UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,916,781 B2
APPLICATION NO. : 12/165606
DATED : March 29, 2011
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:

On the Title Page

Item [63], the sentence reading:
"Continuation of application No. 11/542,950, filed on Oct. 3, 2006, now Pat. No. 7,421,032, which is a continuation of application No. 09/861,102, filed on May 18, 2001, now Pat. No. 7,116,710, which is a continuation-in-part of application No. 09/922,852, filed on Aug. 18, 2000, now Pat. No. 7,089,477."

Should read:
-- Continuation of application No. 11/542,950, filed on Oct. 3, 2006, now Pat. No. 7,421,032, which is a continuation of application No. 09/861,102, filed on May 18, 2001, now Pat. No. 7,116,710. --

In the Specification

Column 1, Line 8, the sentence reading:
"This application is a continuation of U.S. application Ser. No. 11/542,950, filed Oct. 3, 2006 now U.S. Pat. No. 7,421,032, which is a continuation of U.S. application Ser. No. 09/861,102, filed May 18, 2001, now U.S. Pat. No. 7,116,710, which claims the priority of U.S. Provisional Application Ser. No. 60/205,095, filed May 18, 2000, and is a continuation-in-part of U.S. application Ser. No. 09/922,852, filed Aug. 18, 2000, now U.S. Pat. No. 7,089,477."

Should read:
-- This application is a continuation of U.S. application Ser. No. 11/542,950, filed Oct. 3, 2006, now U.S. Pat. No. 7,421,032, which is a continuation of U.S. application Ser. No. 09/861,102, filed May 18, 2001, now U.S. Pat. No. 7,116,710, which claims the priority of U.S. Provisional Application Ser. No. 60/205,095, filed 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.
12/165,606	06/30/2008	Hui Jin	009081-8025.US00	2149

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. 7916781	Applicant(s) Jin et al.
	Issue Date 03/29/2011	Docket No. 009081-8025.US00

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 was issued to dismiss the request for the correction.

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.
12/165,606	06/30/2008	Hui Jin	009081-8025.US00	2149

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. 7,916,781
Issue Date: March 29, 2011
Application No. 12/165,606
Filing or 371(c) Date: 30 Jun 2008
Attorney Docket No. 009081-8025.US00

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. 12/165,606	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

Refund Accounting Date:04/06/2022

Effective Date	Sale Item Reference Number	Refund Total
12/13/2019	12165606	$400.00

Document Number	Fee Code	Fee Code Description	Amount Paid	Payment Method	Account Number
I202246928103071	1462	PETITION FEE- 37 CFR 1.17(F) (GROUP I)	$400.00	DA	232415

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	12165606

Document Number	Fee Code	Fee Code Description	Amount Paid	Payment Method
I202246928103071	1462	PETITION FEE- 37 CFR 1.17(F) (GROUP I)	$400.00	DA

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
12/165,606	06/30/2008	Hui Jin	009081-8025.US00

CONFIRMATION NO. 2149

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

POA ACCEPTANCE LETTER

OC00000132694150

Date Mailed: 03/25/2022

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**.

/sltorres/

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
12/165,606	06/30/2008	Hui Jin	009081-8025.US00

CONFIRMATION NO. 2149

97075
Perkins Coie LLP - SDO General
PO Box 1247
Seattle, WA 98111-1247

POWER OF ATTORNEY NOTICE

OC00000132694145

Date Mailed: 03/25/2022

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**.

/sltorres/

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. : 7,916,781

APPLICATION NO.: 12/165,606

ISSUE DATE : March 29, 2011

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:

On the cover page in the "Related U.S. Application Data" section, the sentence reading

"Continuation of application No. 11/542,950, filed on Oct. 3, 2006, now Pat. No. 7,421,032, which is a continuation of application No. 09/861,102, filed on May 18, 2001, now Pat. No. 7,116,710, which is a continuation-in-part of application No. 09/922,852, filed on Aug. 18, 2000, now Pat. No. 7,089,477."

should read

-- Continuation of application No. 11/542,950, filed on Oct. 3, 2006, now Pat. No. 7,421,032, which is a continuation of application No. 09/861,102, filed on May 18, 2001, now Pat. No. 7,116,710. --

At column 1, line 8, the sentence reading

"This application is a continuation of U.S. application Ser. No. 11/542,950, filed Oct. 3, 2006 now U.S. Pat. No. 7,421,032, which is a continuation of U.S. application Ser. No. 09/861,102, filed May 18, 2001, now U.S. Pat. No. 7,116,710, which claims the priority of U.S. Provisional Application Ser. No. 60/205,095, filed May 18, 2000, and is a continuation-in-part of U.S. application Ser. No. 09/922,852, filed Aug. 18, 2000, now U.S. Pat. No. 7,089,477."

should read

-- This application is a continuation of U.S. application Ser. No. 11/542,950, filed Oct. 3, 2006, now U.S. Pat. No. 7,421,032, which is a continuation of U.S. application Ser. No. 09/861,102, filed May 18, 2001, now U.S. Pat. No. 7,116,710, which claims the priority of U.S. Provisional Application Ser. No. 60/205,095, filed 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:	12165606
Filing Date:	30-Jun-2008
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:	009081-8025.US00

