18, 2000, and [[to]] is a continuation-in-part of U.S. application Ser. No. 09/922,852, filed on Aug. 18, 2000 and entitled Interleaved Serial Concatenation Forming Turbo-Like Codes.

MAILING ADDRESS OF SENDER:

John F. Conroy
Fish & Richardson P.C.
P.O. Box 1022
Minneapolis, Minnesota 55440-1022

Electronic Patent Application Fee Transmittal

Application Number:	09861102
Filing Date:	18-May-2001
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Filer:	John F. Conroy/Jennifer Payne
Attorney Docket Number:	06618-637001 / CIT3220
Filed as Small Entity	

Utility Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Certificate of correction	1811	1	100	100
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**100**

Electronic Acknowledgement Receipt	
EFS ID:	3354625
Application Number:	09861102
International Application Number:	
Confirmation Number:	6026
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Customer Number:	20985
Filer:	John F. Conroy/Jennifer Payne
Filer Authorized By:	John F. Conroy
Attorney Docket Number:	06618-637001 / CIT3220
Receipt Date:	23-MAY-2008
Filing Date:	18-MAY-2001
Time Stamp:	20:55:40
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$100
RAM confirmation Number	4247
Deposit Account	061050
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes) /Message Digest	Multi Part /.zip	Pages (if appl.)

1	Request for Certificate of Correction	06618-637001_CertCorr.pdf	79643 a1d753ed19a07813c665e837d3604e073289fe6f	no	2
Warnings:					
Information:					
2	Fee Worksheet (PTO-06)	fee-info.pdf	8191 2e3f8faf9254a14d81db310b2fc89bc510c63411	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	87834		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
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National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
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08/28/06

PART B – FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571) 273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 4 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Legibly mark-up with any corrections or use Block 1)

20985 7590 05/24/2006

FISH & RICHARDSON P.C.
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

08/29/2006 CNGUYEN3 00000003 09861102

01 FC:2501 700.00 OP
02 FC:8001 30.00 OP

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for express mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO, on the date indicated below.

EV740124458US	(Express Mail Label No.)
August 24, 2006	(Date of Deposit)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/861,102	05/18/2001	Hui Jin	06618-637001/CIT 3220	6026

TITLE OF INVENTION: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$700	$0	$700	08/24/2006

EXAMINER	ART UNIT	CLASS-SUBCLASS
HA, DAC V.	2611	375-240000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
[ ] Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
[ ] "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1. Fish & Richardson P.C.
2. _____
3. _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)
PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. Inclusion of assignee data is only appropriate when an assignment has been previously submitted to the USPTO or is being submitted under separate cover. Completion of this form is NOT a substitute for filing an assignment.
(A) NAME OF ASSIGNEE (B) RESIDENCE (CITY and STATE OR COUNTRY)
California Institute of Technology Pasadena, CA

Please check the appropriate assignee category or categories (will not be printed on the patent): [ ] individual [X] corporation or other private group entity [ ] government

4a. The following fee(s) are enclosed:
[X] Issue Fee
[X] Publication Fee (No small entity discount permitted)
[X] Advance Order - # of Copies 10

4b. Payment of Fee(s):
[X] A check in the amount of the fee(s) is enclosed.
[ ] Payment by credit card. Form PTO-2038 is attached.
[X] The Director is hereby authorized to charge the required fee(s), or credit any overpayment, to Deposit Account Number 06-1050 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
[X].a. Applicant claims SMALL ENTITY status. See 37 CFR 1.2.7. [ ]b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

The Director of the USPTO is requested to apply the Issue Fee and Publication Fee (if any) or to re-apply any previously paid issue fee to the application identified above.
NOTE: The issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant, a registered agent or; or the assignee or other party in interest as shown by the records of the Untied States Patent and Trademark Office.

(Authorized Signature) BY JOHN F. CONROY REG. NO. 45,485 (Date) August 24, 2006

Typed or Printed Name Scott C. Harris Registration No. 32,030

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

TRANSMIT THIS FORM WITH FEE(S)

Attorney's Docket No.: 06618-637001 / CIT3220

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	: Hui Jin et al.	Art Unit	: 2611
Serial No.	: 09/861,102	Examiner	: Dac V. Ha
Filed	: May 18, 2001	Conf. No.	: 6026
Title	: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES		

MAIL STOP ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Notice of Allowance Date: May 24, 2006

RESPONSE TO NOTICE OF ALLOWANCE

In response to the Notice of Allowance mailed May 24, 2006, enclosed are the following:

- Issue Fee Transmittal Form PTOL-85b (1 page);
- Transmittal of Formal Drawings (5 sheets);
- Application Data Sheet (5 pages); and
- A check in the amount of $730 for the required fee, including patent copies.

COMMENTS ON EXAMINER'S REASONS FOR ALLOWANCE

It is agreed that the limitations recited in the examiner's Reasons for Allowance are not taught or suggested by the art of

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Express Mail Label No. EV740124458US

August 24, 2006
Date of Deposit

record, and that the allowed independent claims 1, 11, 15, and 24 are distinguished from the cited prior art for at least the reasons stated in the Reasons for Allowance. Applicant does not concede that the stated reasons are the only grounds for patentability of the allowed claims, that the limitations excluded from the Reasons for Allowance are taught or suggested by the art of record, or that all of the limitations are necessary for patentability of the allowed claims or other claims directed to the disclosed subject matter. For example, other claims including different limitations are patentable over the cited prior art.

Please apply any charges or credits to our Deposit Account No. 06-1050.

Respectfully submitted,

Date: August 24, 2006

Scott C. Harris
Reg. No. 32,030

BY
JOHN F. CONROY
REG. NO. 45,485

Fish & Richardson P.C.
USPTO Customer No. **20985**
12390 El Camino Real
San Diego, CA 92130
Telephone: (858) 678-5070
Facsimile: (858) 678-5099

10654288.doc

Attorney's Docket No.: 06618-637001 / CIT3220

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	: Hui Jin et al.	Art Unit	: 2611
Serial No.	: 09/861,102	Examiner	: Dac V. Ha
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Title	: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES		

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL OF FORMAL DRAWINGS

In response to the Notice of Allowability mailed May 24, 2006, please substitute the enclosed 5 sheets of replacement formal drawings for the corresponding drawings presently in the application.

Please apply any charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

Date: August 24, 2006

Scott C. Harris
Reg. No. 32,030

BY
JOHN F. CONROY
REG. NO. 45,485

Fish & Richardson P.C.
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12390 El Camino Real
San Diego, CA 92130
Telephone: (858) 678-5070
Facsimile: (858) 678-5099

10659042.doc

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August 24, 2006
Date of Deposit

Appl. No.: 09/861,102
Notice of Allowance of May 24, 2006
Replacement Sheet

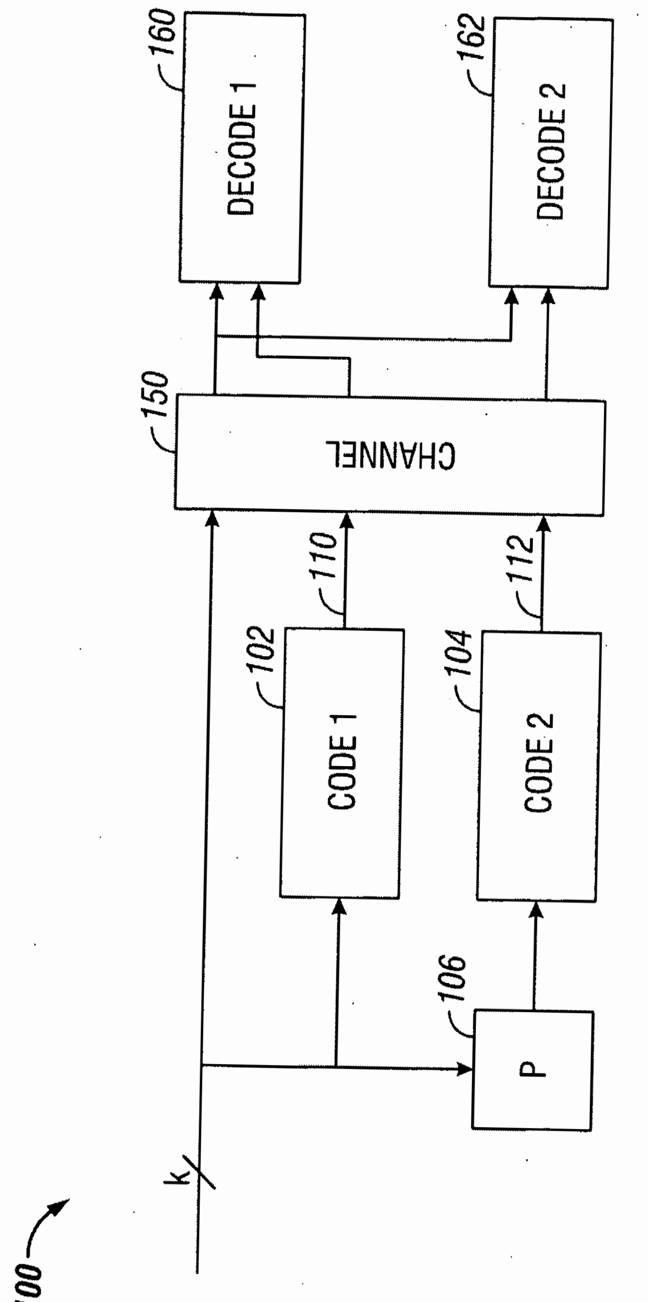

FIG. 1
(Prior Art)

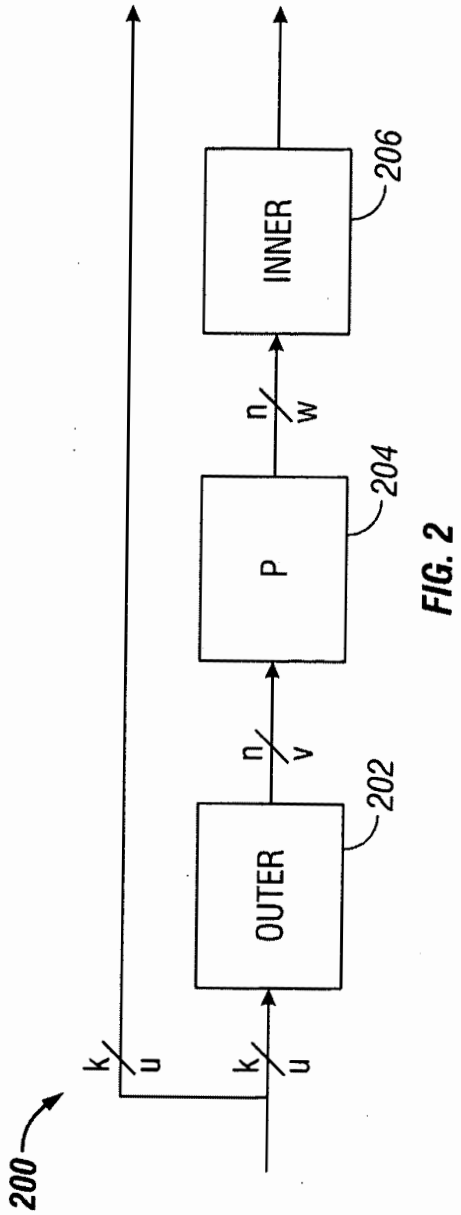

FIG. 2

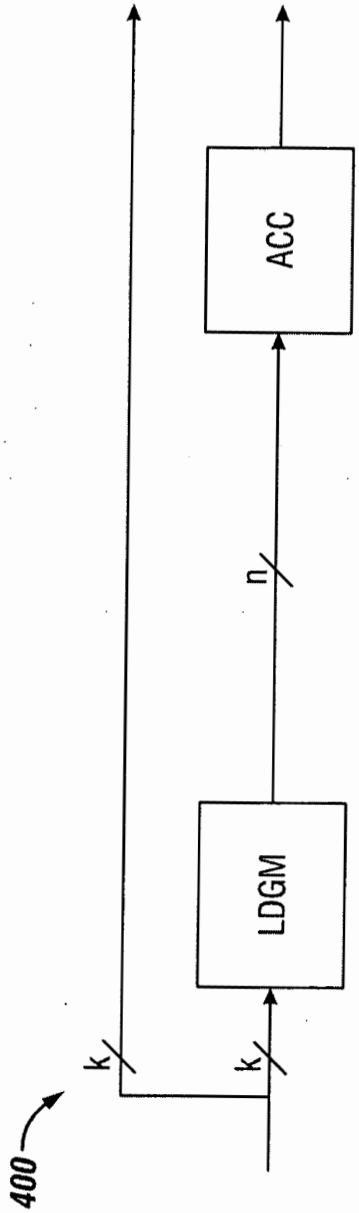

FIG. 4

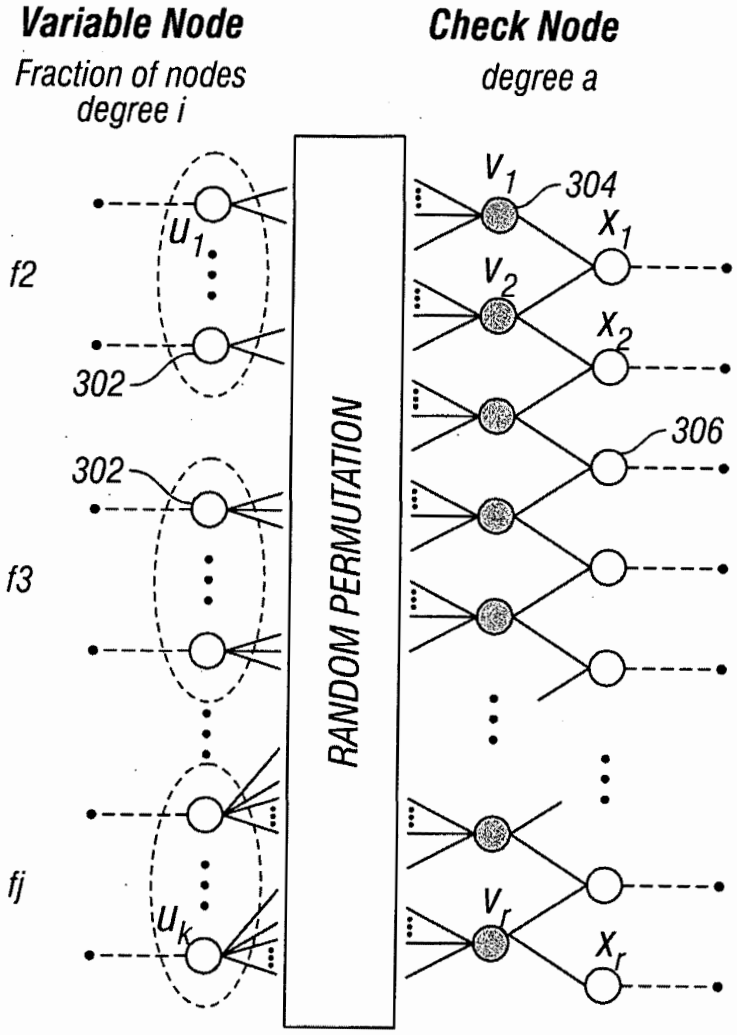
Variable Node
Fraction of nodes
degree i
Check Node
degree a
f2
f3
fj
302
302
304
306
RANDOM PERMUTATION

FIG. 3

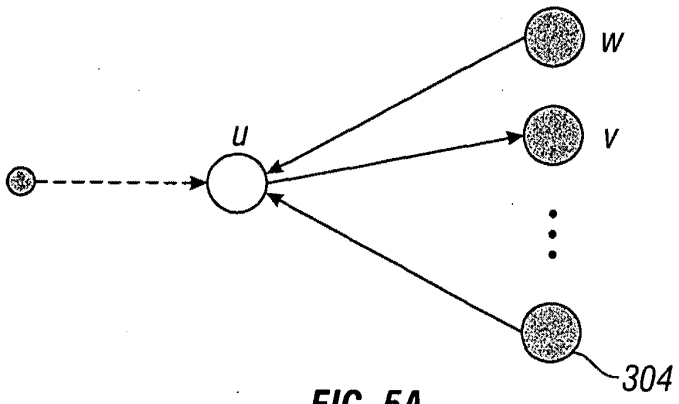

FIG. 5A

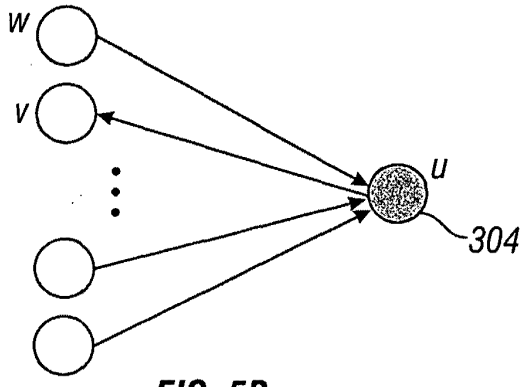

FIG. 5B

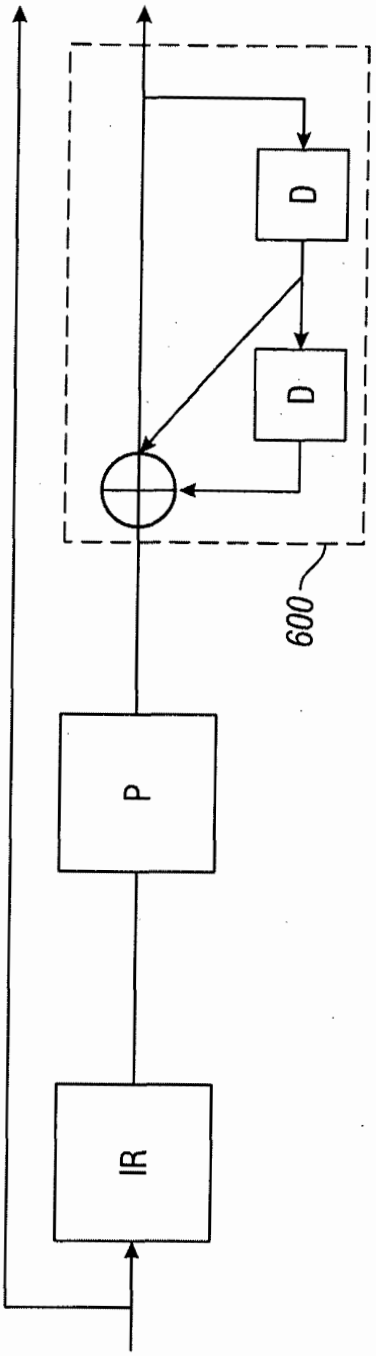

FIG. 6

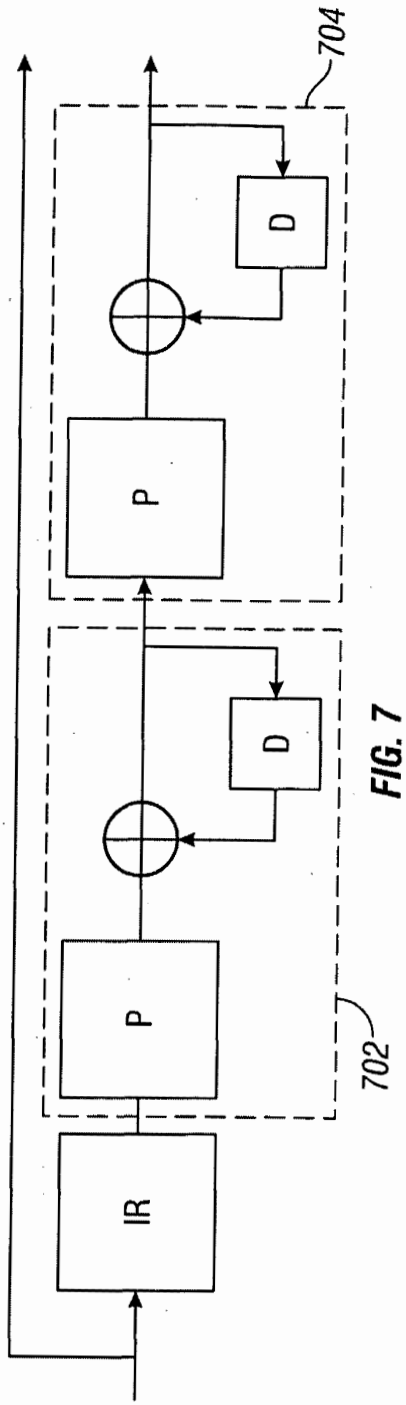

FIG. 7

PTO/SB/14 (06-06)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	06618-637001
	Application Number	09/861,102

Title of Invention	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Applicant Information:

Applicant 1

Applicant Authority ◉ Inventor ○ Legal Representative under 35 U.S.C. 117 ○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Hui		Jin	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Glen Gardner	State/Province	NJ	Country of Residence[i]	US

Citizenship under 37 CFR 1.41(b)[i] CN

Mailing Address of Applicant:

Address 1	2104 Spruce Hills Dr.
Address 2	

City	Glen Gardner	State/Province	NJ
Postal Code	08826	Country[i]	United States

Applicant 2

Applicant Authority ◉ Inventor ○ Legal Representative under 35 U.S.C. 117 ○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Aamod		Khandekar	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Pasadena	State/Province	CA	Country of Residence[i]	US

Citizenship under 37 CFR 1.41(b)[i] IN

Mailing Address of Applicant:

Address 1	1-88 Braun House
Address 2	

City	Pasadena	State/Province	CA
Postal Code	91125	Country[i]	United States

Applicant 3

Applicant Authority ◉ Inventor ○ Legal Representative under 35 U.S.C. 117 ○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Robert	J.	McEliece	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Pasadena	State/Province	CA	Country of Residence[i]	US

Approved for use through 07/31/2006. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	06618-637001
	Application Number	09/861,102
Title of Invention	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES	

Citizenship under 37 CFR 1.41(b) [i]	US			
Mailing Address of Applicant:				
Address 1	1086 Armada Dr.			
Address 2				
City	Pasadena	**State/Province**	CA	
Postal Code	91103	**Country**[i]	United States	

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	20985		
Email Address		Add Email	Remove Email

Application Information:

Title of the Invention	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES		
Attorney Docket Number	06618-637001	**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Suggested Class (if any)	375	**Sub Class (if any)**	24000
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)	5	**Suggested Figure for Publication (if any)**	

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application has not been and will not be the subject of an application filed in another country, or under a multilateral agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Enter either Customer Number or complete the Representative Name section below. If both sections are completed the Customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ US Representative (37 CFR 11.9)

PTO/SB/14 (06-03)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	06618-637001
	Application Number	09/861,102

Title of Invention	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

Customer Number	20985

Domestic Priority Information:

This section allows for the applicant to claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c). Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78(a)(2) or CFR 1.78(a)(4), and need not otherwise be made part of the specification.