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:	45280892
Application Number:	12165606
International Application Number:	
Confirmation Number:	2149
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Customer Number:	97075
Filer:	Ethan Richard Fitzpatrick/Teresa Rodriguez
Filer Authorized By:	Ethan Richard Fitzpatrick
Attorney Docket Number:	009081-8025.US00
Receipt Date:	21-MAR-2022
Filing Date:	30-JUN-2008
Time Stamp:	19:21:31
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	E20223KJ21533580
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	7916781-Request-for-CoC.pdf	130633 985082f4a648cdaa05c900f1dfc0701c538d898d	no	3
Warnings:					
Information:					
2	Request for Certificate of Correction	CoC-Form-US7916781.pdf	648059 8736ae0dcf5d003fd6224d323f5a780d1522d836	no	2
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	38099 23e8ca89496df64aab45a1661ea10a1df044a6b0	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	816791		

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. 7,916,781		)	
Inventors:	Hui Jin *et al.*	)	Examiner Dac V. Ha
Issued:	March 29, 2011	)	Art Unit 2611
Serial No.:	12/165,606	)	
Filed:	June 30, 2008	)	
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:

On the cover page in the "Related U.S. Application Data" section, the sentence reading

"Continuation of application No. 11/542,950, filed on Oct. 3, 2006, now Pat. No. 7,421,032, which is a continuation of application No. 09/861,102, filed on May 18, 2001, now Pat. No. 7,116,710, which is a continuation-in-part of application No. 09/922,852, filed on Aug. 18, 2000, now Pat. No. 7,089,477."

should read

-- Continuation of application No. 11/542,950, filed on Oct. 3, 2006, now Pat. No. 7,421,032, which is a continuation of application No. 09/861,102, filed on May 18, 2001, now Pat. No. 7,116,710. --

At column 1, line 8, the sentence reading

"This application is a continuation of U.S. application Ser. No. 11/542,950, filed Oct. 3, 2006 now U.S. Pat. No. 7,421,032, which is a continuation of U.S. application Ser. No. 09/861,102, filed May 18, 2001, now U.S. Pat. No. 7,116,710, which claims the priority of U.S. Provisional Application Ser. No. 60/205,095, filed May 18, 2000, and is a continuation-in-part of U.S. application Ser. No. 09/922,852, filed Aug. 18, 2000, now U.S. Pat. No. 7,089,477."

should read

-- This application is a continuation of U.S. application Ser. No. 11/542,950, filed Oct. 3, 2006, now U.S. Pat. No. 7,421,032, which is a continuation of U.S. application Ser. No. 09/861,102, filed May 18, 2001, now U.S. Pat. No. 7,116,710, which claims the priority of U.S. Provisional Application Ser. No. 60/205,095, filed 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	7,916,781
Issue Date	March 29, 2011
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		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.: 7,916,781 Filed/Issue Date: March 29, 2011

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 021710, Frame 0863, 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.
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 Acknowledgement Receipt

EFS ID:	45276422
Application Number:	12165606
International Application Number:	
Confirmation Number:	2149
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Customer Number:	97075
Filer:	Ethan Richard Fitzpatrick/Teresa Rodriguez
Filer Authorized By:	Ethan Richard Fitzpatrick
Attorney Docket Number:	009081-8025.US00
Receipt Date:	21-MAR-2022
Filing Date:	30-JUN-2008
Time Stamp:	15:04:13
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	7916781-POA.PDF	615781 c569ca17672ba94158a26f06e4153f1c2ead032a	no	2
Warnings:					

Information:					
2	Assignee showing of ownership per 37 CFR 3.73	7916781-sb0096_2.pdf	171029 b6cea49202c3bd71794627becdab21dbd51e2802	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	786810	

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

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 * 12/165,606 *	Application/Control No. 12/165,606	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: 12 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): 009081-8025.US00

Application/Control Number: 12/165,606
Filing Date: 2008-06-30
First Named Inventor: Hui JIN
Title: SERIAL CONCANTENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
Patent No.: 7.916.781

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. 43312

/Bing Ai/	August 12, 2020
Signature	Date
Bing Ai	(858) 720-5707
Typed or printed name	Telephone number

☑ 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.

This collection of information is required by 37 CFR 1.321. 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 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.

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.: 7,916,781 Filed/Issue Date: 2011-03-29

Titled:
SERIAL CONCANTENATION 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 21710, Frame 0863, 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.