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
09861102	non provisional of	60205095	2000-05-18
Prior Application Status	Patented		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
09861102		09922852	2000-08-18

Additional Domestic Priority Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

This section allows for the applicant to claim benefit of foreign priority and to identify any prior foreign application for which priority is not claimed. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(a).

Remove

Application Number	Country [i]	Parent Filing Date (YYYY-MM-DD)	Priority Claimed
			○ Yes ◉ No

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Assignee Information:

Providing this information in the application data sheet does not substitute for compliance with any requirement of part 3 of Title 37 of the CFR to have an assignment recorded in the Office.

Assignee 1

If the Assignee is an Organization check here. ☒

Organization Name	California Institute of Technology		
Mailing Address Information:			
Address 1	1200 East California Boulevard		
Address 2			
City	Pasadena	**State/Province**	CA
Country [i]	US	Postal Code	91125
Phone Number		Fax Number	
Email Address			

Additional Assignee Data may be generated within this form by selecting the **Add** button.

PTO/SB/14 (08-03)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	06618-637001
	Application Number	09/861,102
Title of Invention	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES	

Signature:

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 10.18. Please see 37 CFR 1.4(d) for the form of the signature.					
Signature	BY JOHN F. CONROY REG. NO. 45,485			Date (YYYY-MM-DD)	2006-08-24
First Name	Scott	Last Name	Harris	Registration Number	32,030

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

20985 7590 05/24/2006

FISH & RICHARDSON, PC
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

EXAMINER	
HA, DAC V	
ART UNIT	PAPER NUMBER
2611	

DATE MAILED: 05/24/2006

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/861,102	05/18/2001	Hui Jin	06618-637001 / CIT3220	6026

TITLE OF INVENTION: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1400	$0	$1400	08/24/2006

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE REFLECTS A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE APPLIED IN THIS APPLICATION. THE PTOL-85B (OR AN EQUIVALENT) MUST BE RETURNED WITHIN THIS PERIOD EVEN IF NO FEE IS DUE OR THE APPLICATION WILL BE REGARDED AS ABANDONED.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL should be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). Even if the fee(s) have already been paid, Part B - Fee(s) Transmittal should be completed and returned. If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PTOL-85 (Rev. 01/06) Approved for use through 04/30/2007.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

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20985 7590 05/24/2006

FISH & RICHARDSON, PC
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

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Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)

(Signature)

(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/861,102	05/18/2001	Hui Jin	06618-637001 / CIT3220	6026

TITLE OF INVENTION: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1400	$0	$1400	08/24/2006

EXAMINER	ART UNIT	CLASS-SUBCLASS
HA, DAC V	2611	375-240000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are enclosed:

☐ Issue Fee

☐ Publication Fee (No small entity discount permitted)

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4b. Payment of Fee(s):

☐ A check in the amount of the fee(s) is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Director is hereby authorized by charge the required fee(s), or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

The Director of the USPTO is requested to apply the Issue Fee and Publication Fee (if any) or to re-apply any previously paid issue fee to the application identified above.
NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/861,102	05/18/2001	Hui Jin	06618-637001 / CIT3220	6026

20985 7590 05/24/2006

FISH & RICHARDSON, PC
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

EXAMINER	
HA, DAC V	
ART UNIT	PAPER NUMBER
2611	

DATE MAILED: 05/24/2006

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 776 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 776 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

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Notice of Allowability	Application No.	Applicant(s)	
	09/861,102	JIN ET AL.	
	Examiner	Art Unit	
	Dac V. Ha	2611	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *IDS filed on 02/24/06*.

2. ☒ The allowed claim(s) is/are *1-16,22,23,17-21,35,24-31,33, renumbered as 1-33, respectively*.

3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date 02/24/06
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☒ Examiner's Amendment/Comment
8. ☐ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

Dac V. Ha
Primary Examiner
Art Unit: 2611

Allowable Subject Matter

1. This office action is in response to the IDS filed on 02/24/06.

2. Claims 1-31, 33, 35 are allowed.

3. The following is a statement of reasons for the indication of allowable subject matter:

Upon considering the supplemental IDS filed on 02/24/06, claims 1-31, 33, 35 are allowed for reason previously indicated.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dac V. Ha whose telephone number is 571-272-3040. The examiner can normally be reached on 5/4.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jay Patel can be reached on 571-272-3086. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Dac V. Ha
Primary Examiner
Art Unit 2611

Substitute Form PTO-1449 (Modified)	U.S. Department of Commerce Patent and Trademark Office	Attorney's Docket No. 06618-637001	Application No. 09/861,102
Information Disclosure Statement by Applicant (Use several sheets if necessary)		Applicant Hui Jin et al.	
(37 CFR §1.98(b))		Filing Date May 18, 2001	Group Art Unit ~~2634~~ 2611

U.S. Patent Documents

Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
DH	AA	2001/0025358	09/27/01	Eidson et al.			
	AB	5,392,299	02/21/95	Rhines et al.			
	AC	5,881,093	03/09/99	Wang et al.			
	AD	6,023,783	02/08/00	Divsalar et al.			
	AE	6,031,874	02/29/00	Chennakeshu et al.			
	AF	6,032,284	02/29/00	Bliss, William G.			
DH	AG	6,044,116	03/28/00	Wang			

Foreign Patent Documents or Published Foreign Patent Applications

Examiner Initial	Desig. ID	Document Number	Publication Date	Country or Patent Office	Class	Subclass	Translation Yes	Translation No

Other Documents (include Author, Title, Date, and Place of Publication)

Examiner Initial	Desig. ID	Document
DH	AH	Appendix A.1 "Structure of Parity Check Matrices of Standardized LDPC Codes," Digital Video Broadcasting (DVB) User guidelines for the second generation system for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications (DVB-S2) ETSI TR 102 376 V1.1.1. (2005-02) Technical Report, pp. 64
DH	AI	Benedetto et al., "Bandwidth efficient parallel concatenated coding schemes," Electronics Letters 31(24): 2067-2069 (November 23, 1995)
DH	AJ	Benedetto et al., "Soft-output decoding algorithms in iterative decoding of turbo codes," The Telecommunications and Data Acquisition (TDA) Progress Report 42-124 for NASA and California Institute of Technology Jet Propulsion Laboratory, Jospeh H. Yuen, Ed., pp. 63-87 (Feburary 15, 1996)
DH	AK	Benedetto et al., "Serial Concatenation of Interleaved Codes: Performace Analysis, Design, and Iterative Decoding," The Telecommunications and Data Acquisition (TDA) Progress Report 42-126 for NASA and California Institute of Technology Jet Propulsion Laboratory, Jospeh H. Yuen, Ed., pp. 1-26 (August 15, 1996)
DH	AL	Benedetto et al., "A Soft-Input Soft-Output Maximum A Posteriori (MAP) Module to Decode Parallel and Serial Concatenated Codes," The Telecommunications and Data Acquisition (TDA) Progress Report 42-127 for NASA and California Institute of Technology Jet Propulsion Laboratory, Jospeh H. Yuen, Ed., pp. 1-20 (November 15, 1996)
DH	AM	Benedetto et al., "Parallel Concatenated Trellis Coded Modulation," ICC '96, IEEE, pp. 974-978, (June 1996)

Examiner Signature	Date Considered
	05/11/06

EXAMINER: Initials citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Substitute Disclosure Form (PTO-1449)

Substitute Form PTO-1449 (Modified)	U.S. Department of Commerce Patent and Trademark Office	Attorney's Docket No. 06618-637001	Application No. 09/861,102
Information Disclosure Statement by Applicant (Use several sheets if necessary)		Applicant Hui Jin et al.	
(37 CFR §1.98(b))		Filing Date May 18, 2001	Group Art Unit ~~2634~~ 2611

Other Documents (include Author, Title, Date, and Place of Publication)

Examiner Initial	Desig. ID	Document
DH	AN	Benedetto, S. et al., "A Soft-Input Soft-Output APP Module for Iterative Decoding of Concatenated Codes," IEEE Communications Letters 1(1): 22-24 (January 1997)
DH	AO	Benedetto et al., "Serial Concatenation of interleaved codes: performance analysis, design, and iterative decoding," Proceedings from the IEEE 1997 International Symposium on Information Theory (ISIT), Ulm, Germany, p. 106, June 29-July 4, 1997
DH	AP	Benedetto et al., "Serial Concatenated Trellis Coded Modulation with Iterative Decoding," Proceedings from the IEEE 1997 International Symposium on Information Theory (ISIT), Ulm, Germany, p. 8, June 29-July 4, 1997
DH	AQ	Benedetto et al., "Design of Serially Concatenated Interleaved Codes," ICC 97, Montreal, Canada, pp. 710-714, (June 1997)
DH	AR	Berrou et al., "Near Shannon Limit Error-Correcting Coding and Decoding: Turbo Codes," ICC pp. 1064-1070 (1993)
DH	AS	Digital Video Broadcasting (DVB) User guidelines for the second generation system for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications (DVB-S2) ETSI TR 102 376 V1.1.1. (2005-02) Technical Report, pp. 1-104 (Feb. 15, 2005)
DH	AT	Divsalar et al., "Coding Theorems for 'Turbo-Like' Codes," Proceedings of the 36th Annual Allerton Conference on Communication, Control, and Computing, 23-25 September 1998, Allerton House, Monticello, Illinois, pp. 201-210 (1998)
DH	AU	Divsalar, D. et al., "Multiple Turbo Codes for Deep-Space Communications," The Telecommunications and Data Acquisition (TDA) Progress Report 42-121 for NASA and California Institute of Technology Jet Propulsion Laboratory, Jospeh H. Yuen, Ed., pp. 60-77 (May 15, 1995)
DH	AV	Divsalar, D. et al., "On the Design of Turbo Codes," The Telecommunications and Data Acquisition (TDA) Progress Report 42-123 for NASA and California Institute of Technology Jet Propulsion Laboratory, Jospeh H. Yuen, Ed., pp. 99-131 (November 15, 1995)
DH	AW	Divsalar, D. et al., "Low-rate turbo codes for Deep Space Communications," Proceedings from the 1995 IEEE International Symposium on Information Theory, 17-22 September 1995, Whistler, British Columbia, Canada, pp. 35
DH	AX	Divsalar, D. et al., "Turbo Codes for PCS Applications," ICC 95, IEEE, Seattle, WA, pp. 54-59 (June 1995)
DH	AY	Divsalar, D. et al., "Multiple Turbo Codes," MILCOM 95, San Diego, CA pp. 279-285 (November 5-6, 1995)
DH	AZ	Divsalar et al., "Effective free distance of turbo codes," Electronics Letters 32(5): 445-446 (February 29, 1996)
DH	BA	Divsalar, D. et al., "Hybrid Concatenated Codes and Iterative Decoding," Proceedings from the IEEE 1997 International Symposium on Information Theory (ISIT), Ulm, Germany, p. 10 (June 29-July 4, 1997)
DH	BB	Divsalar, D. et al., "Serial Turbo Trellis Coded Modulation with Rate-1 Inner Code," Proceedings from the IEEE 2000 International Symposium on Information Theory (ISIT), Italy, pp. 1-14 (June, 2000)
DH	BC	Jin et al., "Irregular Repeat - Accumulate Codes," 2nd International Symposium on Turbo Codes & Related Topics, 4-7 September 2000, Brest, France, 25 slides, (presented on 4 September 2000)
DH	BD	Jin et al., "Irregular Repeat – Accumulate Codes," 2nd International Symposium on Turbo Codes & Related Topics, 4-7 September 2000, Brest, France, pp. 1-8 (2000)

Examiner Signature	Date Considered
	05/11/05

EXAMINER: Initials citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Substitute Disclosure Form (PTO-1449)

Substitute Form PTO-1449 (Modified) U.S. Department of Commerce Patent and Trademark Office **Information Disclosure Statement by Applicant** (Use several sheets if necessary) (37 CFR §1.98(b))	Attorney's Docket No. 06618-637001	Application No. 09/861,102
	Applicant Hui Jin et al.	
	Filing Date May 18, 2001	Group Art Unit ~~2634~~ 2611

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
DH	BE	Richardson et al., "Design of capacity approaching irregular low density parity check codes," IEEE Trans. Inform. Theory 47: 619-637 (February 2001)
DH	BF	Richardson, T. and R. Urbanke, "Efficient encoding of low-density parity check codes," IEEE Trans. Inform. Theory 47: 638-656 (February 2001)

Examiner Signature	Date Considered
	05/11/06

EXAMINER: Initials citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Substitute Disclosure Form (PTO-1449)

Issue Classification	Application/Control No.	Applicant(s)/Patent under Reexamination	
	09/861,102	JIN ET AL.	
	Examiner	Art Unit	
	Dac V. Ha	2611	

ISSUE CLASSIFICATION

ORIGINAL			CROSS REFERENCE(S)							
CLASS	SUBCLASS	CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)							
375	240	375	262	265	341					
INTERNATIONAL CLASSIFICATION		341	51	102						
/		714	752							
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(Assistant Examiner) (Date)

(Legal Instruments Examiner) (Date)

Dac V. Ha 5/11/06

(Primary Examiner) (Date)

Total Claims Allowed: 33

O.G. Print Claim(s)	O.G. Print Fig.
15	2

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	(1)	32	31		61		91		121		151		181
2	2		~~32~~		62		92		122		152		182
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6	6		36		66		96		126		156		186
7	7		37		67		97		127		157		187
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11	(11)		41		71		101		131		161		191
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17	22		52		82		112		142		172		202
18	23		53		83		113		143		173		203
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Index of Claims

Application No.	Applicant(s)
09/861,102	JIN ET AL.
Examiner	**Art Unit**
Dac V. Ha	2634

✓	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim Final	Claim Original	Date 08/12/04	Date 02/11/05	Date 07/08/05	Date 10/02/05	Date 05/11/06	Date	Date	Date	Date
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FISH & RICHARDSON P.C.

Substitute Form PTO/SB/30 (5-03)

OIPE
FEB 2 4 2006
PATENT & TRADEMARK OFFICE

Request For Continued Examination (RCE) Transmittal

Address to:
Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Application Number	09/861,102
Filing Date	May 18, 2001
First Named Inventor	Hui Jin et al.
Group Art Unit	2634
Examiner Name	Dac V. Ha
Attorney Docket Number	06618-637001

This is a Request for Continued Examination (RCE) under 37 C.F.R. §1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. See Instruction Sheet for RCEs (not to be submitted to the USPTO) on page 2.

1. Submission required under 37 C.F.R. §1.114 Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s)

   a. ☐ Previously submitted. If a final Office action is outstanding, any amendment filed after the final Office action may be considered as a submission even if this box is not checked.

      i. ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____

      ii. ☐ Other _____

   b. ☒ Enclosed

      i. ☐ Amendment/Reply

      ii. ☐ Affidavit(s)/Declaration(s)

      iii. ☒ Information Disclosure Statement (IDS)

      iv. ☐ Other _____

2. Miscellaneous

   a. ☐ Suspension of action on the above-identified application is requested under 37 C.F.R. §1.103(c) for a period of _____ months. (Period of suspension shall not exceed 3 months; Fee under 37 C.F.R. §1.17(i) required)

   b. ☐ Other _____

3. Fee The RCE fee under 37 C.F.R. §1.17(e) is required by 37 C.F.R. §1.114 when the RCE is filed.

   a. ☒ The Director is hereby authorized to charge the following fees, or credit any overpayments, to Deposit Account No. 06-1050

      i. ☒ RCE fee required under 37 CFR 1.17(e)

      ii. ☐ Extension of time fee (37 CFR 1.136 and 1.17)

      iii. ☒ Other Any deficiencies

   b. ☐ Check in the amount of $ 395 enclosed

   c. ☐ Payment by credit card (Form PTO-2038 enclosed)

SIGNATURE OF APPLICANT, ATTORNEY OR AGENT REQUIRED

Name (Print/Type)	Scott C. Harris BY JOHN LOWRY REG # 45,148	*Registration No. (Attorney/Agent)*	32,030
Signature		*Date*	February 21, 2006

CERTIFICATE OF MAILING OR TRANSMISSION

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to Mail Stop RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 or facsimile transmitted to the U.S. Patent and Trademark Office on the date shown below.

Name (Print/Type)	Kelly M. Smith		
Signature	Kelly M. Smith	*Date*	February 21, 2006

02/27/2006 EFLORES 00000095 09861102

01 FC:2801 395.00 OP

Attorney's Docket No.: 06618-637001/CIT3220

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Hui Jin et al. Art Unit: 2634
Serial No.: 09/861,102 Examiner: Dac V. Ha
Filed : May 18, 2001
Title : SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

INFORMATION DISCLOSURE STATEMENT

Dear Sir:

Applicants call attention to the attached Information Disclosure Statement and documents listed on form PTO-1449.

This filing is being made before the receipt of a first Office action on the merits of the Request for Continued Examination. No fee is required.

The documents are in the English language; hence no concise explanation is necessary per Rule 98(a)(3).

CERTIFICATE OF MAILING BY FIRST CLASS MAIL

I hereby certify under 37 CFR §1.8(a) that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage on the date indicated below and is addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

February 21, 2006
Date of Deposit

Signature

Kelly M. Smith
Typed or Printed Name of Person Signing Certificate

Applicant makes known to the Examiner the following U.S. application, which is commonly owned and/or has one or more inventors in common:

U.S.S.N.	Filing Date	Docket No.
09/922,852	08/18/00	06618-503001

Consideration of the foregoing and enclosures plus the return of a copy of the enclosed form PTO-1449 with the Examiner's initials in the left column per MPEP 609 are earnestly solicited along with an early action on the merits.

Please apply any additional charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

Date: February 21, 2006

Scott C. Harris
Reg. No. 32,030

BY
JOHN F. CONROY
REG. NO. 45,485

Fish & Richardson P.C.
USPTO Customer No. **20985**
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Substitute Form PTO-1449 (Modified)	U.S. Department of Commerce Patent and Trademark Office	Attorney's Docket No. 06618-637001	Application No. 09/861,102
Information Disclosure Statement by Applicant (Use several sheets if necessary)		Applicant Hui Jin et al.	
(37 CFR §1.98(b))		Filing Date May 18, 2001	Group Art Unit 2634

U.S. Patent Documents

Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
	AA	2001/0025358	09/27/01	Eidson et al.			
	AB	5,392,299	02/21/95	Rhines et al.			
	AC	5,881,093	03/09/99	Wang et al.			
	AD	6,023,783	02/08/00	Divsalar et al.			
	AE	6,031,874	02/29/00	Chennakeshu et al.			
	AF	6,032,284	02/29/00	Bliss, William G.			
	AG	6,044,116	03/28/00	Wang			

Foreign Patent Documents or Published Foreign Patent Applications

Examiner Initial	Desig. ID	Document Number	Publication Date	Country or Patent Office	Class	Subclass	Translation Yes	Translation No

Other Documents (include Author, Title, Date, and Place of Publication)

Examiner Initial	Desig. ID	Document
	AH	Appendix A.1 "Structure of Parity Check Matrices of Standardized LDPC Codes," Digital Video Broadcasting (DVB) User guidelines for the second generation system for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications (DVB-S2) ETSI TR 102 376 V1.1.1. (2005-02) Technical Report, pp. 64
	AI	Benedetto et al., "Bandwidth efficient parallel concatenated coding schemes," Electronics Letters 31(24): 2067-2069 (November 23, 1995)
	AJ	Benedetto et al., "Soft-output decoding algorithms in iterative decoding of turbo codes," The Telecommunications and Data Acquisition (TDA) Progress Report 42-124 for NASA and California Institute of Technology Jet Propulsion Laboratory, Jospeh H. Yuen, Ed., pp. 63-87 (Feburary 15, 1996)
	AK	Benedetto et al., "Serial Concatenation of Interleaved Codes: Performace Analysis, Design, and Iterative Decoding," The Telecommunications and Data Acquisition (TDA) Progress Report 42-126 for NASA and California Institute of Technology Jet Propulsion Laboratory, Jospeh H. Yuen, Ed., pp. 1-26 (August 15, 1996)
	AL	Benedetto et al., "A Soft-Input Soft-Output Maximum A Posteriori (MAP) Module to Decode Parallel and Serial Concatenated Codes," The Telecommunications and Data Acquisition (TDA) Progress Report 42-127 for NASA and California Institute of Technology Jet Propulsion Laboratory, Jospeh H. Yuen, Ed., pp. 1-20 (November 15, 1996)
	AM	Benedetto et al., "Parallel Concatenated Trellis Coded Modulation," ICC '96, IEEE, pp. 974-978, (June 1996)

Examiner Signature	Date Considered

EXAMINER: Initials citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Substitute Disclosure Form (PTO-1449)

Substitute Form PTO-1449 (Modified) U.S. Department of Commerce Patent and Trademark Office	Attorney's Docket No. 06618-637001	Application No. 09/861,102
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))	Applicant Hui Jin et al.	
	Filing Date May 18, 2001	Group Art Unit 2634