/Bing Ai/ August 12, 2020
Signature Date

Bing Ai 43,312
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.
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:	12165606
Filing Date:	30-Jun-2008
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:	009081-8025.US00
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:	40269227
Application Number:	12165606
International Application Number:	
Confirmation Number:	2149
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Customer Number:	97075
Filer:	Bing Ai/Amy Candeloro
Filer Authorized By:	Bing Ai
Attorney Docket Number:	009081-8025.US00
Receipt Date:	12-AUG-2020
Filing Date:	30-JUN-2008
Time Stamp:	20:12:17
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	E20208BK12453586
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 1.20 (Post Issuance fees)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Terminal Disclaimer Filed	2020-08-12_Terminal-Disclaimer-7916781.PDF	171605 8ed801022f3a36b5bc0c0a3bbb3761873bae3ee5	no	2
Warnings:					
Information:					
2	Assignee showing of ownership per 37 CFR 3.73	2020-08-12_373-Statement-Ownership-7916781.PDF	175980 ccb5f6a978f718ef23892bb64ba4156a34f0b564	no	2
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30437 777173d41b7eb9d0ba24cab3025aa8807ea8fa2f	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	378022		

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.

(12) **INTER PARTES REVIEW CERTIFICATE** (1736th)
United States Patent
Jin et al.

(10) **Number: US 7,916,781 K2**
(45) **Certificate Issued: May 1, 2020**

(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:

IPR2017-00297 filed Dec. 12, 2016
IPR2017-00423 filed Dec. 12, 2016

Inter Partes Review Certificate for:

Patent No.: **7,916,781**
Issued: **Mar. 29, 2011**
Appl. No.: **12/165,606**
Filed: **Jun. 30, 2008**

The results of IPR2017-00297; IPR2017-00423 are reflected in this inter partes review certificate under 35 U.S.C. 318(b).

INTER PARTES REVIEW CERTIFICATE
U.S. Patent 7,916,781 K2
Trial No. IPR2017-00297
Certificate Issued May 1, 2020

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

Claims **13-16**, **18**, **22** are found patentable.

Claims **19-21** are cancelled.

* * * * *

Attorney Docket No. 009081-8025.US00
WSGR No. 38075-700

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Patent of:	Confirmation No.: 2149
Inventors: Hui Jin *et al.*	Examiner: Dac V. Ha
Application No.: 12/165,606	Group Art Unit: 2611
Filed: June 30, 2008	Customer No.: 97075
Patent No.: 7,916,781	
Issued: March 29, 2011	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. 7,916,781. The undersigned certifies that the original Letters Patent was lost.

It is hereby respectfully petitioned that the Office expediate 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 C.F.R. § 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:	12165606
Filing Date:	30-Jun-2008
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:	009081-8025.US00

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:	38031333
Application Number:	12165606
International Application Number:	
Confirmation Number:	2149
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Customer Number:	97075
Filer:	Charles C. Hagadorn III/Hillary Pratt
Filer Authorized By:	Charles C. Hagadorn III
Attorney Docket Number:	009081-8025.US00
Receipt Date:	13-DEC-2019
Filing Date:	30-JUN-2008
Time Stamp:	19:18:45
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	E2019BCJ19206023
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_916_781_Petition_1_182.pdf	139311 569d91ad32c65cd534a282bc7593ba2e8ff6f331	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30528 cc77342dea0f94de6a5e5018ae24ca2274cabe9c	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	169839		

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

2018-2332, 2018-2410, 2018-2411, 2018-2412

Appeals from the United States Patent and Trademark Office, Patent Trial and Appeal Board in Nos. IPR2017-00297, IPR2017-00423, IPR2017-00700, IPR2017-00701, IPR2017-00728.

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; MICHAEL H. SMITH, Washington, DC; MARK CHRISTOPHER FLEMING, LAUREN B. FLETCHER, 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 (DYK, TARANTO, and STOLL, *Circuit Judges*).

AFFIRMED. See Fed. Cir. R. 36.

ENTERED BY ORDER OF THE COURT

November 13, 2019
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

2018-2332, 2018-2410, 2018-2411, 2018-2412

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. IPR2017-00297, IPR2017-00423, IPR2017-00700, IPR2017-00701, IPR2017-00728.

MANDATE

In accordance with the judgment of this Court, entered November 13, 2019, and pursuant to Rule 41 of the Federal Rules of Appellate Procedure, the formal mandate is hereby issued.

FOR THE COURT

December 20, 2019

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

Trials@uspto.gov
Tel: 571-272-7822

Paper 18
Entered: June 29, 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 IPR2017-00423[1]
Patent 7,916,781 B2

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

HUDALLA, *Administrative Patent Judge*.

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

In Case IPR2017-00297 ("297 IPR"), Petitioner, Apple, Inc. ("Petitioner"), filed a Petition (Paper 5,[2] "297 Petition" or "297 Pet.") requesting an *inter partes* review of claims 3–12 and 19–21 of U.S. Patent

---

[1] Case IPR2017-00423 has been consolidated with this proceeding.

[2] Unless otherwise indicated, citations to papers and exhibits are made to Case IPR2017-00297.

No. 7,916,781 B2 (Ex. 1001, "the '781 patent"). Patent Owner, California Institute of Technology ("Patent Owner"), filed a Preliminary Response to the 297 Petition. Paper 14 ("297 Preliminary Response" or "297 Prelim. Resp."). Taking into account the arguments presented in Patent Owner's 297 Preliminary Response, we determined that the information presented in the 297 Petition established that there was a reasonable likelihood that Petitioner would prevail in challenging claims 19–21 of the '781 patent under 35 U.S.C. § 102(b). Pursuant to 35 U.S.C. § 314, we instituted this proceeding on July 5, 2017, as to claims 19–21 of the '781 patent. Paper 16 ("297 Institution Decision" or "297 Dec. on Inst.").

In related Case IPR2017-00423 ("423 IPR"), Petitioner filed a second Petition (423 IPR, Paper 5, "423 Petition" or "423 Pet.") requesting an *inter partes* review of claims 13–22 of the '781 patent. Patent Owner filed a Preliminary Response to the 423 Petition. 423 IPR, Paper 14 ("423 Preliminary Response" or "423 Prelim. Resp."). Taking into account the arguments presented in Patent Owner's 423 Preliminary Response, we determined that the information presented in the 423 Petition established that there was a reasonable likelihood that Petitioner would prevail in challenging claims 13–16, 18, and 22 of the '781 patent under 35 U.S.C. § 103(a). Pursuant to 35 U.S.C. § 314, we instituted an *inter partes* review proceeding on July 5, 2017, as to claims 13–16, 18, and 22 of the '781 patent. Paper 18[3] ("423 Institution Decision" or "423 Dec. on Inst."). In the 423 Institution Decision, we ordered the consolidation of the 423 IPR with the 297 IPR for purposes of trial. *Id.* at 25.

[3] The 423 Institution Decision is included in the 297 IPR as Paper 18 because it includes a consolidation order.

During the course of trial, Patent Owner filed a Patent Owner Response (Paper 31, "PO Resp."), and Petitioner filed a Reply to the Patent Owner Response (Paper 38, "Pet. Reply"). Patent Owner also filed a Sur-Reply (Paper 54, "PO Sur-Reply"), as was authorized by our Order of March 2, 2018 (Paper 47). An oral hearing was held on April 19, 2018, and a transcript of the hearing is included in the record. Paper 65 ("Tr.").

Petitioner filed Declarations of James A. Davis, Ph.D., with the 297 Petition (Ex. 1004) and the 423 Petition (Ex. 1024). Petitioner also filed a Declaration of Brendan Frey, Ph.D. (Ex. 1049) with its Reply. Patent Owner filed a Declaration of Michael Mitzenmacher, Ph.D., with its Response (Ex. 2004). The parties also filed transcripts of the depositions of Dr. Davis (Ex. 2033) and Dr. Mitzenmacher (Ex. 1045).

As authorized in our Order of February 10, 2018 (Paper 39), Patent Owner filed a motion for sanctions related to Petitioner's cross-examination of Patent Owner's witness, Dr. Mitzenmacher[4] (Paper 40), and Petitioner filed an opposition (Paper 44).

Patent Owner also filed a motion to exclude certain exhibits filed by Petitioner. Paper 49. Petitioner filed an opposition (Paper 53), and Patent Owner filed a reply (Paper 55).

In light of the U.S. Supreme Court's decision in *SAS Institute, Inc. v. Iancu*, 138 S. Ct. 1348 (2018), we modified the 297 Institution Decision and

---

[4] Petitioner's motion also seeks sanctions related to Petitioner's cross-examination of Dariush Divsalar, Ph.D., in certain related cases. *See* Paper 40, 3–7. Nevertheless, Patent Owner did not file direct testimony from Dr. Divsalar in this consolidated case. Accordingly, we only address Patent Owner's motion for sanctions in this case to the extent it relates to Dr. Mitzenmacher's cross-examination.

the 423 Institution Decision to institute on all of the challenged claims and all of the grounds presented in the 297 Petition and the 423 Petition. Paper 61. Subsequently, the parties filed a joint motion to limit the Petitions to the claims and grounds that were originally instituted. Paper 63. We granted the motion. Paper 64. As a result, the remaining instituted grounds are the same as they had been at the time of the 297 Institution Decision and the 423 Institution Decision. *See id.* at 3.

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 13–16 and 18–22 of the '781 patent. For the reasons discussed below, Petitioner has demonstrated by a preponderance of the evidence that claims 19–21 are unpatentable. Petitioner has not demonstrated by a preponderance of the evidence that claims 13–16, 18, and 22 are unpatentable.

I. BACKGROUND

A. Related Proceedings

The parties identify the following district court cases related to the '781 patent (297 Pet. 1; 423 Pet. 1; Paper 7, 1):

Cal. Inst. of Tech. v. Broadcom Ltd., No. 2:16-cv-03714 (C.D. Cal. filed May 26, 2016);[5]

Cal. Inst. of Tech. v. Hughes Commc'ns, Inc., No. 2:15-cv-01108 (C.D. Cal. filed Feb. 17, 2015); and

[5] Petitioner is a defendant in this case. *See* 297 Pet. 1; 423 Pet. 1.

Cal. Inst. of Tech. v. Hughes Commc'ns, Inc., 2:13-cv-07245 (C.D. Cal. filed Oct. 1, 2013).