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
	AN	Benedetto, S. et al., "A Soft-Input Soft-Output APP Module for Iterative Decoding of Concatenated Codes," IEEE Communications Letters 1(1): 22-24 (January 1997)
	AO	Benedetto et al., "Serial Concatenation of interleaved codes: performance analysis, design, and iterative decoding," Proceedings from the IEEE 1997 International Symposium on Information Theory (ISIT), Ulm, Germany, p. 106, June 29-July 4, 1997
	AP	Benedetto et al., "Serial Concatenated Trellis Coded Modulation with Iterative Decoding," Proceedings from the IEEE 1997 International Symposium on Information Theory (ISIT), Ulm, Germany, p. 8, June 29-July 4, 1997
	AQ	Benedetto et al., "Design of Serially Concatenated Interleaved Codes," ICC 97, Montreal, Canada, pp. 710-714, (June 1997)
	AR	Berrou et al., "Near Shannon Limit Error-Correcting Coding and Decoding: Turbo Codes," ICC pp. 1064-1070 (1993)
	AS	Digital Video Broadcasting (DVB) User guidelines for the second generation system for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications (DVB-S2) ETSI TR 102 376 V1.1.1. (2005-02) Technical Report, pp. 1-104 (Feb. 15, 2005)
	AT	Divsalar et al., "Coding Theorems for 'Turbo-Like' Codes," Proceedings of the 36th Annual Allerton Conference on Communication, Control, and Computing, 23-25 September 1998, Allerton House, Monticello, Illinois, pp. 201-210 (1998)
	AU	Divsalar, D. et al., "Multiple Turbo Codes for Deep-Space Communications," The Telecommunications and Data Acquisition (TDA) Progress Report 42-121 for NASA and California Institute of Technology Jet Propulsion Laboratory, Jospeh H. Yuen, Ed., pp. 60-77 (May 15, 1995)
	AV	Divsalar, D. et al., "On the Design of Turbo Codes," The Telecommunications and Data Acquisition (TDA) Progress Report 42-123 for NASA and California Institute of Technology Jet Propulsion Laboratory, Jospeh H. Yuen, Ed., pp. 99-131 (November 15, 1995)
	AW	Divsalar, D. et al., "Low-rate turbo codes for Deep Space Communications," Proceedings from the 1995 IEEE International Symposium on Information Theory, 17-22 September 1995, Whistler, British Columbia, Canada, pp. 35
	AX	Divsalar, D. et al., "Turbo Codes for PCS Applications," ICC 95, IEEE, Seattle, WA, pp. 54-59 (June 1995)
	AY	Divsalar, D. et al., "Multiple Turbo Codes," MILCOM 95, San Diego, CA pp. 279-285 (November 5-6, 1995)
	AZ	Divsalar et al., "Effective free distance of turbo codes," Electronics Letters 32(5): 445-446 (February 29, 1996)
	BA	Divsalar, D. et al., "Hybrid Concatenated Codes and Iterative Decoding," Proceedings from the IEEE 1997 International Symposium on Information Theory (ISIT), Ulm, Germany, p. 10 (June 29-July 4, 1997)
	BB	Divsalar, D. et al., "Serial Turbo Trellis Coded Modulation with Rate-1 Inner Code," Proceedings from the IEEE 2000 International Symposium on Information Theory (ISIT), Italy, pp. 1-14 (June, 2000)
	BC	Jin et al., "Irregular Repeat - Accumulate Codes," 2nd International Symposium on Turbo Codes & Related Topics, 4-7 September 2000, Brest, France, 25 slides, (presented on 4 September 2000)
	BD	Jin et al., "Irregular Repeat – Accumulate Codes," 2nd International Symposium on Turbo Codes & Related Topics, 4-7 September 2000, Brest, France, pp. 1-8 (2000)

Examiner Signature	Date Considered

EXAMINER: Initials citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Substitute Disclosure Form (PTO-1449)

Substitute Form PTO-1449 (Modified) U.S. Department of Commerce Patent and Trademark Office **Information Disclosure Statement by Applicant** (Use several sheets if necessary) (37 CFR §1.98(b))	Attorney's Docket No. 06618-637001	Application No. 09/861,102
	Applicant Hui Jin et al.	
	Filing Date May 18, 2001	Group Art Unit 2634

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
	BE	Richardson et al., "Design of capacity approaching irregular low density parity check codes," IEEE Trans. Inform. Theory 47: 619-637 (February 2001)
	BF	Richardson, T. and R. Urbanke, "Efficient encoding of low-density parity check codes," IEEE Trans. Inform. Theory 47: 638-656 (February 2001)

Examiner Signature	Date Considered

EXAMINER: Initials citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Substitute Disclosure Form (PTO-1449)

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

20985 7590 11/22/2005

FISH & RICHARDSON, PC
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

EXAMINER	
HA, DAC V	
ART UNIT	PAPER NUMBER
2634	

DATE MAILED: 11/22/2005

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/861,102	05/18/2001	Hui Jin	06618-637001 / CIT3220	6026

TITLE OF INVENTION: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1400	$0	$1400	02/22/2006

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE REFLECTS A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE APPLIED IN THIS APPLICATION. THE PTOL-85B (OR AN EQUIVALENT) MUST BE RETURNED WITHIN THIS PERIOD EVEN IF NO FEE IS DUE OR THE APPLICATION WILL BE REGARDED AS ABANDONED.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL should be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). Even if the fee(s) have already been paid, Part B - Fee(s) Transmittal should be completed and returned. If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

or Fax **(571) 273-2885**

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

20985 7590 11/22/2005

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P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)

(Signature)

(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/861,102	05/18/2001	Hui Jin	06618-637001 / CIT3220	6026

TITLE OF INVENTION: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1400	$0	$1400	02/22/2006

EXAMINER	ART UNIT	CLASS-SUBCLAS S
HA, DAC V	2634	375-240000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are enclosed:

☐ Issue Fee

☐ Publication Fee (No small entity discount permitted)

☐ Advance Order - # of Copies _____

4b. Payment of Fee(s):

☐ A check in the amount of the fee(s) is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Director is hereby authorized by charge the required fee(s), or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

The Director of the USPTO is requested to apply the Issue Fee and Publication Fee (if any) or to re-apply any previously paid issue fee to the application identified above.
NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/861,102	05/18/2001	Hui Jin	06618-637001 / CIT3220	6026

20985 7590 11/22/2005

FISH & RICHARDSON, PC
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

EXAMINER	
HA, DAC V	

ART UNIT	PAPER NUMBER
2634	

DATE MAILED: 11/22/2005

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 778 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 778 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571) 272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at (703) 305-8283.

PTOL-85 (Rev. 07/05) Approved for use through 04/30/2007.

Notice of Allowability	Application No.	Applicant(s)	
	09/861,102	JIN ET AL.	
	Examiner	Art Unit	
	Dac V. Ha	2634	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *amendment after Final filed on 10/21/05*.

2. ☒ The allowed claim(s) is/are *1-16, 22, 23, 17-21, 35, 24-31, 33, renumbered as 1-33, respectively*.

3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☐ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

Dac V. Ha
Primary Examiner
Art Unit: 2634

Allowable Subject Matter

1. This office action is in response to the amendment filed on 10/21/05.

2. Claims 1-31, 33, 35 are allowed.

3. The following is a statement of reasons for the indication of allowable subject matter:

Upon further consideration and comparison with prior art of record (closest reference, Laumen et al. – US 6,396,423), the examiner agrees with applicant's argument in the REMARKS on page 1. More particularly, Laumen, taking individually or collectively, fails to fairly teach particular method and apparatus for coding, as claimed, in independent claims 1, 11, 15 and 24 (claims 2-10,12-14,16-23, 25-31, 33, 35 depend therefrom). Thus, claims 1-31, 33, 35 are found to be novel and unobvious over prior art of record.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dac V. Ha whose telephone number is 571-272-3040. The examiner can normally be reached on 5/4.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Chin can be reached on 571-272-3056. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only.

For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Dac V. Ha
Primary Examiner
Art Unit 2634

Attorney's Docket No.: 06618-637001
Client's Ref. No.: CIT3220

OFFICIAL COMMUNICATION FACSIMILE:

OFFICIAL FAX NO: (571) 273-8300

Number of pages including this page 11

Applicant : Hui Jin et al.
Serial No. : 09/861,102
Filed : May 18, 2001

Art Unit : 2634
Examiner : Dac V. Ha

Title : SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Attached to this facsimile communication cover sheet is an Amendment in response to 7/21/2005 Office action, faxed this 21st day of October, 2005, to the United States Patent and Trademark Office.

Respectfully submitted,

Date: October 21, 2005

John F. Conroy
Reg. No. 45,485

Fish & Richardson P.C.
PTO Customer No. 20985
12390 El Camino Real
San Diego, California 92130
Telephone: (858) 678-5070
Fax: (858) 678-5099

SCH/JFC/cla

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DH

Issue Classification	Application/Control No.	Applicant(s)/Patent under Reexamination	
	09/861,102	JIN ET AL.	
	Examiner	Art Unit	
	Dac V. Ha	2634	

ISSUE CLASSIFICATION

ORIGINAL					CROSS REFERENCE(S)								
CLASS				SUBCLASS	CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)							
375				240	375	262	265	341					
INTERNATIONAL CLASSIFICATION					341	51	102						
H	0	4	B	1/66	714	752							
				/									
				/									
				/									
				/									

(Assistant Examiner) (Date)

L. Mc D 11/20/05
(Legal Instruments Examiner) (Date)

Dac V. Ha 11/02/05
(Primary Examiner) (Date)

Total Claims Allowed: 33

O.G. Print Claim(s)	O.G. Print Fig.
15	2

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	(1)	32	31		61		91		121		151		181
2	2		~~32~~		62		92		122		152		182
3	3	33	33		63		93		123		153		183
4	4		~~34~~		64		94		124		154		184
5	5	24	35		65		95		125		155		185
6	6		36		66		96		126		156		186
7	7		37		67		97		127		157		187
8	8		38		68		98		128		158		188
9	9		39		69		99		129		159		189
10	10		40		70		100		130		160		190
11	(11)		41		71		101		131		161		191
12	12		42		72		102		132		162		192
13	13		43		73		103		133		163		193
14	14		44		74		104		134		164		194
15	(15)		45		75		105		135		165		195
16	16		46		76		106		136		166		196
19	17		47		77		107		137		167		197
20	18		48		78		108		138		168		198
21	19		49		79		109		139		169		199
22	20		50		80		110		140		170		200
23	21		51		81		111		141		171		201
17	22		52		82		112		142		172		202
18	23		53		83		113		143		173		203
25	(24)		54		84		114		144		174		204
26	25		55		85		115		145		175		205
27	26		56		86		116		146		176		206
28	27		57		87		117		147		177		207
29	28		58		88		118		148		178		208
30	29		59		89		119		149		179		209
31	30		60		90		120		150		180		210

Search Notes

Application No.	Applicant(s)	
09/861,102	JIN ET AL.	
Examiner	**Art Unit**	
Dac V. Ha	2634	

SEARCHED

Class	Subclass	Date	Examiner
375	259,262, 265,285, 296, 341	8/11/2004	DH
	346, 348		
714	746, 752,		
	755, 756,		
	786, 792		
	794, 795		
	796		
341	51, 52,		
	56, 102		
	103	8/11/2004	DH
+ Update		7/8/05	DH
+ Update		10/25/05	DH

INTERFERENCE SEARCHED

Class	Subclass	Date	Examiner
Same	Above	10/25/05	DH

SEARCH NOTES (INCLUDING SEARCH STRATEGY)

	DATE	EXMR

Index of Claims

Application No.	Applicant(s)
09/861,102	JIN ET AL.
Examiner	Art Unit
Dac V. Ha	2634

✓	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim Final	Claim Original	Date 8/12/04	Date 02/11/05	Date 07/08/05	Date 11/02/05
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14	14	/	=	=	
15	15	✓	✓	✓	
16	16	O	O	O	
19	17	✓	✓	✓	
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23	21	✓	✓	✓	
17	22	O	O	O	
18	23	O	O	O	
25	24	✓	✓	✓	
26	25		O	O	
27	26		O	O	
28	27		✓	✓	
29	28			✓	
30	29			✓	
31	30			✓	
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Claim Final	Claim Original	Date
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Attorney's Docket No.: 06618-637001
Client's Ref. No.: CIT3220

OFFICIAL COMMUNICATION FACSIMILE:

OFFICIAL FAX NO: (571) 273-8300

Number of pages including this page 11

Applicant : Hui Jin et al.
Serial No. : 09/861,102
Filed : May 18, 2001

Art Unit : 2634
Examiner : Dac V. Ha

Title : SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Attached to this facsimile communication cover sheet is an Amendment in response to 7/21/2005 Office action, faxed this 21st day of October, 2005, to the United States Patent and Trademark Office.

Respectfully submitted,

Date: October 21, 2005

John F. Conroy
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SCH/JFC/cla

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Attorney's Docket No.: 06618-637001/CIT3220

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Hui Jin et al. Art Unit: 2634
Serial No.: 09/861,102 Examiner: Dac V. Ha
Filed : May 18, 2001
Title : SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

VIA FACSIMILE

Mail Stop AF
Commissioner For Patents
P.O. Box 1450
Alexandria, Va 22313-1450

AMENDMENT

In response to the Office action mailed July 21, 2005, please reconsider this application in light of the following:

Amendments to the claims reflected in the **Listing of Claims** beginning on page 2; and

Remarks beginning on page 9.

CERTIFICATE OF TRANSMISSION BY FACSIMILE

I hereby certify that this correspondence is being transmitted by facsimile to the Patent and Trademark Office on the date indicated below.

October 21, 2005
Date of Transmission

Signature

Carroll Allman
Typed or Printed Name of Person Signing Certificate

Listing of Claims

This listing of claims replaces all prior versions, and listings, of claims in the application:

1. (Previously Presented) A method of encoding a signal, comprising:

obtaining a block of data in the signal to be encoded;

partitioning said data block into a plurality of sub-blocks, each sub-block including a plurality of data elements;

first encoding the data block to form a first encoded data block, said first encoding including repeating the data elements in different sub-blocks a different number of times;

interleaving the repeated data elements in the first encoded data block; and

second encoding said first encoded data block using an encoder that has a rate close to one.

2. (Original) The method of claim 1, wherein said second encoding is via a rate 1 linear transformation.

3. (Original) The method of claim 1, wherein said first encoding is carried out by a first coder with a variable rate less than one, and said second encoding is carried out by a second coder with a rate substantially close to one.

4. (Original) The method of claim 3, wherein the second coder comprises an accumulator.

5. (Original) The method of claim 4, wherein the data elements comprises bits.

6. (Original) The method of claim 5, wherein the first coder comprises a repeater operable to repeat different sub-blocks a different number of times in response to a selected degree profile.

7. (Original) The method of claim 4, wherein the first coder comprises a low-density generator matrix coder and the second coder comprises an accumulator.

8. (Original) The method of claim 1, wherein the second encoding uses a transfer function of $1/(1+D)$.

9. (Original) The method of claim 1, wherein the second encoding uses a transfer function of $1/(1+D+D^2)$.

10. (Original) The method of claim 1, wherein said second encoding utilizes two accumulators.

11. (Previously Presented) A method of encoding a signal, comprising:

receiving a block of data in the signal to be encoded, the data block including a plurality of bits;

first encoding the data block such that each bit in the data block is repeated and two or more of said plurality of bits are repeated a different number of times in order to form a first encoded data block; and

second encoding the first encoded data block in such a way that bits in the first encoded data block are accumulated.

12. (Previously Presented) The method of claim 11, wherein the said second encoding is via a rate 1 linear transformation.

13. (Previously Presented) The method of claim 11, wherein the first encoding is via a low-density generator matrix transformation.

14. (Original) The method of claim 11, wherein the signal to be encoded comprises a plurality of data blocks of fixed size.

15. (Currently Amended) A coder comprising:

a first coder having an input configured to receive a stream of bits, said first coder operative to repeat said stream of bits irregularly and scramble the repeated bits; and

a second coder operative to further encode bits output from the first coder at a rate within [[50%]] 10% of one.

16. (Previously Presented) The coder of claim 15, wherein the stream of bits includes a data block, and wherein the first coder is operative to apportion said data block into a plurality of sub-blocks and to repeat bits in each sub-block a number of times, wherein bits in different sub-blocks are repeated a different number of times.

17. (Original) The coder of claim 15, wherein the first coder comprises a repeater having a variable rate and an interleaver.

18. (Original) The coder of claim 15, wherein the first coder comprises a low-density generator matrix coder.

19. (Original) The coder of claim 15, wherein the second coder comprises a rate 1 linear encoder.

20. (Original) The coder of claim 19, wherein the second coder comprises an accumulator.

21. (Original) The coder of claim 20, wherein the second coder further comprises a second accumulator.

22. (Original) The coder of claim 16, wherein the second coder comprises a recursive convolutional encoder with a transfer function of $1/(1 + D)$.

23. (Original) The coder of claim 16, wherein the second coder comprises a recursive convolutional encoder with a transfer function of $1/(1 + D + D^2)$.

24. (Currently Amended) A coding system comprising:

a first coder having an input configured to receive a stream of bits, said first coder operative to repeat said stream of bits irregularly and scramble the repeated bits;

a second coder operative to further encode bits output from the first coder at a rate within [[50%]] 10% of one in order to form an encoded data stream; and

a decoder operative to receive the encoded data stream and decode the encoded data stream using an iterative decoding technique.

25. (Previously Presented) The coding system of claim 24, wherein the first coder comprises a repeater operative to receive a data block including a plurality of bits from said stream of bits and to repeat bits in the data block a different number of times according to a selected a degree profile.

26. (Original) The coding system of claim 25, wherein the first coder comprises an interleaver.

27. (Original) The coding system of claim 24, wherein the first coder comprises a low-density generator matrix coder.

28. (Original) The coding system of claim 24, wherein the second coder comprises a rate 1 accumulator.

29. (Previously Presented) The coding system of claim 24, wherein the decoder is operative to decode the encoded data stream using a posterior decoding techniques.

30. (Previously Presented) The coding system of claim 24, wherein the decoder is operative to decode the encoded data stream based on a Tanner graph representation.

31. (Previously Presented) The coding system of claim 24, wherein the decoder is operative to decode the encoded data stream in linear time.

32. (Canceled)

33. (Previously Presented) The coding system of claim 24, wherein the second coder comprises a coder operative to further encode bits output from the first coder at a rate within 1% of one.

34. (Canceled)

35. (Currently Amended) The ~~coding system~~ coder of claim ~~10~~ 15, wherein the second coder comprises a coder operative to further encode bits output from the first coder at a rate within 1% of one.

REMARKS

Claims 1-31, 33, 34, and 35 are pending. Claims 32 and 34 have been canceled and their subject matter added to claims 15 and 24. Claim 35 has been amended to correct typographical informalities.

In the action mailed July 21, 2005, claims 1-14 were allowed and claims 16, 22, 23, 25, and 26 were objected to as dependent from a rejected base claim but otherwise allowable. Applicant acknowledges with appreciation the indication of patentable subject matter.

Applicant also thanks the Examiner for the courtesy of a telephone interview granted to Applicant's representative on August 29, 2005, at which time the Examiner explained that the rejections of claims 15 and 24 in the action mailed July 21, 2005 under 35 U.S.C. § 102(e) as anticipated by U.S. Patent No. 6,396,423 to Laumen et al. (hereinafter "Laumen") were made on the basis of 1/2 being "within 50% of one."

Although applicant does not agree that 1/2 is "within 50% of one," to advance prosecution, claims 15 and 24 have been amended to recite coders operative at a rate "within 10% of one."

Applicant submits that it is self-evident that 1/2 is not within 10% of one.

Attorney's Docket No.:06618-637001

This amendment is submitted in accordance with the provisions of 37 C.F.R. § 1.116, which permits the entry of amendments that reduce the number of issues for consideration on appeal. Since the present amendment cancels claims 32 and 34 and adds their subject matter to claims 15 and 24, the number of issues for consideration on appeal has been reduced. Further, please note that no further search and/or consideration of this subject matter is necessary since it was already present in the application before a final rejection was issued.

Applicant asks that all claims be allowed. No fees are believed due at this time. Please apply any charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

BY
JOHN F. CONROY
REG. NO. 45,485

Date: October 21, 2005

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PTO/SB/06 (08-03)
Approved for use through 7/31/2006. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD
Substitute for Form PTO-875

Application or Docket Number: 09/861,102

CLAIMS AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE	SMALL ENTITY FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY FEE
BASIC FEE (37 CFR 1.16(a))				$	OR		$
TOTAL CLAIMS (37 CFR 1.16(c))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(b))	minus 3 =	*	X $ =		OR	X $ =	
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(d))			+ $ =		OR	+ $ =	
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL		OR	TOTAL	

CLAIMS AS AMENDED – PART II

5/5/05

AMENDMENT	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE	SMALL ENTITY ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY ADDITIONAL FEE
Total (37 CFR 1.16(c))	* 35	Minus	** 31	= 4	X $25 =	100.00	OR	X $ =	
Independent (37 CFR 1.16(b))	* 4	Minus	*** 4	=	X $ =		OR	X $ =	
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(d))					+ $ =		OR	+ $ =	
					TOTAL ADD'L FEE	100.00	OR	TOTAL ADD'L FEE	

10/21/05

AMENDMENT	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
Total (37 CFR 1.16(c))	* 33	Minus	** 35	=	X $ =		OR	X $ =	
Independent (37 CFR 1.16(b))	* 4	Minus	*** 4	=	X $ =		OR	X $ =	
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(d))					+ $ =		OR	+ $ =	
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

AMENDMENT	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
Total (37 CFR 1.16(c))	*	Minus	**	=	X $ =		OR	X $ =	
Independent (37 CFR 1.16(b))	*	Minus	***	=	X $ =		OR	X $ =	
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(d))					+ $ =		OR	+ $ =	
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/861,102	05/18/2001	Hui Jin	06618-637001 / CIT3220	6026

20985 7590 07/21/2005

FISH & RICHARDSON, PC
12390 EL CAMINO REAL
SAN DIEGO, CA 92130-2081

EXAMINER	
HA, DAC V	

ART UNIT	PAPER NUMBER
2634	

DATE MAILED: 07/21/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	09/861,102	JIN ET AL.	
	Examiner	Art Unit	
	Dac V. Ha	2634	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 May 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-35* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *1-14,34 and 35* is/are allowed.

6)☒ Claim(s) *15,17-21,24 and 27-33* is/are rejected.

7)☒ Claim(s) *16,22,23,25 and 26* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. This office action is in response to the amendment filed on 05/05/05.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. **Claims 15, 17, 24** are rejected under 35 U.S.C. 102(e) as being anticipated by Laumen et al. (US 6,396,423) (hereafter Laumen).