The '781 patent was previously subject to an *inter partes* review in Case IPR2015-00059 ("059 IPR"). 297 Pet. 1, 19; 423 Pet. 1, 19; Ex. 1011; Paper 7, 1. In the Final Written Decision from the 059 IPR, which Petitioner filed as Exhibit 1011 in this proceeding, the Board determined that claims 1 and 2 of the '781 patent are unpatentable as anticipated by a reference known as "Divsalar" that is no longer at issue in this consolidated proceeding. *See* Ex. 1011, 43.

Petitioner additionally states that patents in the priority chain of the '781 patent were challenged in Cases IPR2015-00068, IPR2015-00067, IPR2015-00060, IPR2015-00061, and IPR2015-00081. 297 Pet. 1; 423 Pet. 1. We additionally identify the following cases between the parties: Cases IPR2017-00210, IPR2017-00211, IPR2017-00219, IPR2017-00700, IPR2017-00701, IPR2017-00702, IPR2017-00703, and IPR2017-00728.

B. The '781 patent

The '781 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.

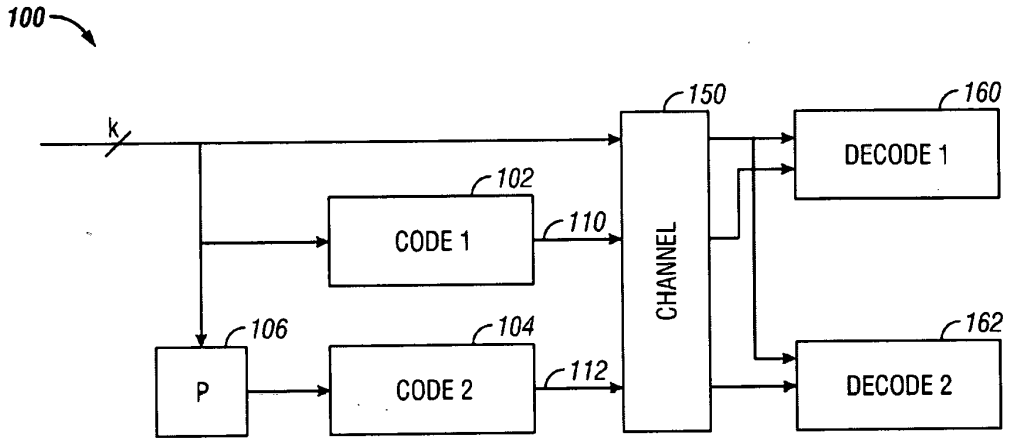


FIG. 1
(Prior Art)

Figure 1 is a schematic diagram of a prior "turbo code" system. *Id.* at 2:20–21. The '781 patent specification describes Figure 1 as follows:

> 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 1:44–60.

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

Trials@uspto.gov
Tel: 571-272-7822

Paper 66
Entered: June 29, 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 IPR2017-00297[1]
Patent 7,916,781 B2

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

HUDALLA, *Administrative Patent Judge*.

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

In Case IPR2017-00297 ("297 IPR"), Petitioner, Apple, Inc. ("Petitioner"), filed a Petition (Paper 5,[2] "297 Petition" or "297 Pet.") requesting an *inter partes* review of claims 3–12 and 19–21 of U.S. Patent

---

[1] Case IPR2017-00423 has been consolidated with this proceeding.

[2] Unless otherwise indicated, citations to papers and exhibits are made to Case IPR2017-00297.

No. 7,916,781 B2 (Ex. 1001, "the '781 patent"). Patent Owner, California Institute of Technology ("Patent Owner"), filed a Preliminary Response to the 297 Petition. Paper 14 ("297 Preliminary Response" or "297 Prelim. Resp."). Taking into account the arguments presented in Patent Owner's 297 Preliminary Response, we determined that the information presented in the 297 Petition established that there was a reasonable likelihood that Petitioner would prevail in challenging claims 19–21 of the '781 patent under 35 U.S.C. § 102(b). Pursuant to 35 U.S.C. § 314, we instituted this proceeding on July 5, 2017, as to claims 19–21 of the '781 patent. Paper 16 ("297 Institution Decision" or "297 Dec. on Inst.").

In related Case IPR2017-00423 ("423 IPR"), Petitioner filed a second Petition (423 IPR, Paper 5, "423 Petition" or "423 Pet.") requesting an *inter partes* review of claims 13–22 of the '781 patent. Patent Owner filed a Preliminary Response to the 423 Petition. 423 IPR, Paper 14 ("423 Preliminary Response" or "423 Prelim. Resp."). Taking into account the arguments presented in Patent Owner's 423 Preliminary Response, we determined that the information presented in the 423 Petition established that there was a reasonable likelihood that Petitioner would prevail in challenging claims 13–16, 18, and 22 of the '781 patent under 35 U.S.C. § 103(a). Pursuant to 35 U.S.C. § 314, we instituted an *inter partes* review proceeding on July 5, 2017, as to claims 13–16, 18, and 22 of the '781 patent. Paper 18[3] ("423 Institution Decision" or "423 Dec. on Inst."). In the 423 Institution Decision, we ordered the consolidation of the 423 IPR with the 297 IPR for purposes of trial. *Id.* at 25.

[3] The 423 Institution Decision is included in the 297 IPR as Paper 18 because it includes a consolidation order.

During the course of trial, Patent Owner filed a Patent Owner Response (Paper 31, "PO Resp."), and Petitioner filed a Reply to the Patent Owner Response (Paper 38, "Pet. Reply"). Patent Owner also filed a Sur-Reply (Paper 54, "PO Sur-Reply"), as was authorized by our Order of March 2, 2018 (Paper 47). An oral hearing was held on April 19, 2018, and a transcript of the hearing is included in the record. Paper 65 ("Tr.").

Petitioner filed Declarations of James A. Davis, Ph.D., with the 297 Petition (Ex. 1004) and the 423 Petition (Ex. 1024). Petitioner also filed a Declaration of Brendan Frey, Ph.D. (Ex. 1049) with its Reply. Patent Owner filed a Declaration of Michael Mitzenmacher, Ph.D., with its Response (Ex. 2004). The parties also filed transcripts of the depositions of Dr. Davis (Ex. 2033) and Dr. Mitzenmacher (Ex. 1045).

As authorized in our Order of February 10, 2018 (Paper 39), Patent Owner filed a motion for sanctions related to Petitioner's cross-examination of Patent Owner's witness, Dr. Mitzenmacher[4] (Paper 40), and Petitioner filed an opposition (Paper 44).

Patent Owner also filed a motion to exclude certain exhibits filed by Petitioner. Paper 49. Petitioner filed an opposition (Paper 53), and Patent Owner filed a reply (Paper 55).

In light of the U.S. Supreme Court's decision in *SAS Institute, Inc. v. Iancu*, 138 S. Ct. 1348 (2018), we modified the 297 Institution Decision and

---

[4] Petitioner's motion also seeks sanctions related to Petitioner's cross-examination of Dariush Divsalar, Ph.D., in certain related cases. *See* Paper 40, 3–7. Nevertheless, Patent Owner did not file direct testimony from Dr. Divsalar in this consolidated case. Accordingly, we only address Patent Owner's motion for sanctions in this case to the extent it relates to Dr. Mitzenmacher's cross-examination.

the 423 Institution Decision to institute on all of the challenged claims and all of the grounds presented in the 297 Petition and the 423 Petition. Paper 61. Subsequently, the parties filed a joint motion to limit the Petitions to the claims and grounds that were originally instituted. Paper 63. We granted the motion. Paper 64. As a result, the remaining instituted grounds are the same as they had been at the time of the 297 Institution Decision and the 423 Institution Decision. *See id.* at 3.

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 13–16 and 18–22 of the '781 patent. For the reasons discussed below, Petitioner has demonstrated by a preponderance of the evidence that claims 19–21 are unpatentable. Petitioner has not demonstrated by a preponderance of the evidence that claims 13–16, 18, and 22 are unpatentable.

I. BACKGROUND

A. Related Proceedings

The parties identify the following district court cases related to the '781 patent (297 Pet. 1; 423 Pet. 1; Paper 7, 1):

Cal. Inst. of Tech. v. Broadcom Ltd., No. 2:16-cv-03714 (C.D. Cal. filed May 26, 2016);[5]

Cal. Inst. of Tech. v. Hughes Commc'ns, Inc., No. 2:15-cv-01108 (C.D. Cal. filed Feb. 17, 2015); and

[5] Petitioner is a defendant in this case. *See* 297 Pet. 1; 423 Pet. 1.

Cal. Inst. of Tech. v. Hughes Commc'ns, Inc., 2:13-cv-07245 (C.D. Cal. filed Oct. 1, 2013).

The '781 patent was previously subject to an *inter partes* review in Case IPR2015-00059 ("059 IPR"). 297 Pet. 1, 19; 423 Pet. 1, 19; Ex. 1011; Paper 7, 1. In the Final Written Decision from the 059 IPR, which Petitioner filed as Exhibit 1011 in this proceeding, the Board determined that claims 1 and 2 of the '781 patent are unpatentable as anticipated by a reference known as "Divsalar" that is no longer at issue in this consolidated proceeding. *See* Ex. 1011, 43.

Petitioner additionally states that patents in the priority chain of the '781 patent were challenged in Cases IPR2015-00068, IPR2015-00067, IPR2015-00060, IPR2015-00061, and IPR2015-00081. 297 Pet. 1; 423 Pet. 1. We additionally identify the following cases between the parties: Cases IPR2017-00210, IPR2017-00211, IPR2017-00219, IPR2017-00700, IPR2017-00701, IPR2017-00702, IPR2017-00703, and IPR2017-00728.

B. The '781 patent

The '781 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.