Regarding claim 15, Laumen discloses the claimed subject matter "a first coder having an input configured to receive stream of bits, said first coder operative to repeat said stream of bits irregularly and scramble said the repeated bits; and a second coder operative to further encode bits output from the first coder at a rate within 50% of one" including a "first coder" (Fig. 2, elements 11-11a) and "second coder" (Fig. 2, element 12) wherein the first coder provides varied redundancy to the signal to be encoded (col. 4, lines 8-29).

Regarding claim 17, the "first coder" in Laumen inherently discloses "a repeater" (col. 4, line 13) and "interleaver" (Fig. 2, element 11a).

Regarding claim 24, see claim 15 above and Fig. 2, elements 21-22, col. 4, lines 49-54.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. **Claims 18-21, 27-33** are rejected under 35 U.S.C. 103(a) as being unpatentable over Laumen.

Regarding claims 18-21, 27-33, these claimed subject matter would have been obvious to one skilled in the art as design preference based upon the concept of coding from Laumen.

Allowable Subject Matter

6. **Claims 1-14, 34, 35** are allowed.

7. **Claims 16, 22, 23, 25, 26** are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Arguments

8. Applicant's arguments filed on 05/05/05 have been fully considered but they are not persuasive.

In the REMARKS, page 10, applicants have argued "In other words, Lauman's coder IQ does not encode bits at a rate close to one. Nevertheless, to advance

prosecution, Applicant has amended claims 15 and 24 to recite coders that encode bits at a rate within 50% of one. Since the highest transmission rate that Lauman describes is 1/2, and 1/2 is not within 50% of one, Applicant submits that claims 15 and 24 are not anticipated by Lauman. Thus, the rejections of claims 15 and 24, and their dependent claims, should be withdrawn." It is believed, however, the coding rates used in Lauman are "within 50% of one".

Conclusion

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dac V. Ha whose telephone number is 571-272-3040. The examiner can normally be reached on 5/4.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Chin can be reached on 571-272-3056. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Dac V. Ha
Primary Examiner
Art Unit 2634

Index of Claims

Application No.	Applicant(s)	
09/861,102	JIN ET AL.	
Examiner	**Art Unit**	
Dac V. Ha	2634	

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
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Claim		Date									
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Search Notes

Application No.	Applicant(s)	
09/861,102	JIN ET AL.	
Examiner	**Art Unit**	
Dac V. Ha	2634	

SEARCHED			
Class	Subclass	Date	Examiner
375	259,262, 265,285, 296, 341	8/11/2004	DH
	346, 348		
714	746, 752,		
	755, 756,		
	786, 792		
	794, 795		
	796		
341	51, 52,		
	56, 102		
	103	8/11/2004	DH
re Update		7/8/05	DH

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR

Attorney's Docket No.: 06618-637001
Client's Ref. No.: CIT3220

OFFICIAL COMMUNICATION FACSIMILE:

OFFICIAL FAX NO: (703) 872-9306

Number of pages including this page 12

Applicant : Hui Jin et al.
Serial No. : 09/861,102
Filed : May 18, 2001

Art Unit : 2634
Examiner : Dac V. Ha

Title : SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Attached to this facsimile communication cover sheet is an Amendment to the 03/04/2005 Office action and Transmittal Letter, faxed this 5th day of May, 2005, to the United States Patent and Trademark Office.

Respectfully submitted,

Date: May 5, 2005

BY JOHN F. CONROY REG. NO. 45,485

Scott C. Harris
Reg. No. 32,030

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Attorney's Docket No.: 06618-637001 / CIT3220

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	: Hui Jin et al.	Art Unit	: 2634
Serial No.	: 09/861,102	Examiner	: Dac V. Ha
Filed	: May 18, 2001		
Title	: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES		

VIA FACSIMILE

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL LETTER

Correspondence relating to this application is enclosed. The required fees are computed below. Please apply the excess claims fee to Deposit Account No. 06-1050. Please apply any charges not covered, or any credits, to Deposit Account No. 06-1050.

Total Claims	35	-	31	=	4	$100
Independent	4	-	4	=	0	$0
TOTAL FEE DUE						$100

Please apply the $100 fee to Deposit Account No. 06-1050.

Respectfully submitted,

BY JOHN F. CONROY REG. NO. 45,485

Date: May 5, 2005

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CERTIFICATE OF TRANSMISSION BY FACSIMILE
I hereby certify that this correspondence is being transmitted by facsimile to the Patent and Trademark Office on the date indicated below.

May 5, 2005
Date of Transmission

Signature

Carroll Allmon
Typed or Printed Name of Person Signing Certificate

Attorney's Docket No.: 06618-637001/CIT3220

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Hui Jin et al. Art Unit: 2634
Serial No.: 09/861,102 Examiner: Dac V. Ha
Filed : May 18, 2001
Title : SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

VIA FACSIMILE

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT

In response to the Office action mailed March 4, 2005, please reconsider this application in light of the following:

Amendments to the claims reflected in the **Listing of Claims** beginning on page 2.

Remarks beginning on page 9.

05/06/2005 CNGUYEN 00000065 061050 09861102
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CERTIFICATE OF TRANSMISSION BY FACSIMILE

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May 5, 2005
Date of Transmission

Signature

Carroll Allman
Typed or Printed Name of Person Signing Certificate

Listing of Claims

This listing of claims replaces all prior versions, and listings, of claims in the application:

1. (Currently Amended) A method of encoding a signal, comprising:

obtaining a block of data in the signal to be encoded;

partitioning said data block into a plurality of sub-blocks, each sub-block including a plurality of data elements;

first encoding the data block to form a first encoded data block, said first encoding including repeating the data elements in different sub-blocks a different number of times;

interleaving the repeated data elements in the first encoded data block; and

second encoding said first encoded data block using an encoder that has a rate close to one.

2. (Original) The method of claim 1, wherein said second encoding is via a rate 1 linear transformation.

3. (Original) The method of claim 1, wherein said first encoding is carried out by a first coder with a variable rate less than one, and said second encoding is carried out by a second coder with a rate substantially close to one.

4. (Original) The method of claim 3, wherein the second coder comprises an accumulator.

5. (Original) The method of claim 4, wherein the data elements comprises bits.

6. (Original) The method of claim 5, wherein the first coder comprises a repeater operable to repeat different sub-blocks a different number of times in response to a selected degree profile.

7. (Original) The method of claim 4, wherein the first coder comprises a low-density generator matrix coder and the second coder comprises an accumulator.

8. (Original) The method of claim 1, wherein the second encoding uses a transfer function of $1/(1+D)$.

9. (Original) The method of claim 1, wherein the second encoding uses a transfer function of $1/(1+D+D^2)$.

10. (Original) The method of claim 1, wherein said second encoding utilizes two accumulators.

11. (Previously Presented) A method of encoding a signal, comprising:

receiving a block of data in the signal to be encoded, the data block including a plurality of bits;

first encoding the data block such that each bit in the data block is repeated and two or more of said plurality of bits are repeated a different number of times in order to form a first encoded data block; and

second encoding the first encoded data block in such a way that bits in the first encoded data block are accumulated.

12. (Previously Presented) The method of claim 11, wherein the said second encoding is via a rate 1 linear transformation.

13. (Previously Presented) The method of claim 11, wherein the first encoding is via a low-density generator matrix transformation.

14. (Original) The method of claim 11, wherein the signal to be encoded comprises a plurality of data blocks of fixed size.

15. (Currently Amended) A coder comprising:

a first coder having an input configured to receive a stream of bits, said first coder operative to repeat said stream of bits irregularly and scramble the repeated bits; and

a second coder operative to further encode bits output from the first coder at a rate ~~close to~~ within 50% of one.

16. (Previously Presented) The coder of claim 15, wherein the stream of bits includes a data block, and wherein the first coder is operative to apportion said data block into a plurality of sub-blocks and to repeat bits in each sub-block a number of times, wherein bits in different sub-blocks are repeated a different number of times.

17. (Original) The coder of claim 15, wherein the first coder comprises a repeater having a variable rate and an interleaver.

18. (Original) The coder of claim 15, wherein the first coder comprises a low-density generator matrix coder.

19. (Original) The coder of claim 15, wherein the second coder comprises a rate 1 linear encoder.

20. (Original) The coder of claim 19, wherein the second coder comprises an accumulator.

21. (Original) The coder of claim 20, wherein the second coder further comprises a second accumulator.

22. (Original) The coder of claim 16, wherein the second coder comprises a recursive convolutional encoder with a transfer function of $1/(1 + D)$.

23. (Original) The coder of claim 16, wherein the second coder comprises a recursive convolutional encoder with a transfer function of $1/(1 + D + D^2)$.

24. (Currently Amended) A coding system comprising:

a first coder having an input configured to receive a stream of bits, said first coder operative to repeat said stream of bits irregularly and scramble the repeated bits;

a second coder operative to further encode bits output from the first coder at a rate ~~close to~~ within 50% of one in order to form an encoded data stream; and

a decoder operative to receive the encoded data stream and decode the encoded data stream using an iterative decoding technique.

25. (Previously Presented) The coding system of claim 24, wherein the first coder comprises a repeater operative to receive a data block including a plurality of bits from said stream of bits and to repeat bits in the data block a different number of times according to a selected ~~a~~ degree profile.

26. (Original) The coding system of claim 25, wherein the first coder comprises an interleaver.

27. (Original) The coding system of claim 24, wherein the first coder comprises a low-density generator matrix coder.

28. (Original) The coding system of claim 24, wherein the second coder comprises a rate 1 accumulator.

29. (Previously Presented) The coding system of claim 24, wherein the decoder is operative to decode the encoded data stream using a posterior decoding techniques.

30. (Previously Presented) The coding system of claim 24, wherein the decoder is operative to decode the encoded data stream based on a Tanner graph representation.

31. (Previously Presented) The coding system of claim 24, wherein the decoder is operative to decode the encoded data stream in linear time.

32. (New) The coding system of claim 24, wherein the second coder comprises a coder operative to further encode bits output from the first coder at a rate within 10% of one.

33. (New) The coding system of claim 24, wherein the second coder comprises a coder operative to further encode bits output from the first coder at a rate within 1% of one.

34. (New) The coding system of claim 10, wherein the second coder comprises a coder operative to further encode bits output from the first coder at a rate within 10% of one.

35. (New) The coding system of claim 10, wherein the second coder comprises a coder operative to further encode bits output from the first coder at a rate within 1% of one.

Attorney's Docket No.: 06618-637001/CIT3220

REMARKS

Claims 1-35 are pending. Claims 32-35 have been added. Claims 15 and 24 have been amended. Support for the new claims and the claim amendments can be found in para. [0021].

In the action mailed March 4, 2005, claims 1-14 were allowed and claims 16, 22, 23, 25, and 26 were objected to as dependent from a rejected base claim but otherwise allowable. Applicant gratefully acknowledges the indication that these claims are patentable.

Claims 15 and 24 were rejected under 35 U.S.C. § 102(e) as anticipated by U.S. Patent No. 6,396,423 to Laumen et al. (hereinafter "Laumen").

The rejection of claims 15 and 24 contends that Lauman's coder 12 encodes bits "at a rate close to one." Applicant respectfully disagrees.

In particular, Lauman describes that coding in function block 12

> "takes place, e.g., using a convolutional code or a turbo code. Coders 12 of this type usually have transmission rates of 1/2, 1/3, 1/4, etc., i.e., from one input bit, two output bits, or three or four output bits, are generated. The coded bit rate coming from inner coder 12 is thus always double, triple, or quadruple the data rate made available by block coder 11."

In other words, Lauman's coder 12 does not encode bits "at a rate close to one." Nevertheless, to advance prosecution, Applicant has amended claims 15 and 24 to recite coders that encode bits at a rate within 50% of one.

Since the highest transmission rate that Lauman describes is 1/2, and 1/2 is not within 50% of one, Applicant submits that claims 15 and 24 are not anticipated by Lauman. Thus, the rejections of claims 15 and 24, and their dependent claims, should be withdrawn.

Applicant asks that all claims be allowed. Please apply excess claim fees to Deposit Account No. 06-1050. Please apply any other charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

BY JOHN F. CONROY REG. NO. 45,485

Date: May 5, 2005

Scott C. Harris
Reg. No. 32,030

Fish & Richardson P.C.
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PTO/SB/06 (08-03)
Approved for use through 7/31/2006. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD
Substitute for Form PTO-875

Application or Docket Number: 09/861,702

CLAIMS AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE	SMALL ENTITY FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY FEE
BASIC FEE (37 CFR 1.16(a))				$____	OR		$____
TOTAL CLAIMS (37 CFR 1.16(c))	minus 20 =	*	X $____ =		OR	X $____ =	
INDEPENDENT CLAIMS (37 CFR 1.16(b))	minus 3 =	*	X $____ =		OR	X $____ =	
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(d))			+ $____ =		OR	+ $____ =	
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL		OR	TOTAL	

CLAIMS AS AMENDED – PART II

5/5/05

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE	SMALL ENTITY ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY ADDITIONAL FEE
	Total (37 CFR 1.16(c))	* 35	Minus	** 31	= 4	X $25 =	100.00	OR	X $____ =	
	Independent (37 CFR 1.16(b))	* 4	Minus	*** 4	=	X $____ =		OR	X $____ =	
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(d))					+ $____ =		OR	+ $____ =	
						TOTAL ADD'L FEE	100.00	OR	TOTAL ADD'L FEE	

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE	SMALL ENTITY ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY ADDITIONAL FEE
	Total (37 CFR 1.16(c))	*	Minus	**	=	X $____ =		OR	X $____ =	
	Independent (37 CFR 1.16(b))	*	Minus	***	=	X $____ =		OR	X $____ =	
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(d))					+ $____ =		OR	+ $____ =	
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE	SMALL ENTITY ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY ADDITIONAL FEE
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	Independent (37 CFR 1.16(b))	*	Minus	***	=	X $____ =		OR	X $____ =	
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(d))					+ $____ =		OR	+ $____ =	
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/861,102	05/18/2001	Hui Jin	06618-637001 / CIT3220	6026

20985 7590 03/04/2005

FISH & RICHARDSON, PC
12390 EL CAMINO REAL
SAN DIEGO, CA 92130-2081

EXAMINER	
HA, DAC V	
ART UNIT	**PAPER NUMBER**
2634	

DATE MAILED: 03/04/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	09/861,102	JIN ET AL.	
	Examiner	Art Unit	
	Dac V. Ha	2634	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 November 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-31* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *1-14* is/are allowed.

6)☒ Claim(s) *15,17-21,24 and 27-31* is/are rejected.

7)☒ Claim(s) *16,22,23,25 and 26* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. This office action is in response to the amendment filed on 11/24/04.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. **Claims 15, 17, 24** are rejected under 35 U.S.C. 102(e) as being anticipated by Laumen et al. (US 6,396,423) (hereafter Laumen).

Regarding claim 15, Laumen discloses the claimed subject matter "a first coder having an input configured to receive stream of bits, said first coder operative to repeat said stream of bits irregularly and scramble said the repeated bits; and a second coder operative to further encode bits output from the first coder at a rate close to one" including a "first coder" (Fig. 2, elements 11-11a) and "second coder" (Fig. 2, element 12) wherein the first coder provides varied redundancy to the signal to be encoded (col. 4, lines 8-29).

Regarding claim 17, the "first coder" in Laumen inherently discloses "a repeater" (col. 4, line 13) and "interleaver" (Fig. 2, element 11a).

Regarding claim 24, see claim 15 above and Fig. 2, elements 21-22, col. 4, lines 49-54.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. **Claims 18-21, 27-31** are rejected under 35 U.S.C. 103(a) as being unpatentable over Laumen.

Regarding claims 18-21, 27-31, these claimed subject matter would have been obvious to one skilled in the art as design preference based upon the concept of coding from Laumen.

Allowable Subject Matter

6. **Claims 1-14** allowed.

7. **Claims 16, 22, 23, 25, 26** objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dac V. Ha whose telephone number is 571-273-3040. The examiner can normally be reached on 5/4.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Chin can be reached on 571-272-3056. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Dac V. Ha
Examiner
Art Unit 2634

Notice of References Cited	Application/Control No. 09/861,102	Applicant(s)/Patent Under Reexamination JIN ET AL.	
	Examiner Dac V. Ha	Art Unit 2634	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-6,396,423	05-2002	Laumen et al.	341/95
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims

Application No.	Applicant(s)	
09/861,102	JIN ET AL.	
Examiner	**Art Unit**	
Dac V. Ha	2634	

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	+	Restricted	I	Interference	O	Objected

Claim		Date									
Final	Original	8/12/04	02/11/05								
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2634

Attorney's Docket No.: 06618-637001 / CIT3220

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	: Hui Jin et al.	Art Unit	: 2634
Serial No.	: 09/861,102	Examiner	: Dac V. Ha
Filed	: May 18, 2001	Confirmation No.	: 6036
Title	: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES		

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT IN REPLY TO ACTION OF SEPTEMBER 3, 2004

Please amend the above-identified application as follows:

CERTIFICATE OF MAILING BY FIRST CLASS MAIL

I hereby certify under 37 CFR §1.8(a) that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage on the date indicated below and is addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

November 22, 2004
Date of Deposit

Signature

Susan Regan
Typed or Printed Name of Person Signing Certificate

Amendments to the Specification:

Please replace paragraph [0001] beginning at page 1 with the following amended paragraph:

This application claims priority to U.S. Provisional Application Serial No. 60/205,095, filed on May 18, 2000, and to U.S. Application Serial No. 09/922,852, filed on August 18, 2000 and entitled Interleaved Serial Concatenation Forming Turbo-Like Codes.

Amendments to the Claims:

This listing of claims replaces all prior versions and listings of claims in the application:

Listing of Claims:

1. (Currently amended) A method of encoding a signal, comprising:

obtaining a block of data in the signal to be encoded;

partitioning said data block into a plurality of sub-blocks, each sub-block including a plurality of data elements;

first encoding ~~said~~ the data block to form a first encoded data block, said first encoding including repeating the data elements in different sub-blocks a different number of times

interleaving the repeated data elements in the first encoded data block; and

second encoding said first encoded data block using an encoder that has a rate close to one.

2. (Original) The method of claim 1, wherein said second encoding is via a rate 1 linear transformation.

3. (Original) The method of claim 1, wherein said first encoding is carried out by a first coder with a variable rate

less than one, and said second encoding is carried out by a second coder with a rate substantially close to one.

4. (Original) The method of claim 3, wherein the second coder comprises an accumulator.

5. (Original) The method of claim 4, wherein the data elements comprises bits.

6. (Original) The method of claim 5, wherein the first coder comprises a repeater operable to repeat different sub-blocks a different number of times in response to a selected degree profile.

7. (Original) The method of claim 4, wherein the first coder comprises a low-density generator matrix coder and the second coder comprises an accumulator.

8. (Original) The method of claim 1, wherein the second encoding uses a transfer function of $1/(1+D)$.

9. (Original) The method of claim 1, wherein the second encoding uses a transfer function of $1/(1+D+D^2)$.

10. (Original) The method of claim 1, wherein said second encoding utilizes two accumulators.

11. (Currently amended) A method of encoding a signal, comprising:

receiving a block of data in the signal to be encoded, ~~said~~ the data block including a plurality of bits;

first encoding the data block such that each bit in the data block is repeated and two or more of said plurality of bits are repeated a different number of times in order to form a first encoded data block; and

second encoding the first encoded data block in such a way that ~~the~~ bits in the first encoded data block are accumulated.

12. (Currently amended) The method of claim 11, wherein the said second ~~coding~~ encoding is via a rate 1 linear transformation.

13. (Currently amended) The method of claim 11, wherein the first ~~coding~~ encoding is via a low-density generator matrix transformation.

14. (Original) The method of claim 11, wherein the signal to be encoded comprises a plurality of data blocks of fixed size.

15. (Currently amended) A coder comprising:

a first coder having an input configured to receive a stream of bits, said first coder operative to repeat said stream of bits irregularly and scramble ~~said~~ the repeated bits; and

a second coder operative to further encode bits output from the first coder at a rate close to one.

16. (Currently amended) The coder of claim 15, wherein the stream of bits includes a data block, and wherein the first coder is operative to apportion said data block into a plurality of sub-blocks and to repeat bits in ~~the~~ each sub-block a number of times, wherein bits in different sub-blocks are repeated a different number of times.

17. (Original) The coder of claim 15, wherein the first coder comprises a repeater having a variable rate and an interleaver.

18. (Original) The coder of claim 15, wherein the first coder comprises a low-density generator matrix coder.

19. (Original) The coder of claim 15, wherein the second coder comprises a rate 1 linear encoder.

20. (Original) The coder of claim 19, wherein the second coder comprises an accumulator.

21. (Original) The coder of claim 20, wherein the second coder further comprises a second accumulator.

22. (Original) The coder of claim 16, wherein the second coder comprises a recursive convolutional encoder with a transfer function of $1/(1 + D)$.

23. (Original) The coder of claim 16, wherein the second coder comprises a recursive convolutional encoder with a transfer function of $1/(1 + D + D^2)$.

24. (Currently amended) A coding system comprising:

a first coder having an input configured to receive a stream of bits, said first coder operative to repeat said stream of bits irregularly and scramble ~~said~~ the repeated bits;

a second coder operative to further encode ~~the~~ bits output from the first coder at a rate close to one in order to form an encoded data stream; and

a decoder operative to receive the encoded data stream and decode the encoded data stream using an iterative decoding technique.

25. (Currently amended) The coding system of claim 24, wherein the first coder comprises a repeater operative to receive a data block including a plurality of bits from said stream of bits and to repeat bits in the data block a different number of times according to a selected ~~a~~ degree profile.

26. (Original) The coding system of claim 25, wherein the first coder comprises an interleaver.

27. (Original) The coding system of claim 24, wherein the first coder comprises a low-density generator matrix coder.

28. (Original) The coding system of claim 24, wherein the second coder comprises a rate 1 accumulator.

29. (Currently amended) The coding system of claim 24, wherein the decoder is operative to decode the encoded data stream using a posterior decoding techniques.

30. (Currently amended) The coding system of claim 24, wherein the decoder is operative to decode the encoded data stream based on a Tanner graph representation.

31. (Currently amended) The coding system of claim 24, wherein the decoder is operative to decode the encoded data stream in linear time.

REMARKS

Reconsideration and allowance of the above-referenced application are respectfully requested.

Upon entry of this amendment, claims 1-31 will remain in the application.

Allowed Claims

The indication that claims 1-10 are allowed and claims 16, 22, and 23 are allowable is appreciatively noted.

Claim Objections

Claims 1-31 were objected to for informalities. The claims have been amended to overcome the objections.

Claim Rejections - 35 USC § 102

Claims 11-12, 14, 15, 17, 19-21, 24-26, 28, 29, and 31 were rejected under 35 U.S.C. 102(e) as being allegedly anticipated by Wang (U.S. Patent No. 6,014,411). Applicant traverses the rejections.

The Action asserts that the BIT REPETITION and SYSTEMATIC INTERLEAVER elements shown in Figure 5 of Wang "repeat" "bits irregularly and scramble the repeated bits". Applicant disagrees with this characterization of Wang.

The encoding arrangement shown in Figure 5 of Wang uses a fixed repetition rate "r". As described in Wang at column 15, lines 30-32,

"The encoder bit partitioning uses a repetition rate r repeating the systematic sequence data bits prior to encoding."

Also, at column 15, lines 55-61,

"Referring particularly to FIG. 5, the encoder input of one block of N bits dk is partitioned by a bit partitioner using a rate of r, in which each input bit is simply divided into r

output bits during each input bit time interval. As each bit of the input block is received, the bit is duplicated r times, each of which takes 1/r input bit time. The encoder may operate at a r-times faster clock rate."

There is no indication in Wang that the rate r is irregular. Rather, all bits are repeated the same number of times, i.e., regularly.

Each of independent claims 11, 15, and 24 recites that in a first encoding, bits are repeated "irregularly" or "a different number of times". Accordingly, Applicant submits that claims 11, 15, and 24, and their dependencies, are allowable.

Claim Rejections - 35 USC § 103

Claims 13, 18, and 27 were rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Wang. Claims 13, 18, and 27 depend from allowable independent claims 11, 15, and 24. Accordingly, Applicant submits that these claims should be allowed for the reasons given above and for their additional limitations.

Conclusion

It is believed that all of the pending claims have been addressed in this paper. However, failure to address a specific rejection, issue, or comment, does not signify agreement with or concession of that rejection, issue or comment. In addition, because the arguments made above are not intended to be exhaustive, there may be reasons for patentability of any or all pending claims (or other claims) that have not been expressed. Finally, nothing in this paper should be construed as an intent to concede any issue with regard to any claim, except as specifically stated in this paper, and the amendment of any claim does not necessarily signify concession of unpatentability of the claim prior to its amendment.

Claims 1-31 are in condition for allowance, and a notice to that effect is respectfully solicited. If the Examiner has any questions regarding this response, the Examiner is invited to telephone the undersigned at (858) 678-4331.

Please apply any charges or credits to deposit account 06-1050.

Respectfully submitted,

Date: November 22, 2004

Scott C. Harris
Reg. No. 32,030

/BY
KENYON S. JENCKES
REG. NO. 41,873

PTO Customer No. 20985
Fish & Richardson P.C.
12390 El Camino Real
San Diego, California 92130
Telephone: (858) 678-5070
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REMARKS

Reconsideration and allowance of the above-referenced application are respectfully requested.

Upon entry of this amendment, claims 1-31 will remain in the application.

Allowed Claims

The indication that claims 1-10 are allowed and claims 16, 22, and 23 are allowable is appreciatively noted.

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The Action asserts that the BIT REPETITION and SYSTEMATIC INTERLEAVER elements shown in Figure 5 of Wang "repeat" "bits irregularly and scramble the repeated bits". Applicant disagrees with this characterization of Wang.

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"Referring particularly to FIG. 5, the encoder input of one block of N bits dk is partitioned by a bit partitioner using a rate of r, in which each input bit is simply divided into r

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Please apply any charges or credits to deposit account 06-1050.

Respectfully submitted,

Date: November 22, 2004

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Facsimile: (858) 678-5099

10456019.doc

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2000

Application or Docket Number: 09861102

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	31	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	31 minus 20=	* 11
INDEPENDENT CLAIMS	4 minus 3 =	* 1
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☐		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	355.00	OR	BASIC FEE	710.00
X$ 9=	99.00	OR	X$18=	
X40=	40.00	OR	X80=	
+135=		OR	+270=	
TOTAL	494.00	OR	TOTAL	

CLAIMS AS AMENDED - PART II

AMENDMENT A	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 31	Minus	** 31	=
Independent	* 4	Minus	*** 4	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
***If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/861,102	05/18/2001	Hui Jin	06618-637001 / CIT3220	6026

20985 7590 09/03/2004

FISH & RICHARDSON, PC
12390 EL CAMINO REAL
SAN DIEGO, CA 92130-2081

EXAMINER	
HA, DAC V	
ART UNIT	**PAPER NUMBER**
2634	

DATE MAILED: 09/03/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/861,102	JIN ET AL.	
	Examiner	Art Unit	
	Dac V. Ha	2634	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *18 May 2001*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-31* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *11-15,17-21 and 24-31* is/are rejected.

7)☒ Claim(s) *1-10,16,22 and 23* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1. **Claims 1-31** are objected to because of the following informalities:

Claim 1:

Line 3, "said data block" should be changed to "the data block".

Claim 11:

Line 2, "a block of data the signal" should be changed to "a block of data in the signal".

Line 3, "said data block" should be changed to "the data block".

Line 5, "said bits" should be changed to "said plurality of bits".

Line 9, "the bits" should be changed to "bits".

Claim 12:

Lines 1-2, "the said second coding" should be changed to "the second encoding" or "said second encoding".

Claim 13:

Line 1, "the first coding" should be changed to "the first encoding".

Claim 15:

Lines 2-3, "said bits" should be changed to "said stream of bits".

Line 3, "said repeated bits" should be changed to "the repeated bits".

Claim 16:

Line 4, "the each sub-block" should be changed to "each sub-block".

Claim 24:

Line 2-3, "said bits" should be changed to "said stream of bits".

Line 3, "said repeated bits" should be changed to "the repeated bits".

Line 4, "the bits" should be changed to "bits".

Claim 25:

Line 5, "selected a degree profile" should be changed to "a selected degree profile".

Claim 29:

Line 2, "the data" should be changed to "the encoded data stream".

Claim 30:

Line 2, "the data" should be changed to "the encoded data stream".

Claim 31:

Line 2, "the data" should be changed to "the encoded data stream".

Appropriate correction is required.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting

directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

3. **Claims 11-12, 14, 15, 17, 19-21, 24-26, 28, 29, 31** are rejected under 35 U.S.C. 102(e) as being anticipated by Wang (US 6,014,4411).

Regarding claim 15, Wang discloses an encoding arrangement including "first coder" (Figure 5, BIT REPETITION and SYSTEMATIC INTERLEAVER), that "repeat" "bits irregularly and scramble the repeated bits", followed by "second coder" (Figure 5, SECOND ENCODER) that apparently has a rate=1 (Figure 6).

Regarding claim 17, Wang discloses "first encoder" including BIT REPETITION using rate r and an "interleaver" (SYSTEMATIC INTERLEAVER).

Regarding claim 11, similar to that of claim 15, also, Wang's second constituent encoder as "second encoding" is apparently provided with accumulator.

Regarding claims 12, 19, Wang's second constituent encoder (SECOND ENCODER) is apparently a "linear transformation" as it is apparently a convolutional recursive encoder (col. 2, line 4).

Regarding claim 20, Wang's second constituent encoder as "second encoding" is apparently provided with accumulator.

Regarding claim 21, considering the combination of Wang's first and second constituent encoders as the "second encoding", "a second accumulator" is apparently provided in "second encoding".

Regarding claim 14, Wang also discloses "data blocks of fixed size" in operation of ENCODER INPUT, Figure 5.

Regarding claim 24, see claim 15 above. Further, Wang discloses "a decoder" via operation of turbo decoder in Figure 7.

Regarding claim 25, Wang discloses "first coder" including "repeat bits in the data blocks a different number of times according to a selected degree profile" in col. 15, lines 28-43.

Regarding claim 26, Wang's "first coder" apparently includes an "interleaver" (SYSTEMATIC INTERLEAVER, Figure 5).

Regarding claim 28, Wang's first constituent encoder (FIRST ENCODER) is apparently also a convolutional recursive encoder, it provides a form of "accumulator" where Wang's second constituent encoder (SECOND ENCODER) apparently has a rate =1 (Figure 6).

Regarding claim 29, Wang's turbo decoder use "a posterior" decoding technique (Figure 7).

Regarding claim 31, Wang's second constituent encoder (SECOND ENCODER) of the encoding arrangement is apparently "linear" as it is apparently a convolutional recursive encoder (col. 2, line 4).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. **Claims 13, 18, 27** are rejected under 35 U.S.C. 103(a) as being unpatentable over Wang.

Regarding claims 13, 18, 27, Wang disclose utilization of matrix (col. 14, line 2), thus utilization of "a low-density generator matrix transmformation" in encoding would have been desired to one skilled in the art.

6. **Claim 30** is rejected under 35 U.S.C. 103(a) as being unpatentable over Wang in view of the publication to Wiberg et al, "Codes and Iterative Decoding On General Graphs".

Regarding claim 30, Wang does not discuss the operation of the turbo decoder specifically in terms easily identifiable as a "tanner graph representation". Wiberg discloses turbo decoder operation in accordance with a Tanner graph representation, which was conventional in the turbo code art at the time of the invention was made. Thus, it would have been obvious to a person of ordinary skill in the art at the time of the invention on implement Wang's turbo decoder using a "Tanner graph representation" since turbo decoder operation in accordance with a Tanner graph representation was already conventional in the turbo code art.

Allowable Subject Matter

7. **Claims 1-10** are allowed.

8. **Claims 16, 22, 23** are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Kim et al. (US 6,437,714) disclose Channel Encoding Device And Method For Communication System.

Seshadri et al. (US 5,751,739) disclose Methods OF And Devices For Enhancing Commmunications That Use Spread Spectrum Technology.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dac V. Ha whose telephone number is 703-306-5536. The examiner can normally be reached on 5/4.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Chin can be reached on 703-305-4714. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should

you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Dac V. Ha
Examiner
Art Unit 2634

Notice of References Cited	Application/Control No. 09/861,102	Applicant(s)/Patent Under Reexamination JIN ET AL.	
	Examiner Dac V. Ha	Art Unit 2634	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-6,014,411	01-2000	Wang, Charles C.	375/259
	B	US-6,437,714	08-2002	Kim et al.	341/81
	C	US-5,751,739	05-1998	Seshadri et al.	714/746
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	Wiberg et al., "Codes and Iteratie Decoding on General Graphs", 1995 Intl. Symposium on Information Theory, Sept. 1995, p. 506.
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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BIBDATASHEET

Bib Data Sheet

CONFIRMATION NO. 6026

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
09/861,102	05/18/2001 RULE	375	2634	06618-637001 / CIT3220

APPLICANTS

Hui Jin, Glen Gardner, NJ;

Aamod Khandekar, Pasadena, CA;
Robert J. McEliece, Pasadena, CA;

** CONTINUING DATA **********
This appln claims benefit of 60/205,095 05/18/2000 OK! DH

** FOREIGN APPLICATIONS ********** NONE! DH

IF REQUIRED, FOREIGN FILING LICENSE GRANTED OK!
** 07/27/2001

Foreign Priority claimed	35 USC 119 (a-d) conditions met	Verified and Acknowledged	STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
☐ yes ☑ no	☐ yes ☑ no ☐ Met after Allowance	Examiner's Signature DH Initials	NJ	5	31	4

ADDRESS
20985
FISH & RICHARDSON, PC
12390 EL CAMINO REAL
SAN DIEGO , CA
92130-2081

TITLE
Serial concatenation of interleaved convolutional codes forming turbo-like codes

FILING FEE RECEIVED	FEES: Authority has been given in Paper
576	No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:

☐ All Fees
☐ 1.16 Fees (Filing)
☐ 1.17 Fees (Processing Ext. of time)
☐ 1.18 Fees (Issue)
☐ Other _____

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Index of Claims

Application No.	Applicant(s)	
09/861,102	JIN ET AL.	
Examiner	**Art Unit**	
Dac V. Ha	2634	

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim		Date
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Claim		Date
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Search Notes

Application No.	Applicant(s)	
09/861,102	JIN ET AL.	
Examiner	**Art Unit**	
Dac V. Ha	2634	

SEARCHED			
Class	Subclass	Date	Examiner
375	259,262, 265,285, 296, 341	8/11/2004	
	346, 348		
714	746, 752,		
	755, 756,		
	786, 792		
	794, 795		
	796		
341	51, 52,		
	56, 102		
	103	8/11/2004	

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR

L Number	Hits	Search Text	DB	Time stamp
1	1	6014411.pn. and matrix	USPAT	2004/08/12 12:48
2	0	6014411.pn. and (variable adj rate)	USPAT	2004/08/12 12:49
3	1	6014411.pn. and (rate)	USPAT	2004/08/12 12:53
4	1	5751739.pn.	USPAT	2004/08/12 13:34
5	1	6014411.pn.	USPAT	2004/08/12 13:34
-	8	("6437714" "5392299" "5751739" "5881093" "6014411" "6023783" "6031874" "6032284").pn.	USPAT	2004/08/11 19:39
-	8	("4771400" | "5446747" | "5684915" | "5721745" | "5862153" | "5907582" | "5978365" | "5996104" | "2001/0009569" | "2002/0021763").PN.	USPAT	2004/08/11 19:38
-	0	6437714.URPN.	USPAT	2004/08/11 19:38
-	16	6032284.URPN.	USPAT	2004/08/11 19:38
-	31	("5220466" | "5257272" | "5258933" | "5280489" | "5293369" | "5295128" | "5321559" | "5327440" | "5329554" | "5341249" | "5359631" | "5452325" | "5485472" | "5497384" | "5521767" | "5526200" | "5537424" | "5548600" | "5552942" | "5585975" | "5604497" | "5642243" | "5696639" | "5726818" | "5801649" | "5805619" | "5809080" | "5812334" | "5812336" | "5835295" | "5859601").PN.	USPAT	2004/08/11 19:38
-	7	6031874.URPN.	USPAT	2004/08/11 19:38
-	22	("3810021" | "4015222" | "4170764" | "4247940" | "4304962" | "4457004" | "4489418" | "4520490" | "4597090" | "4802171" | "5029185" | "5105442" | "5164963" | "5168509" | "5289501" | "5349589" | "5416804" | "5581481" | "5724385" | "5734962" | "5761249" | "5886989").PN.	USPAT	2004/08/11 19:38
-	60	6023783.URPN.	USPAT	2004/08/11 19:38
-	5	("5233629" | "5446747" | "5721745" | "5729560" | "5734962").PN.	USPAT	2004/08/11 19:39
-	13	6014411.URPN.	USPAT	2004/08/11 19:39
-	1	"5721745".PN.	USPAT	2004/08/11 19:39
-	3	5881093.URPN.	USPAT	2004/08/11 19:39

-	6	("4446747" | "5159608" | "5383217" | "5384810" | "5453997" | "5537444").PN.	USPAT	2004/08/11 19:39
-	16	5751739.URPN.	USPAT	2004/08/11 19:39
-	11	("5197061" | "5204876" | "5259003" | "5280472" | "5287374" | "5295152" | "5329547" | "5341401" | "5383219" | "5396516" | "5416801").PN.	USPAT	2004/08/11 19:39
-	16	("Re30187" | "Re31311" | "3786439" | "3868632" | "4413340" | "4541091" | "4567594" | "4598403" | "4637021" | "4677622" | "4680764" | "4730321" | "4742517" | "4802170" | "4852099" | "4852102").PN.	USPAT	2004/08/11 19:39
-	38	5392299.URPN.	USPAT	2004/08/11 19:39

-	245	(("6437714" "5392299" "5751739" "5881093" "6014411" "6023783" "6031874" "6032284").pn.) (("4771400" | "5446747" | "5684915" | "5721745" | "5862153" | "5907582" | "5978365" | "5996104" | "2001/0009569" | "2002/0021763").PN.) 6032284.URPN. (("5220466" | "5257272" | "5258933" | "5280489" | "5293369" | "5295128" | "5321559" | "5327440" | "5329554" | "5341249" | "5359631" | "5452325" | "5485472" | "5497384" | "5521767" | "5526200" | "5537424" | "5548600" | "5552942" | "5585975" | "5604497" | "5642243" | "5696639" | "5726818" | "5801649" | "5805619" | "5809080" | "5812334" | "5812336" | "5835295" | "5859601").PN.) 6031874.URPN. (("3810021" | "4015222" | "4170764" | "4247940" | "4304962" | "4457004" | "4489418" | "4520490" | "4597090" | "4802171" | "5029185" | "5105442" | "5164963" | "5168509" | "5289501" | "5349589" | "5416804" | "5581481" | "5724385" | "5734962" | "5761249" | "5886989").PN.) 6023783.URPN. (("5233629" | "5446747" | "5721745" | "5729560" | "5734962").PN.) 6014411.URPN. "5721745".PN. 5881093.URPN. (("4446747" | "5159608" | "5383217" | "5384810" | "5453997" | "5537444").PN.) 5751739.URPN. (("5197061" | "5204876" | "5259003" | "5280472" | "5287374" | "5295152" | "5329547" | "5341401" | "5383219" | "5396516" | "5416801").PN.) (("Re30187" | "Re31311" | "3786439" | "3868632" | "4413340" | "4541091" | "4567594" | "4598403" | "4637021" | "4677622" | "4680764" | "4730321" | "4742517" | "4802170" | "4852099" | "4852102").PN.) 5392299.URPN.	USPAT	2004/08/11 19:40
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-	283	(((cod$3 decod$3 encod$3) with rate) same first same second) same interleav$3	USPAT	2004/08/11 19:41
-	2	((((cod$3 decod$3 encod$3) with rate) same first same second) same interleav$3) and (("6437714" "5392299" "5751739" "5881093" "6014411" "6023783" "6031874" "6032284").pn.)	USPAT	2004/08/11 19:42
-	77	((((cod$3 decod$3 encod$3) with rate) same first same second) same interleav$3) and (turbo with (cod$3 encod$3 decod$3))	USPAT	2004/08/11 19:43

-	65	((((cod$3 decod$3 encod$3) with rate) same first same second) same interleav$3) and (turbo with (cod$3 encod$3 decod$3))) and (375/$.ccls. or 714/$.ccls.)	USPAT	2004/08/11 19:44
-	25	(((((cod$3 decod$3 encod$3) with rate) same first same second) same interleav$3) and (turbo with (cod$3 encod$3 decod$3))) and (375/$.ccls. or 714/$.ccls.)) and ((cod$3 encod$3 decod$3) with rate).clm.	USPAT	2004/08/12 12:41
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-	1	"5909434".PN.	USPAT	2004/08/12 10:28
-	0	6665833.URPN.	USPAT	2004/08/12 10:29
-	5	("6298461" | "6347385" | "6400703" | "6427214" | "6460159").PN.	USPAT	2004/08/12 10:29
-	5	("6298461" | "6347385" | "6400703" | "6427214" | "6460159").PN.	USPAT	2004/08/12 10:29

Attorney's Docket No.: 06618-637001 / CIT3220

Sector 8 ✓ #3

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant :	Hui Jin et al.	Art Unit :	Unknown
Serial No.:	09/861,102	Examiner :	Unknown
Filed :	May 18, 2001		
Title :	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES		

BOX MISSING PARTS
Commissioner for Patents
Washington, D.C. 20231

RESPONSE TO NOTICE TO FILE MISSING PARTS OF APPLICATION

In response to the Notice to File Missing Parts of Application under 37 CFR §1.53(b) mailed July 27, 2001 (copy enclosed), applicant as a small entity submits herewith the following:

- ☒ Payment of the basic filing fee of $355;
- ☒ Payment of the additional/multiple dependent claims fees of $139;
- ☒ Check in payment of $65 surcharge for filing the basic filing fee and/or declaration on a date later than the filing date of the application;
- ☒ Combined Declaration and Power of Attorney in compliance with 37 CFR §1.63; and
- ☒ Submittal of 5 Formal Drawings.

It is understood that this perfects the application and no additional papers or filing fees are required. Please apply any

CERTIFICATE OF MAILING BY FIRST CLASS MAIL
I hereby certify under 37 CFR §1.8(a) that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage on the date indicated below and is addressed to the Commissioner for Patents, Washington, D.C. 20231.

9/27/2001
Date of Deposit

Debbrah K. Sim
Signature

Debbrah K. Sim
Typed or Printed Name of Person Signing Certificate

other charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

Date: 9/27/01

Scott C. Harris
Reg. No. 32,030

Fish & Richardson P.C.
PTO Customer No. 20985
4350 La Jolla Village Drive, Suite 500
San Diego, California 92122
Telephone: (858) 678-5070
Facsimile: (858) 678-5099
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#3

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APPLICATION NUMBER	FILING/RECEIPT DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
09/861,102	05/18/2001	Hui Jin	06618-637001/CIT3220

10/05/2001 NMOHAMM1 00000002 061050 09861102

CONFIRMATION NO. 6026

20985
FISH & RICHARDSON, PC
4350 LA JOLLA VILLAGE DRIVE
SUITE 500
SAN DIEGO, CA 92122

01 FC:201 370.00 DP
02 FC:205 65.00
03 FC:203 99.00 DP
04 FC:202 17.00 CH 25.00 DP

FORMALITIES LETTER

C000000006354800

Date Mailed: 07/27/2001

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee is missing.
  Applicant must submit $ **355** *to complete the basic filing fee and/or file a small entity statement claiming such status (37 CFR 1.27).*
- Total additional claim fee(s) for this application is $139.
  - **$99** for **11** total claims over 20.
  - **$40** for **1** independent claims over 3 .
- The oath or declaration is missing.
  A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.
- To avoid abandonment, a late filing fee or oath or declaration surcharge as set forth in 37 CFR 1.16(e) of $65 for a small entity in compliance with 37 CFR 1.27, must be submitted with the missing items identified in this letter.
- **The balance due by applicant is $ 559.**

The application is informal since it does not comply with the regulations for the reason(s) indicated below.