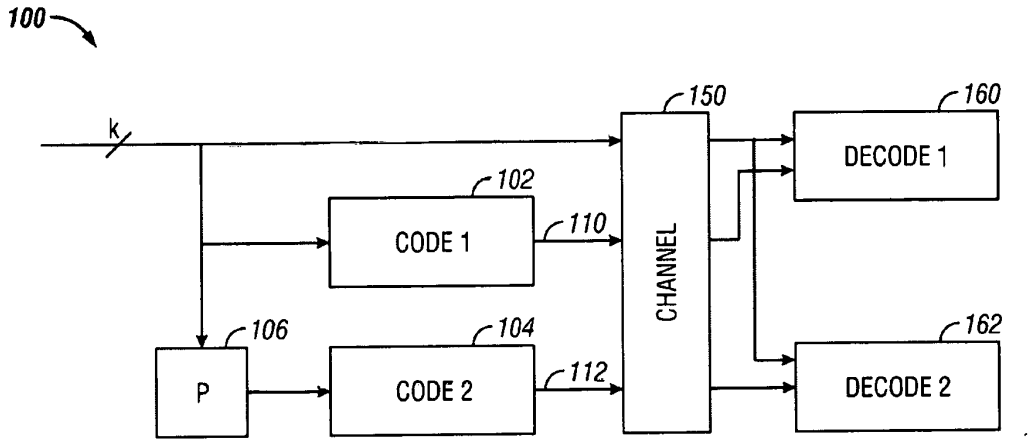


FIG. 1
(Prior Art)

Figure 1 is a schematic diagram of a prior "turbo code" system. *Id.* at 2:20–21. The '781 patent specification describes Figure 1 as follows:

> 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 1:44–60.

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

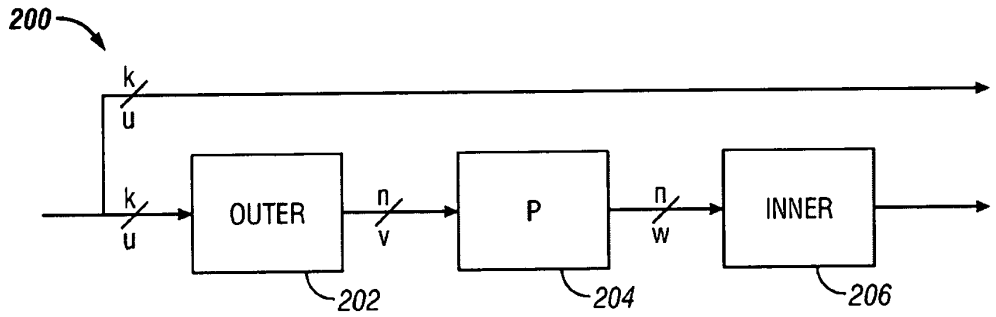


FIG. 2

Figure 2 of the '781 patent is a schematic diagram of coder 200.

> The coder 200 may include an outer coder 202, an interleaver 204, and inner coder 206. . . . The outer coder 202 receives the uncoded data [that] may be partitioned into blocks of fixed size, [e.g.] 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×k matrix, and the rate[6] 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 profilc, 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 $x=T_Iw$, where T_I

[6] We understand that 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.

> is a nonsingular n×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 2:40–3:2 (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 '781 patent is reproduced below.

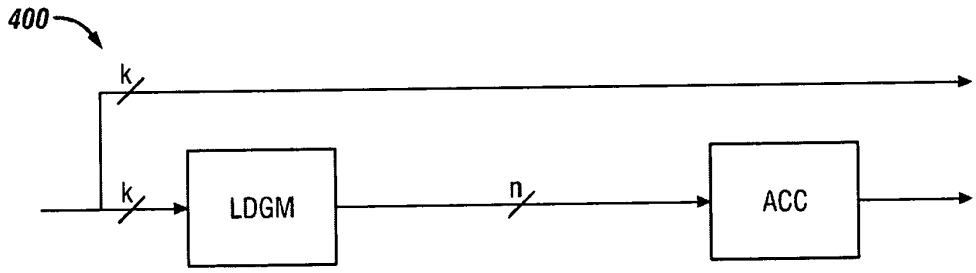


FIG. 4

Figure 4 shows an alternative embodiment in which the first encoding is carried out by a low density generator matrix. Low density generator matrix (LDGM)[7] codes are a special class of low density parity check codes that

[7] We understand that 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.

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 arrangement because the LDGM provides scrambling otherwise provided by the interleaver in the Figure 2 embodiment.

Petitioner notes (297 Pet. 3; 423 Pet. 3) that the '781 patent claims priority to a provisional application filed on May 18, 2000. Ex. 1001, [60]. Patent Owner does not dispute that May 18, 2000, is the effective filing date for the challenged claims of the '781 patent.

C. Illustrative Claims

Claims 13 and 19–21 of the '781 patent are independent. Claims 14–16 and 18 depend directly or indirectly from claim 13, and claim 22 depends from claim 21. Claims 13 and 19 are illustrative of the challenged claims and recite:

> 13. A method of encoding a signal, comprising:
>
> receiving a block of data in the signal to be encoded, the block of data including information bits; and
>
> performing an encoding operation using the information bits as an input, the encoding operation including an accumulation of mod-2 or exclusive-OR sums of bits in subsets of the information bits, the encoding operation generating at least a portion of a codeword,
>
> wherein the information bits appear in a variable number of subsets.
>
> 19. A method of encoding a signal, comprising:
>
> receiving a block of data in the signal to be encoded, the block of data including information bits; and

> performing an encoding operation using the information bits as an input, the encoding operation including an accumulation of mod-2 or exclusive-OR sums of bits in subsets of the information bits, the encoding operation generating at least a portion of a codeword,
>
> wherein at least two of the information bits appear in three subsets of the information bits.