The required item(s) identified below must be timely submitted to avoid abandonment:

- Substitute drawings in compliance with 37 CFR 1.84 because:
  - drawing sheets do not have the appropriate margin(s) (see 37 CFR 1.84(g)). Each sheet must include a top margin of at least 2.5 cm. (1 inch), a left side margin of at least 2.5 cm. (1 inch), a right side margin of at least 1.5 cm. (5/8 inch), and a bottom margin of at least 1.0 cm. (3/8 inch);

A copy of this notice MUST be returned with the reply.

Customer Service Center
Initial Patent Examination Division (703) 308-1202
PART 2 - COPY TO BE RETURNED WITH RESPONSE

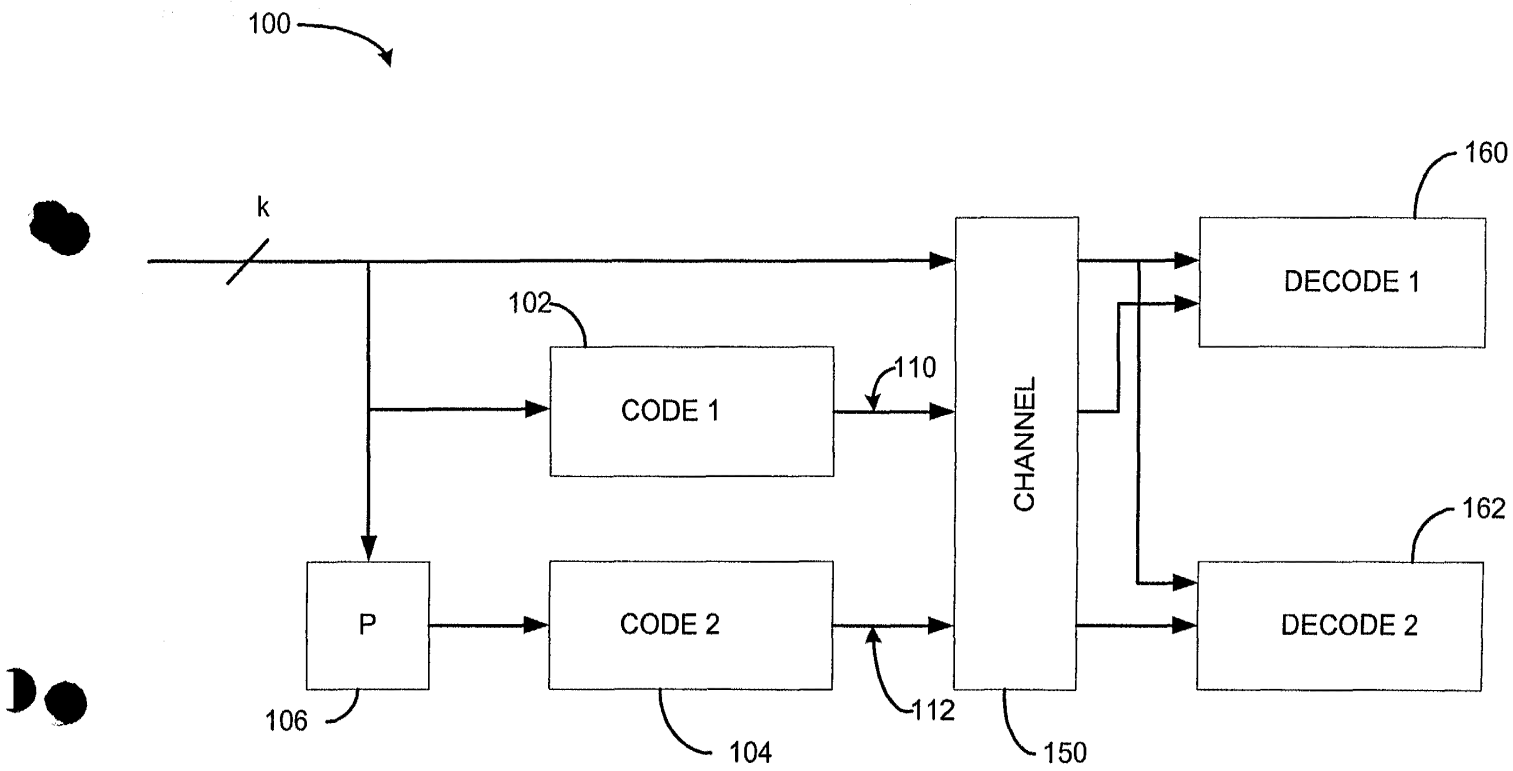

FIG. 1
PRIOR ART

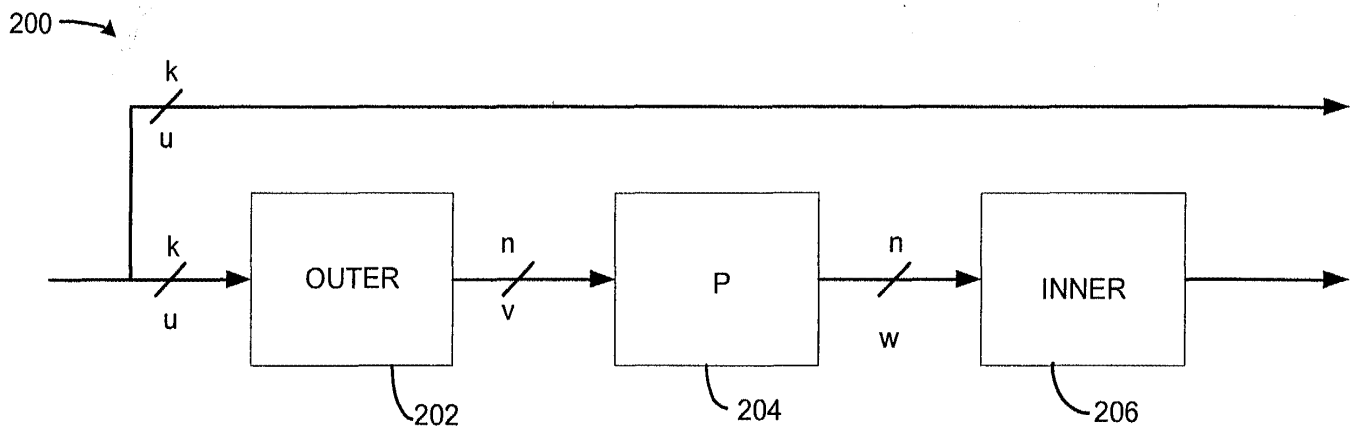

FIG. 2

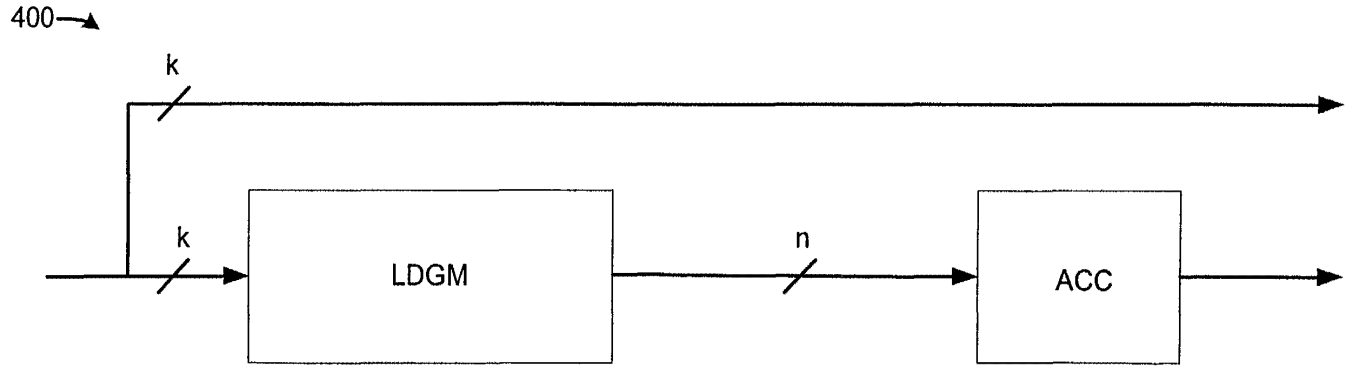

FIG. 4

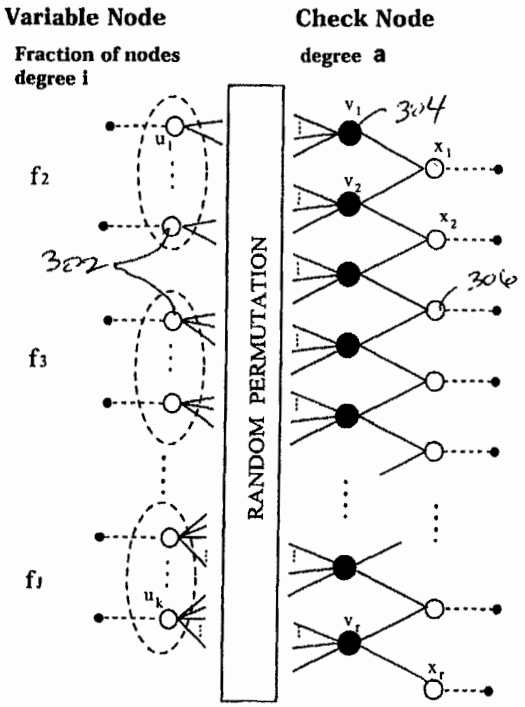

FIG. 3

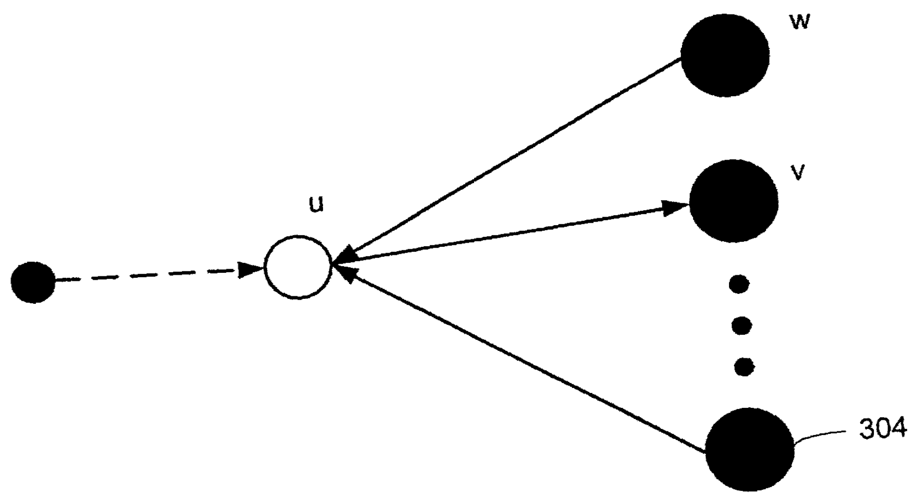

FIG. 5A

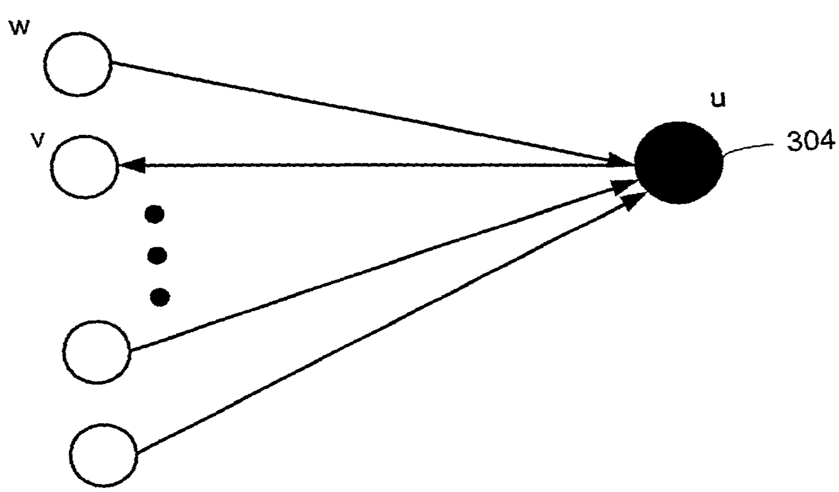

FIG. 5B

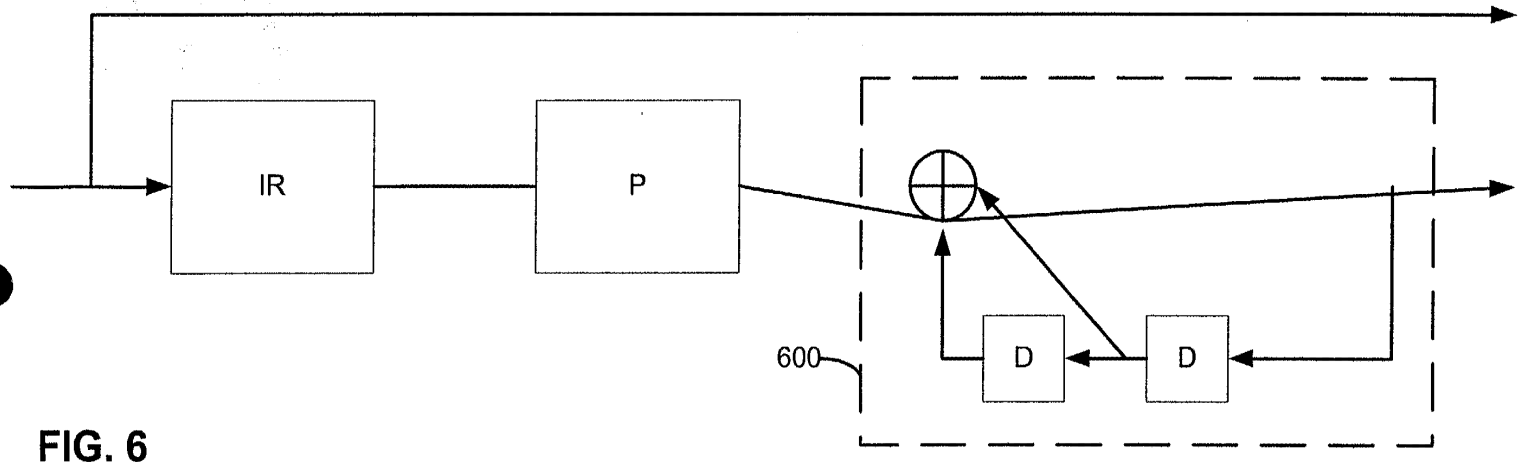

FIG. 6

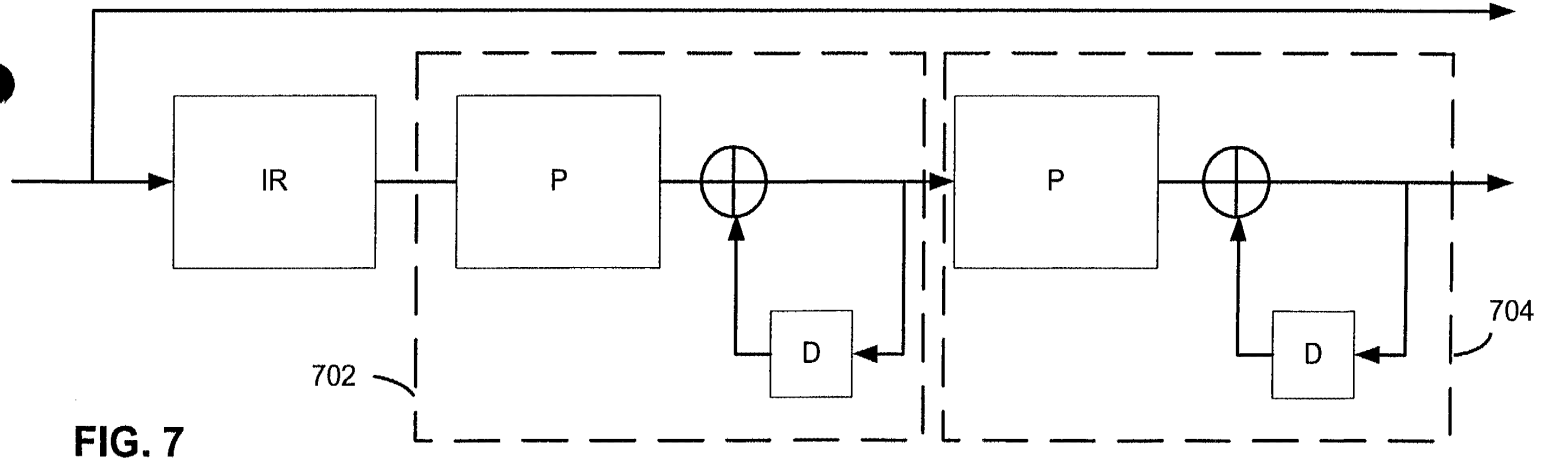

FIG. 7

Attorney's Docket No.: 06618-637001/CIT3220

#3

COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES, the specification of which:

[] is attached hereto.
[X] was filed on May 18, 2001 as Application Serial No. 09/861,102 and was amended on _____.
[] was described and claimed in PCT International Application No. _____ filed on _____ and as amended under PCT Article 19 on _____.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information I know to be material to patentability in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim the benefit under Title 35, United States Code, §119(e)(1) of any United States provisional application(s) listed below:

U.S. Serial No.	Filing Date	Status
60/205,095	05/18/2000	Abandoned

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose all information I know to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56(a) which became available between the filing date of the prior application and the national or PCT international filing date of this application:

U.S. Serial No.	Filing Date	Status

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

Country	Application No.	Filing Date	Priority Claimed
			[] Yes [] No

I hereby appoint the following attorneys and/or agents to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Scott C. Harris, Reg. No. 32,030
David L. Feigenbaum, Reg. No. 30,378
Hans R. Troesch, Reg. No.36,950
John C. Phillips, Reg. No. 35,322
Frederick H. Rabin, Reg. No. 24,488
William J. Egan, III, Reg. No. 28,411
Bing Ai, Reg. No. 43,312
Kenyon S. Jenckes, Reg. No. 41,873
Richard J. Anderson, Reg. No. 36,732
Samuel Borodach, Reg. No. 38,388

Attorney's Docket No.: 06618-637001/CIT3220

Combined Declaration and Power of Attorney

James T. Hagler, Reg. No., 40,631 Adam Cochran, Reg. No. 29,373

Address all telephone calls to SCOTT C. HARRIS at telephone number (858) 678-5070.

Address all correspondence to SCOTT C. HARRIS at:

FISH & RICHARDSON P.C.
4350 La Jolla Village Drive, Suite 500
San Diego, California 92122

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patents issued thereon.

Full Name of Inventor: HUI JIN

Inventor's Signature: _____ Date: _____
Residence Address: _____
_____
Citizenship: _____
Post Office Address: _____
_____

Full Name of Inventor: AAMOD KHANDEKAR

Inventor's Signature: _____ Date: _____
Residence Address: _____
_____
Citizenship: _____
Post Office Address: _____
_____

Full Name of Inventor: ROBERT J. MCELIECE

Inventor's Signature: R J McEliece Date: 8/29/01
Residence Address: 1086 Armada Dr.
Pasadena, CA 91103
Citizenship: USA
Post Office Address: _____
_____

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Attorney's Docket No.: 06618-637001/CIT3220

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San Diego, California 92122

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Full Name of Inventor: HUI JIN

Inventor's Signature: _____ Date: _____
Residence Address: _____
_____
Citizenship: _____
Post Office Address: _____
_____

Full Name of Inventor: AAMOD KHANDEKAR

Inventor's Signature: AK Date: 9/12/2001
Residence Address: 1-88 BRAUN HOUSE
CALTECH, PASADENA CA 91106
Citizenship: INDIAN
Post Office Address: 136-93 CALTECH
PASADENA, CA 91125

Full Name of Inventor: ROBERT J. MCELIECE

Inventor's Signature: _____ Date: _____
Residence Address: _____
_____
Citizenship: _____
Post Office Address: _____
_____

Attorney's Docket No.: 06618-637001/CIT3220

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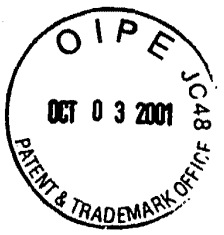

Attorney's Docket No.: 06618-637001/CIT3220

Combined Declaration and Power of Attorney

James T. Hagler, Reg. No., 40,631 Adam Cochran, Reg. No. 29,373

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Full Name of Inventor: HUI JIN

Inventor's Signature: _____ Date: 09/26/01

Residence Address: 2104 Spruce Hills Dr
Glen Gardner, NJ 08826

Citizenship: P.R China

Post Office Address: 2104 Spruce Hills Dr.
Glen Gardner, NJ 08826, U.S.

Full Name of Inventor: AAMOD KHANDEKAR

Inventor's Signature: _____ Date: _____

Residence Address: _____

Citizenship: _____

Post Office Address: _____

Full Name of Inventor: ROBERT J. MCELIECE

Inventor's Signature: _____ Date: _____

Residence Address: _____

Citizenship: _____

Post Office Address: _____

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UNITED STATES PATENT AND TRADEMARK OFFICE

COMMISSIONER FOR PATENTS
UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. 20231
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APPLICATION NUMBER	FILING/RECEIPT DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
09/861,102	05/18/2001	Hui Jin	06618-637001/CIT3220

CONFIRMATION NO. 6026

20985
FISH & RICHARDSON, PC
4350 LA JOLLA VILLAGE DRIVE
SUITE 500
SAN DIEGO, CA 92122

FORMALITIES LETTER

OC000000006354800

Date Mailed: 07/27/2001

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee is missing.
  Applicant must submit $ **355** *to complete the basic filing fee and/or file a small entity statement claiming such status (37 CFR 1.27).*
- Total additional claim fee(s) for this application is $139.
  - **$99** for **11** total claims over 20.
  - **$40** for **1** independent claims over 3 .
- The oath or declaration is missing.
  A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.
- To avoid abandonment, a late filing fee or oath or declaration surcharge as set forth in 37 CFR 1.16(e) of $65 for a small entity in compliance with 37 CFR 1.27, must be submitted with the missing items identified in this letter.
- **The balance due by applicant is $ 559.**

The application is informal since it does not comply with the regulations for the reason(s) indicated below.

The required item(s) identified below must be timely submitted to avoid abandonment:

- Substitute drawings in compliance with 37 CFR 1.84 because:
  - drawing sheets do not have the appropriate margin(s) (see 37 CFR 1.84(g)). Each sheet must include a top margin of at least 2.5 cm. (1 inch), a left side margin of at least 2.5 cm. (1 inch), a right side margin of at least 1.5 cm. (5/8 inch), and a bottom margin of at least 1.0 cm. (3/8 inch);

A copy of this notice MUST be returned with the reply.

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A

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TWIN CITIES
WASHINGTON, DC

May 18, 2001

Attorney Docket No.: 06618-637001/CIT3220

Box Patent Application
Commissioner for Patents
Washington, DC 20231

Presented for filing is a new patent application claiming priority from a provisional patent application of:

Applicant: HUI JIN, AAMOD KHANDEKAR AND ROBERT J. McELIECE

Title: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

Enclosed are the following papers, including those required to receive a filing date under 37 CFR §1.53(b):

	Pages
Specification	16
Claims	6
Abstract	1
Declaration	[To be Filed at a Later Date]
Drawing(s)	5

Enclosures:
— Postcard.

Under 35 USC §120, this application claims the benefit of prior U.S. application No. _____, filed August 18, 2000, and entitled "Interleaved Serial Concatenation Forming Turbo-Like Codes".

CERTIFICATE OF MAILING BY EXPRESS MAIL

Express Mail Label No. EL688320048US

I hereby certify under 37 CFR §1.10 that this correspondence is being deposited with the United States Postal Service as Express Mail Post Office to Addressee with sufficient postage on the date indicated below and is addressed to the Commissioner for Patents, Washington, D.C. 20231.

May 18, 2001
Date of Deposit

Signature

Gildardo Vargas
Typed or Printed Name of Person Signing Certificate

Under 35 USC §119(e)(1), this application claims the benefit of prior U.S. provisional application 60/205,095, filed May 18, 2000.

This application is entitled to small entity status.

Basic filing fee	$0
Total claims in excess of 20 times $9	$0
Independent claims in excess of 3 times $40	$0
Fee for multiple dependent claims	$0
Total filing fee:	$0

Under 37 CFR §1.53(f), no filing fee is being paid at this time.

If this application is found to be incomplete, or if a telephone conference would otherwise be helpful, please call the undersigned at (858) 678-5070.

Kindly acknowledge receipt of this application by returning the enclosed postcard.

Please send all correspondence to:

SCOTT C. HARRIS
Fish & Richardson P.C.
PTO Customer No. 20985
4350 La Jolla Village Drive, Suite 500
San Diego, CA 92122

Respectfully submitted,

Scott C. Harris
Reg. No. 32,030
Enclosures
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PTO/SB/35 (11-00)
Approved for use through 10/31/2002 OMB 0651-0031
U.S. Patent and Trademark Office: U.S DEPARTMENT OF COMMERCE

REQUEST AND CERTIFICATION UNDER 35 U.S.C. 122(b)(2)(B)(i)

First Named Inventor	Hui Jin et al.
Title	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
Atty Docket Number	06618-637001

I hereby certify that the invention disclosed in the attached application **has not and will not be** the subject of an application filed in another country, or under a multilateral agreement, that requires publication at eighteen months after filing. I hereby request that the attached application not be published under 35 U.S.C. 122(b).

5/18/01
Date

Signature

Scott C. Harris
Typed or printed name

This request must be signed in compliance with 38 CFR 1.33(b) and submitted with the application **upon filing**.

Applicant may rescind this nonpublication request at any time. If applicant rescinds a request that an application not be published under 35 U.S.C. 122(b), the application will be scheduled for publication at eighteen months from the earliest claimed filing date for which a benefit is claimed.

If applicant subsequently files an application directed to the invention disclosed in the attached application in another country, or under a multilateral international agreement, that requires publication of applications eighteen months after filing, the applicant **must** notify the United States Patent and Trademark Office of such filing within forty-five (45) days after the date of the filing of such foreign or international application. **Failure to do so will result in abandonment of this application (35 U.S.C. 122(b)(2)(B)(iii)).**

Burden Hour Statement: This collection of information is required by 37 CFR 1.213(a). The information is used by the public to request that an application not be published under 35 U.S.C 122(b) (and the PTO to process that request). Confidentiality is governed by 35 U.S C 122 and 37 CFR 1.14 This form is estimated to take 6 minutes to complete This time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to completed this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231 DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

Attorney's Docket No.: 06618/637001 / CIT3220

APPLICATION

FOR

UNITED STATES LETTERS PATENT

TITLE: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

APPLICANT: HUI JIN, AAMOD KHANDEKAR AND ROBERT J. MCELIECE

CERTIFICATE OF MAILING BY EXPRESS MAIL

Express Mail Label No. EL688320048US

I hereby certify under 37 CFR §1.10 that this correspondence is being deposited with the United States Postal Service as Express Mail Post Office to Addressee with sufficient postage on the date indicated below and is addressed to the Commissioner for Patents, Washington, D.C. 20231.

May 18, 2001
Date of Deposit

Signature

Gildardo Vargas
Typed or Printed Name of Person Signing Certificate

SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Application Serial No. 60/205,095, filed on May 18, 2000, and to U.S. Application Serial No. _____, filed on August 18, 2000 and entitled Interleaved Serial Concatenation Forming Turbo-Like Codes.

GOVERNMENT LICENSE RIGHTS

[0002] The U.S. Government has a paid-up license in this invention and the right in limited circumstances to require the patent owner to license others on reasonable terms as provided for by the terms of Grant No. CCR-9804793 awarded by the National Science Foundation.

BACKGROUND

[0003] Properties of a channel affect the amount of data that can be handled by the channel. The so-called "Shannon limit" defines the theoretical limit of the amount of data that a channel can carry.

[0004] Different techniques have been used to increase the data rate that can be handled by a channel. "Near Shannon Limit Error-Correcting Coding and Decoding: Turbo Codes," by Berrou et al. ICC, pp 1064-1070, (1993), described a new "turbo code" technique that has revolutionized the field of error correcting codes. Turbo codes have sufficient randomness to allow reliable communication over the channel at a high data rate near capacity. However, they still retain sufficient structure to allow practical encoding and decoding algorithms. Still, the technique for encoding and decoding turbo codes can be relatively complex.

[0005] A standard turbo coder 100 is shown in Figure 1. A block of k information bits is input directly to a first coder 102. A k bit interleaver 106 also receives the k bits and interleaves them prior to applying them to a second coder 104. The second coder produces an output that has more bits than its input, that is, it is a coder with rate that is less than 1. The coders 102, 104 are typically recursive convolutional coders.

[0006] Three different items are sent over the channel 150: the original k bits, first encoded bits 110, and second encoded bits 112. At the decoding end, two decoders are used: a first constituent decoder 160 and a second

constituent decoder 162. Each receives both the original k bits, and one of the encoded portions 110, 112. Each decoder sends likelihood estimates of the decoded bits to the other decoders. The estimates are used to decode the uncoded information bits as corrupted by the noisy channel.

SUMMARY

[0007] A coding system according to an embodiment is configured to receive a portion of a signal to be encoded, for example, a data block including a fixed number of bits. The coding system includes an outer coder, which repeats and scrambles bits in the data block. The data block is apportioned into two or more sub-blocks, and bits in different sub-blocks are repeated a different number of times according to a selected degree profile. The outer coder may include a repeater with a variable rate and an interleaver. Alternatively, the outer coder may be a low-density generator matrix (LDGM) coder.

[0008] The repeated and scrambled bits are input to an inner coder that has a rate substantially close to one. The inner coder may include one or more accumulators that perform recursive modulo two addition operations on the input bit stream.

[0009] The encoded data output from the inner coder may be transmitted on a channel and decoded in linear time at a destination using iterative decoding techniques. The decoding techniques may be based on a Tanner graph representation of the code.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Figure 1 is a schematic diagram of a prior "turbo code" system.

[0011] Figure 2 is a schematic diagram of a coder according to an embodiment.

[0012] Figure 3 is a Tanner graph for an irregular repeat and accumulate (IRA) coder.

[0013] Figure 4 is a schematic diagram of an IRA coder according to an embodiment.

[0014] Figure 5A illustrates a message from a variable node to a check node on the Tanner graph of Figure 3.

[0015] Figure 5B illustrates a message from a check node to a variable node on the Tanner graph of Figure 3.

[0016] Figure 6 is a schematic diagram of a coder according to an alternate embodiment.

[0017] Figure 7 is a schematic diagram of a coder according to another alternate embodiment.

DETAILED DESCRIPTION

[0018] Figure 2 illustrates a coder 200 according to an embodiment. The coder 200 may include an outer coder 202, an interleaver 204, and inner coder 206. The coder may be used to format blocks of data for transmission, introducing redundancy into the stream of data to protect the data from loss due to transmission errors. The encoded data may then be decoded at a destination in linear time at rates that may approach the channel capacity.

[0019] The outer coder 202 receives the uncoded data. The data may be partitioned into blocks of fixed size, say k bits. The outer coder may be an (n,k) binary linear block coder, where $n > k$. The coder accepts as input a block u of k data bits and produces an output block v of n data bits. The mathematical relationship between u and v is $v=T_0u$, where T_0 is an n x k matrix, and the rate of the coder is k/n.

[0020] The rate of the coder may be irregular, that is, the value of T_0 is not constant, and may differ for sub-blocks of bits in the data block. In an embodiment, the outer coder 202 is a repeater that repeats the k bits in a block a number of times q to produce a block with n bits, where $n = qk$. Since the repeater has an irregular output, different bits in the block may be repeated a different

number of times. For example, a fraction of the bits in the block may be repeated two times, a fraction of bits may be repeated three times, and the remainder of bits may be repeated four times. These fractions define a degree sequence, or degree profile, of the code.

[0021] The inner coder 206 may be a linear rate-1 coder, which means that the n-bit output block x can be written as $x=T_I w$, where T_I is a nonsingular n x n matrix. The inner coder 210 can have a rate that is close to 1, e.g., within 50%, more preferably 10% and perhaps even more preferably within 1% of 1.

[0022] In an embodiment, the inner coder 206 is an accumulator, which produces outputs that are the modulo two (mod-2) partial sums of its inputs. The accumulator may be a truncated rate-1 recursive convolutional coder with the transfer function 1/(1+D). Such an accumulator may be considered a block coder whose input block $[x_1,\ldots,x_n]$ and output block $[y_1,\ldots,y_n]$ are related by the formula

$$y_1 = x_1$$

$$y_2 = x_1 \oplus x_2$$

$$y_3 = x_1 \oplus x_2 \oplus x_3$$

$$\vdots$$

$$y_n = x_1 \oplus x_2 \oplus x_3 \oplus \ldots \oplus x_n.$$

where "⊕" denotes mod-2, or exclusive-OR (XOR), addition. An advantage of this system is that only mod-2 addition is necessary for the accumulator. The accumulator may be embodied using only XOR gates, which may simplify the design.

[0023] The bits output from the outer coder 202 are scrambled before they are input to the inner coder 206. This scrambling may be performed by the interleaver 204, which performs a pseudo-random permutation of an input block v, yielding an output block w having the same length as v.

[0024] The serial concatenation of the interleaved irregular repeat code and the accumulate code produces an irregular repeat and accumulate (IRA) code. An IRA code is a linear code, and as such, may be represented as a set of parity checks. The set of parity checks may be represented in a bipartite graph, called the Tanner graph, of the code. Figure 3 shows a Tanner graph 300 of an IRA code with parameters $(f_1, \ldots, f_j; a)$, where $f_i \geq 0$, $\Sigma_i f_i = 1$ and "a" is a positive integer. The Tanner graph includes two kinds of nodes: variable nodes (open circles) and check nodes (filled circles). There are k variable nodes 302 on the left, called information nodes. There are r variable nodes 306 on the right, called parity nodes. There are r =

$(k\Sigma_i if_i)/a$ check nodes 304 connected between the information nodes and the parity nodes. Each information node 302 is connected to a number of check nodes 304. The fraction of information nodes connected to exactly i check nodes is f_i. For example, in the Tanner graph 300, each of the f_2 information nodes are connected to two check nodes, corresponding to a repeat of q = 2, and each of the f_3 information nodes are connected to three check nodes, corresponding to q = 3.

[0025] Each check node 304 is connected to exactly "a" information nodes 302. In Figure 3, a = 3. These connections can be made in many ways, as indicated by the arbitrary permutation of the ra edges joining information nodes 302 and check nodes 304 in permutation block 310. These connections correspond to the scrambling performed by the interleaver 204.

[0026] In an alternate embodiment, the outer coder 202 may be a low-density generator matrix (LDGM) coder that performs an irregular repeat of the k bits in the block, as shown in Figure 4. As the name implies, an LDGM code has a sparse (low-density) generator matrix. The IRA code produced by the coder 400 is a serial concatenation of the LDGM code and the accumulator code. The interleaver 204 in

Figure 2 may be excluded due to the randomness already present in the structure of the LDGM code.

[0027] If the permutation performed in permutation block 310 is fixed, the Tanner graph represents a binary linear block code with k information bits $(u_1, \ldots, u_k)$ and r parity bits $(x_1, \ldots, x_r)$, as follows. Each of the information bits is associated with one of the information nodes 302, and each of the parity bits is associated with one of the parity nodes 306. The value of a parity bit is determined uniquely by the condition that the mod-2 sum of the values of the variable nodes connected to each of the check nodes 304 is zero. To see this, set $x_0=0$. Then if the values of the bits on the ra edges coming out the permutation box are $(v_1, \ldots, v_{ra})$, then we have the recursive formula

$$x_j = x_{j-1} + \sum_{i=1}^{a} v_{(j-1)a+i}$$

for j = 1, 2, ..., r. This is in effect the encoding algorithm.

[0028] Two types of IRA codes are represented in Figure 3, a nonsystematic version and a systematic version. The nonsystematic version is an (r,k) code, in which the codeword corresponding to the information bits $(u_1, \ldots, u_k)$ is $(x_1, \ldots, x_r)$. The systematic version is a (k+r, k) code, in which the codeword is $(u_1, \ldots, u_k; x_1, \ldots, x_r)$.

[0029] The rate of the nonsystematic code is

$$R_{nsys} = \frac{a}{\sum_i i f_i}$$

[0030] The rate of the systematic code is

$$R_{sys} = \frac{a}{a + \sum_i i f_i}$$

[0031] For example, regular repeat and accumulate (RA) codes can be considered nonsystematic IRA codes with a = 1 and exactly one f_i equal to 1, say $f_q = 1$, and the rest zero, in which case R_{nsys} simplifies to R = 1/q.

[0032] The IRA code may be represented using an alternate notation. Let λ_i be the fraction of edges between the information nodes 302 and the check nodes 304 that are adjacent to an information node of degree i, and let ρ_i be the fraction of such edges that are adjacent to a check node of degree i+2 (i.e., one that is adjacent to i information nodes). These edge fractions may be used to represent the IRA code rather than the corresponding node fractions. Define $\lambda(x) = \Sigma_i \lambda_i x^{i-1}$ and $\rho(x) = \Sigma_i \rho_i x^{i-1}$ to be the generating functions of these sequences. The pair (λ, ρ) is called a degree distribution. For $L(x) = \Sigma_i f_i x_i$,

$$f_i = \frac{\lambda_i / i}{\sum_j \lambda_j / j}$$

$$L(x) = \int_0^x \lambda(t)\,dt \Big/ \int_0^1 \lambda(t)\,dt$$

[0033] The rate of the systematic IRA code given by the degree distribution is given by

$$\text{Rate} = \left(1 + \frac{\sum_j \rho_j / j}{\sum_j \lambda_j / j}\right)^{-1}$$

[0034] "Belief propagation" on the Tanner Graph realization may be used to decode IRA codes. Roughly speaking, the belief propagation decoding technique allows the messages passed on an edge to represent posterior densities on the bit associated with the variable node. A probability density on a bit is a pair of non-negative real numbers p(0), p(1) satisfying p(0) + p(1) = 1, where p(0) denotes the probability of the bit being 0, p(1) the probability of it being 1. Such a pair can be represented by its log likelihood ratio, m = log(p(0)/p(1)). The outgoing message from a variable node u to a check node v represents information about u, and a message from a check node u to a variable node v represents information about u, as shown in Figures 5A and 5B, respectively.

[0035] The outgoing message from a node u to a node v depends on the incoming messages from all neighbors w of u except v. If u is a variable message node, this outgoing message is

$$m(u \rightarrow v) = \sum_{w \neq v} m(w \rightarrow u) + m_0(u)$$

where $m_0(u)$ is the log-likelihood message associated with u. If u is a check node, the corresponding formula is

$$\tanh \frac{m(u \rightarrow v)}{2} = \prod_{w \neq v} \tanh \frac{m(w \rightarrow u)}{2}$$

[0036] Before decoding, the messages $m(w \rightarrow u)$ and $m(u \rightarrow v)$ are initialized to be zero, and $m_0(u)$ is initialized to be the log-likelihood ratio based on the channel received information. If the channel is memoryless, i.e., each channel output only relies on its input, and y is the output of the channel code bit u, then $m_0(u) = \log(p(u = 0|y)/p(u = 1|y))$. After this initialization, the decoding process may run in a fully parallel and local manner. In each iteration, every variable/check node receives messages from its neighbors, and sends back updated messages. Decoding is terminated after a fixed number of iterations or detecting that all the constraints are satisfied. Upon termination, the decoder outputs a decoded sequence based on the messages $m(u) = \sum w_m(w \rightarrow u)$.

[0037] Thus, on various channels, iterative decoding only differs in the initial messages $m_0(u)$. For example, consider three memoryless channel models: a binary erasure channel (BEC); a binary symmetric channel (BSC); and an additive white Gaussian noise (AGWN) channel.

[0038] In the BEC, there are two inputs and three outputs. When 0 is transmitted, the receiver can receive either 0 or an erasure E. An erasure E output means that the receiver does not know how to demodulate the output. Similarly, when 1 is transmitted, the receiver can receive either 1 or E. Thus, for the BEC, $y \in \{0, E, 1\}$, and

$$m_0(u) = \begin{cases} +\infty & \text{if } y = 0 \\ 0 & \text{if } y = E \\ -\infty & \text{if } y = 1 \end{cases}$$

[0039] In the BSC, there are two possible inputs (0,1) and two possible outputs (0, 1). The BSC is characterized by a set of conditional probabilities relating all possible outputs to possible inputs. Thus, for the BSC $y \in \{0, 1\}$,

$$m_0(u) = \begin{cases} \log\frac{1-p}{p} & \text{if } y = 0 \\ -\log\frac{1-p}{p} & \text{if } y = 1 \end{cases}$$

and

[0040] In the AWGN, the discrete-time input symbols X take their values in a finite alphabet while channel output symbols Y can take any values along the real line. There is assumed to be no distortion or other effects other than the addition of white Gaussian noise. In an AWGN with a Binary Phase Shift Keying (BPSK) signaling which maps 0 to the symbol with amplitude $\sqrt{Es}$ and 1 to the symbol with amplitude $-\sqrt{Es}$, output y ∈ R, then

$$m_0(u) = 4y\sqrt{E_s} / N_0$$

where $N_0/2$ is the noise power spectral density.

[0041] The selection of a degree profile for use in a particular transmission channel is a design parameter, which may be affected by various attributes of the channel. The criteria for selecting a particular degree profile may include, for example, the type of channel and the data rate on the channel. For example, Table 1 shows degree profiles that have been found to produce good results for an AWGN channel model.

a	2	3	4
λ_2	0.139025	0.078194	0.054485
λ_3	0.2221555	0.128085	0.104315
λ_5		0.160813	
λ_6	0.638820	0.036178	0.126755
λ_{10}			0.229816
λ_{11}			0.016484
λ_{12}		0.108828	
λ_{13}		0.487902	
λ_{14}			
λ_{16}			
λ_{27}			0.450302
λ_{28}			0.017842
Rate	0.333364	0.333223	0.333218
σ_{GA}	1.1840	1.2415	1.2615
σ^*	1.1981	1.2607	1.2780
(Eb/N0)*(dB)	0.190	-0.250	-0.371
S.L. (dB)	-0.4953	-0.4958	-0.4958

TABLE 1

[0042] Table 1 shows degree profiles yielding codes of rate approximately 1/3 for the AWGN channel and with a = 2, 3, 4. For each sequence, the Gaussian approximation noise threshold, the actual sum-product decoding threshold and the corresponding energy per bit (E_b)-noise power (N_0) ratio in dB are given. Also listed is the Shannon limit (S.L.).

[0043] As the parameter "a" is increased, the performance improves. For example, for a = 4, the best

code found has an iterative decoding threshold of E_b/N_0 = -0.371 dB, which is only 0.12 dB above the Shannon limit.

[0044] The accumulator component of the coder may be replaced by a "double accumulator" 600 as shown in Figure 6. The double accumulator can be viewed as a truncated rate 1 convolutional coder with transfer function $1/(1 + D + D^2)$.

[0045] Alternatively, a pair of accumulators may be the added, as shown in Figure 7. There are three component codes: the "outer" code 700, the "middle" code 702, and the "inner" code 704. The outer code is an irregular repetition code, and the middle and inner codes are both accumulators.

[0046] IRA codes may be implemented in a variety of channels, including memoryless channels, such as the BEC, BSC, and AWGN, as well as channels having non-binary input, non-symmetric and fading channels, and/or channels with memory.

[0047] A number of embodiments have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention. Accordingly, other embodiments are within the scope of the following claims.

CLAIMS

1. A method of encoding a signal, comprising:

obtaining a block of data in the signal to be encoded;

partitioning said data block into a plurality of sub-blocks, each sub-block including a plurality of data elements;

first encoding said data block to form a first encoded data block, said first encoding including repeating the data elements in different sub-blocks a different number of times

interleaving the repeated data elements in the first encoded data block; and

second encoding said first encoded data block using an encoder that has a rate close to one.

2. The method of claim 1, wherein said second encoding is via a rate 1 linear transformation.

3. The method of claim 1, wherein said first encoding is carried out by a first coder with a variable rate less than one, and said second encoding is carried out by a second coder with a rate substantially close to one.

4. The method of claim 3, wherein the second coder comprises an accumulator.

5. The method of claim 4, wherein the data elements comprises bits.

6. The method of claim 5, wherein the first coder comprises a repeater operable to repeat different sub-blocks a different number of times in response to a selected degree profile.

7. The method of claim 4, wherein the first coder comprises a low-density generator matrix coder and the second coder comprises an accumulator.

8. The method of claim 1, wherein the second encoding uses a transfer function of $1/(1+D)$.

9. The method of claim 1, wherein the second encoding uses a transfer function of $1/(1+D+D^2)$.

10. The method of claim 1, wherein said second encoding utilizes two accumulators.

11. A method of encoding a signal, comprising:

receiving a block of data the signal to be encoded, said data block including a plurality of bits;

first encoding the data block such that each bit in the data block is repeated and two or more of said bits are repeated a different number of times in order to form a first encoded data block; and

second encoding the first encoded data block in such a way that the bits in the first encoded data block are accumulated.

12. The method of claim 11, wherein the said second coding is via a rate 1 linear transformation.

13. The method of claim 11, wherein the first coding is via a low-density generator matrix transformation.

14. The method of claim 11, wherein the signal to be encoded comprises a plurality of data blocks of fixed size.

15. A coder comprising:

a first coder having an input configured to receive a stream of bits, said first coder operative to repeat said bits irregularly and scramble said repeated bits; and

a second coder operative to further encode bits output from the first coder at a rate close to one.

16. The coder of claim 15, wherein the stream of bits includes a data block, and wherein the first coder is operative to apportion said data block into a plurality of sub-blocks and to repeat bits in the each sub-block a number of times, wherein bits in different sub-blocks are repeated a different number of times.

17. The coder of claim 15, wherein the first coder comprises a repeater having a variable rate and an interleaver.

18. The coder of claim 15, wherein the first coder comprises a low-density generator matrix coder.

19. The coder of claim 15, wherein the second coder comprises a rate 1 linear encoder.

20. The coder of claim 19, wherein the second coder comprises an accumulator.

21. The coder of claim 20, wherein the second coder further comprises a second accumulator.

22. The coder of claim 16, wherein the second coder comprises a recursive convolutional encoder with a transfer function of $1/(1 + D)$.

23. The coder of claim 16, wherein the second coder comprises a recursive convolutional encoder with a transfer function of $1/(1 + D + D^2)$.

24. A coding system comprising:

a first coder having an input configured to receive a stream of bits, said first coder operative to repeat said bits irregularly and scramble said repeated bits;

a second coder operative to further encode the bits output from the first coder at a rate close to one in order to form an encoded data stream; and

a decoder operative to receive the encoded data stream and decode the encoded data stream using an iterative decoding technique.

25. The coding system of claim 24, wherein the first coder comprises a repeater operative to receive a data

block including a plurality of bits from said stream of bits and to repeat bits in the data block a different number of times according to selected a degree profile.

26. The coding system of claim 25, wherein the first coder comprises an interleaver.

27. The coding system of claim 24, wherein the first coder comprises a low-density generator matrix coder.

28. The coding system of claim 24, wherein the second coder comprises a rate 1 accumulator.

29. The coding system of claim 24, wherein the decoder is operative to decode the data using a posterior decoding techniques.

30. The coding system of claim 24, wherein the decoder is operative to decode the data based on a Tanner graph representation.

31. The coding system of claim 24, wherein the decoder is operative to decode the data in linear time.

ABSTRACT OF THE DISCLOSURE

[0048] A serial concatenated coder includes an outer coder and an inner coder. The outer coder irregularly repeats bits in a data block according to a degree profile and scrambles the repeated bits. The scrambled and repeated bits are input to an inner coder, which has a rate substantially close to one.

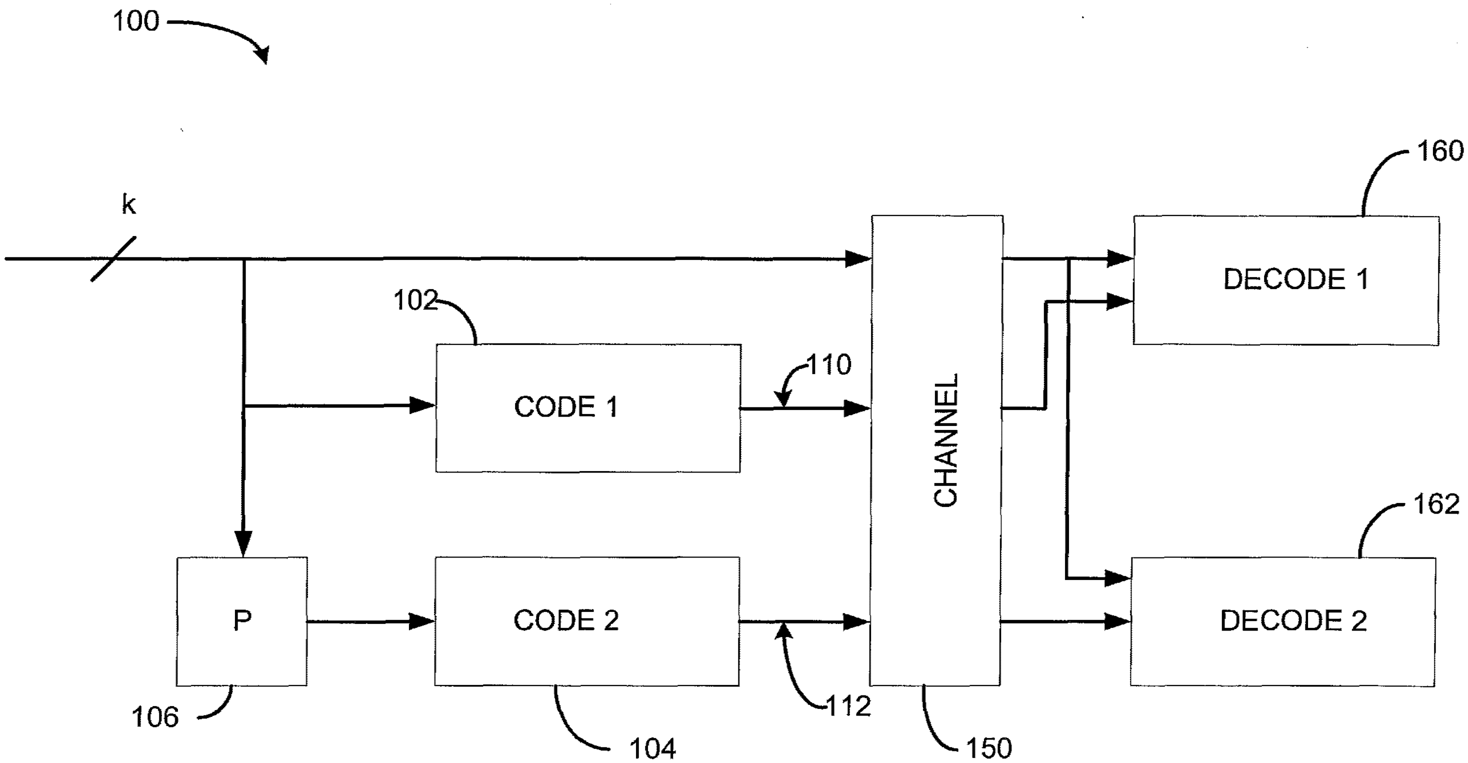

FIG. 1
PRIOR ART

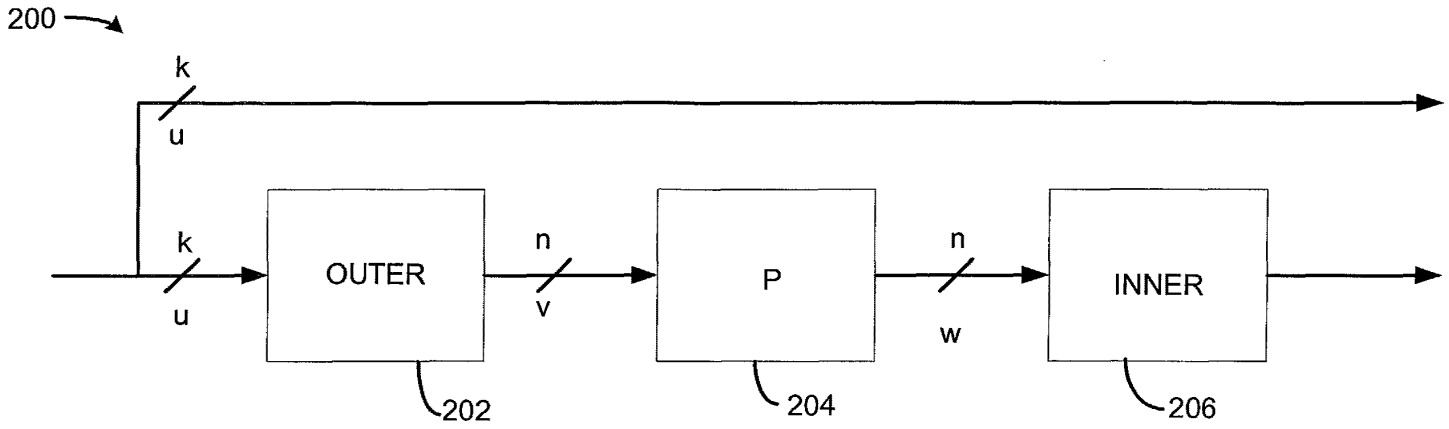

FIG. 2

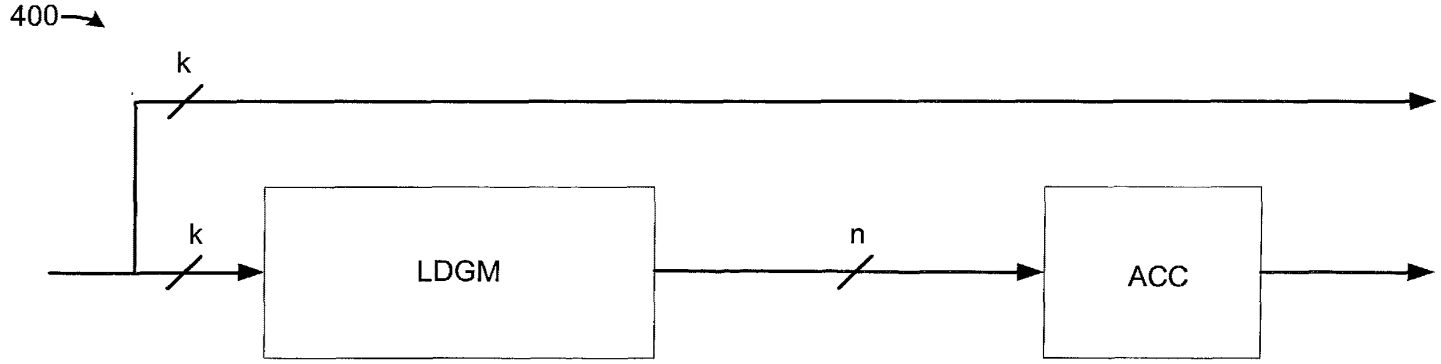

FIG. 4

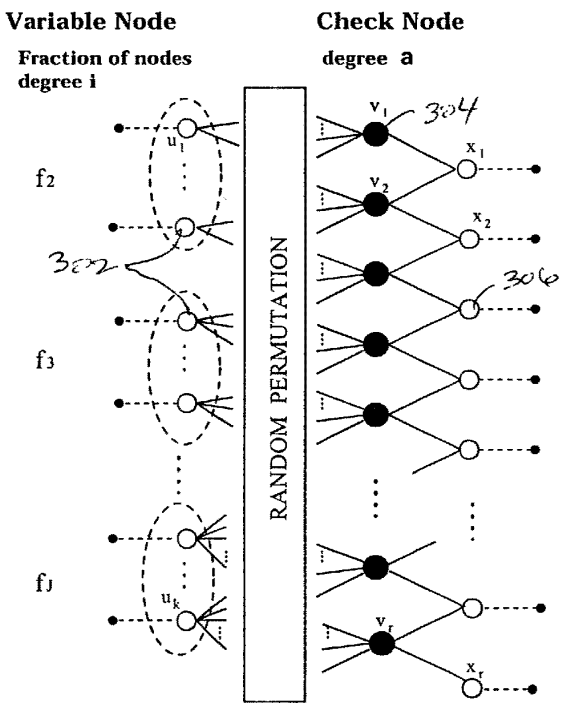
Variable Node
Fraction of nodes degree i
Check Node
degree a
f2
f3
fJ
RANDOM PERMUTATION
304
306
302

FIG. 3

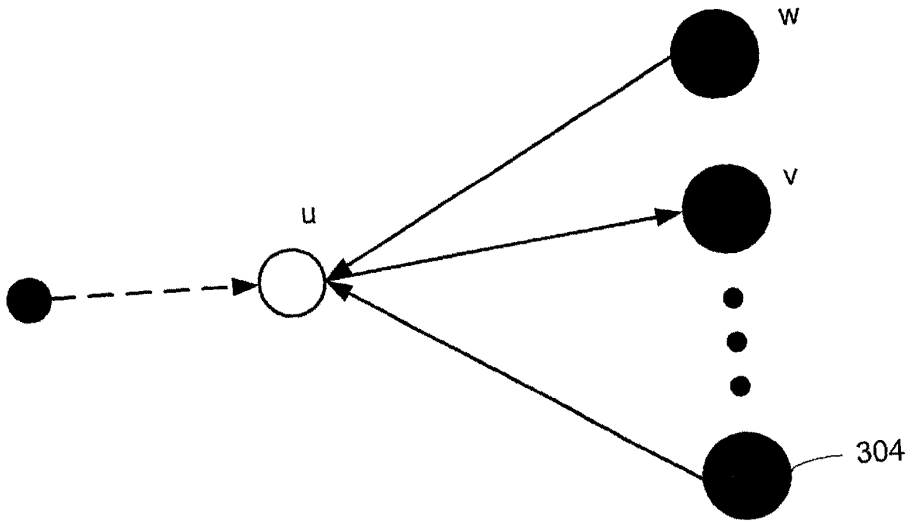

FIG. 5A

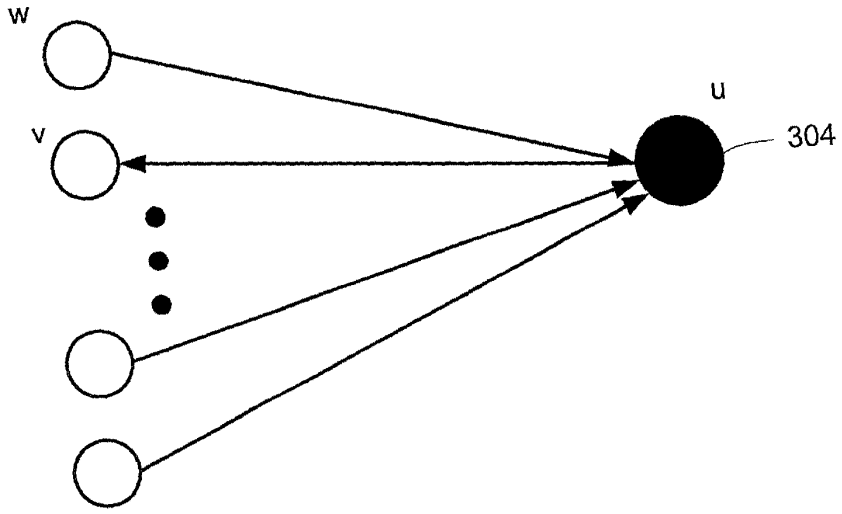

FIG. 5B

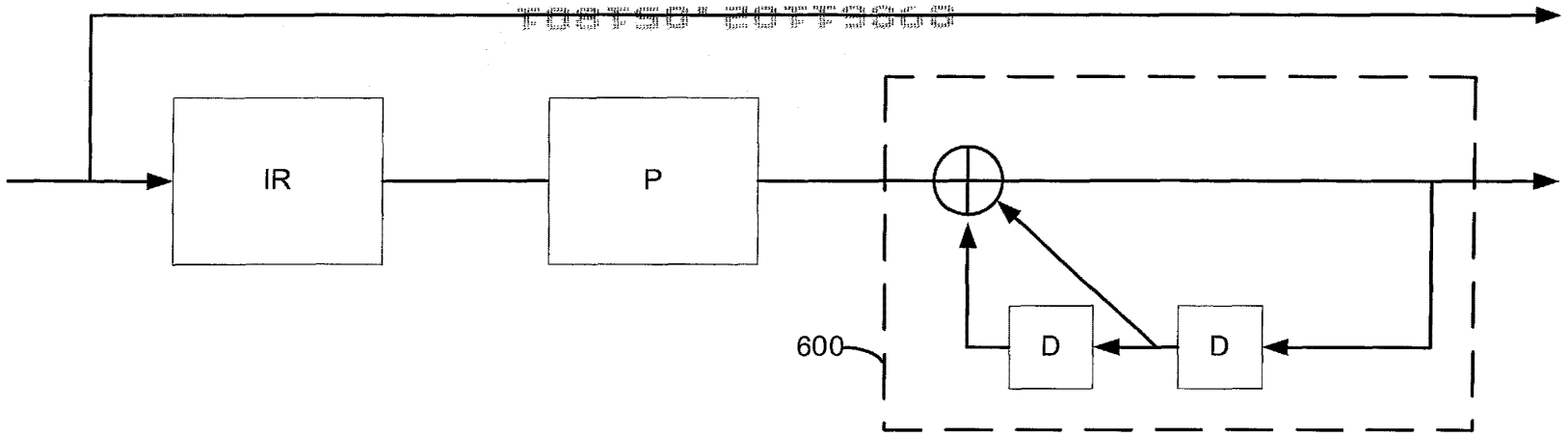

FIG. 6

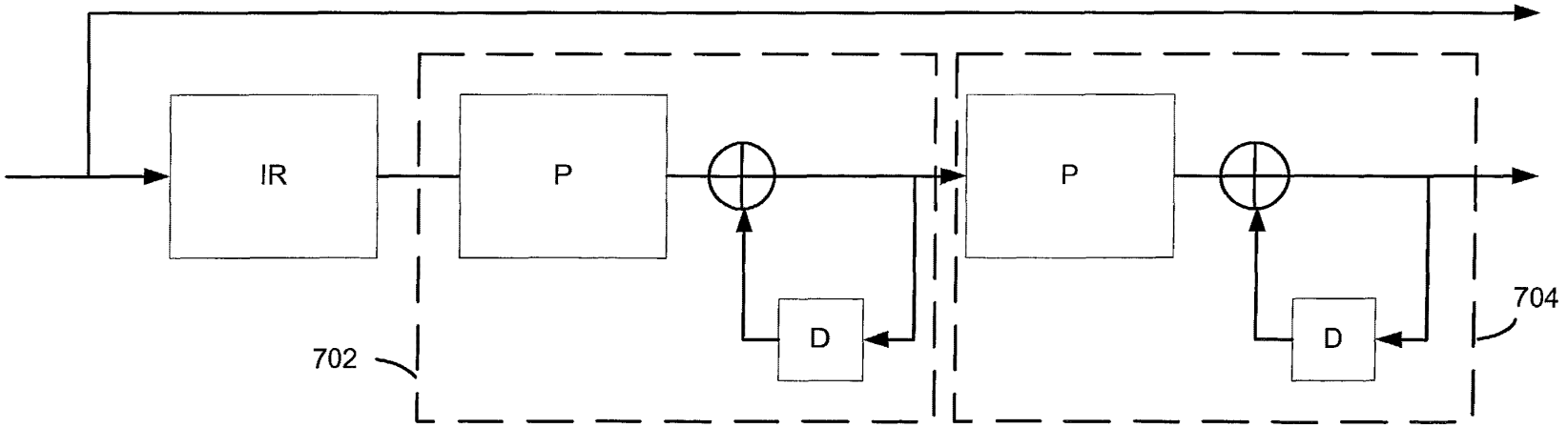

FIG. 7

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Bib Data Sheet

CONFIRMATION NO. 6026

SERIAL NUMBER	FILING DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
09/861,102	05/18/2001 RULE	375	~~2671~~ 2634	06618-637001 / CIT3220

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Aamod Khandekar, Pasadena, CA;
Robert J. McEliece, Pasadena, CA;

**** CONTINUING DATA ***************************

THIS APPLN CLAIMS BENEFIT OF 60/205,095 05/18/2000 OK! DH

**** FOREIGN APPLICATIONS ******************** NONE! DH

IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 07/27/2001 ** SMALL ENTITY ** OK! DH

Foreign Priority claimed	STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
☐ yes ☑ no	NJ	5	31	4
35 USC 119 (a-d) conditions met: ☐ yes ☑ no ☐ Met after Allowance				
Verified and Acknowledged: Examiner's Signature _____ Initials DH				

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TITLE

Serial concatenation of interleaved convolutional codes forming turbo-like codes

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PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2000

Application or Docket Number: 09861102

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	31	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	31 minus 20=	* 11
INDEPENDENT CLAIMS	4 minus 3 =	* 1
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☐		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	355.00	OR	BASIC FEE	710.00
X$ 9=	99.00	OR	X$18=	
X40=	40.00	OR	X80=	
+135=		OR	+270=	
TOTAL	494.00	OR	TOTAL	

CLAIMS AS AMENDED - PART II

AMENDMENT A	(Column 1) [redacted]	(Column 2) [redacted]	(Column 3)
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Independent	*	Minus ***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM			☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
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X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B	(Column 1) [redacted]	(Column 2) [redacted]	(Column 3)
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Independent	*	Minus ***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM			☐

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X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C	(Column 1) [redacted]	(Column 2) [redacted]	(Column 3)
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Independent	*	Minus ***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM			☐

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X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
***If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

CLAIMS ONLY

SERIAL NO.	FILING DATE
09861102	

APPLICANT(S)

CLAIMS

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TOTAL DEP.		⬅		⬅		⬅
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TOTAL IND.		⬇		⬇		⬇
TOTAL DEP.		⬅		⬅		⬅
TOTAL CLAIMS						

* *MAY BE USED FOR ADDITIONAL CLAIMS OR ADMENDMENTS*

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