Id. at 8:7–17, 8:35–44.

D. The Prior Art

Petitioner relies on the following prior art:

> MacKay et al., "Comparison of Constructions of Irregular Gallager Codes," IEEE TRANSACTIONS ON COMMUNICATIONS, Vol. 47, No. 10, pp. 1449–54, October 1999 (Ex. 1002, "MacKay");
>
> Ping et al., "Low Density Parity Check Codes with Semi-Random Parity Check Matrix," IEE ELECTRONICS LETTERS, Vol. 35, No. 1, pp. 38–39, Jan. 7, 1999 (Ex. 1003, "Ping"); and
>
> Coombes et al., U.S. Patent No. 4,271,520, filed June 25, 1979, issued June 2, 1981 (Ex. 1018, "Coombes").

E. Remaining Instituted Grounds

The following instituted grounds remain at issue in this consolidated proceeding (297 Dec. on Inst. 26; 423 Dec. on Inst. 24; Paper 64, 3):

Reference(s)	Basis	Claim(s) Challenged	Citation
Ping	35 U.S.C. § 102(b)	19–21	297 Pet. 57–60
Ping and MacKay	35 U.S.C. § 103(a)	13–15, 18, and 22	423 Pet. 31–43, 47–48
Ping, MacKay, and Coombes	35 U.S.C. § 103(a)	16	423 Pet. 48–50

F. Claim Interpretation

In an *inter partes* review, we construe claims by applying the broadest reasonable interpretation in light of the specification. 37 C.F.R. § 42.100(b); *see Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). Under the broadest reasonable interpretation standard, and absent any special definitions, 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. *See In re Translogic Tech. Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Any special definitions for claim terms or phrases must be set forth "with reasonable clarity, deliberateness, and precision." *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

We determine that no terms require explicit construction. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) ("[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy").

G. Level of Ordinary Skill in the Art

Citing testimony from Dr. Davis, Petitioner contends a person of ordinary skill in the art was "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." 297 Pet. 21 (citing Ex. 1004 ¶ 84); 423 Pet. 22 (citing Ex. 1024 ¶ 77). Patent Owner takes no position on the level of ordinary skill in the art, but Dr. Mitzenmacher applies the same standard advanced by Petitioner. Ex. 2004 ¶ 64.

We determine that Petitioner's proposed definition comports with the qualifications a person would have needed to understand and implement the teachings of the '781 patent and the prior art of record. Accordingly, we apply Petitioner's definition of the level of ordinary skill in the art.

II. ANALYSIS

A. Anticipation Ground Based on Ping (297 IPR)

Petitioner contends that claims 19–21 are anticipated by Ping. 297 Pet. 57–59; Pet. Reply 1–2. Patent Owner disputes Petitioner's contention. PO Resp. 49–51; PO Sur-Reply 1.

1. Ping

Ping is an article directed to "[a] semi-random approach to low density parity check [LDPC] code design." Ex. 1003, 38. In this approach, "only part of [parity check matrix] **H** is generated randomly, and the remaining part is deterministic," which "achieve[s] essentially the same performance as the standard LDPC encoding method with significantly reduced complexity." *Id.* The size of matrix **H** is $(n–k) \times n$ where k is the information length and n is the coded length. *Id.* A codeword **c** is decomposed "as $\mathbf{c} = [\mathbf{p}, \mathbf{d}]$, where **p** and **d** contain the parity and information bits, respectively." *Id.* Parity check matrix **H** can be decomposed into two parts corresponding to **p** and **d** as "$\mathbf{H} = [\mathbf{H}^p, \mathbf{H}^d]$." *Id.* $\mathbf{H}^p$ is defined as follows:

$$\mathbf{H}^p = \begin{pmatrix} 1 & & & 0 \\ 1 & 1 & & \\ & \ddots & \ddots & \\ 0 & & 1 & 1 \end{pmatrix}$$

Id. $\mathbf{H^d}$ is created such that it "has a column weight of t and a row weight of $kt/(n–k)$ (the weight of a vector is the number of 1s among its elements)" such that

$$\mathbf{H^d} = \begin{bmatrix} h^d_{1,1} & h^d_{1,2} & h^d_{1,3} & \cdots & h^d_{1,k} \\ h^d_{2,1} & h^d_{2,2} & h^d_{2,3} & \cdots & h^d_{2,k} \\ h^d_{3,1} & h^d_{3,2} & h^d_{3,3} & \cdots & h^d_{3,k} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ h^d_{n-k,1} & h^d_{n-k,2} & h^d_{n-k,3} & \cdots & h^d_{n-k,k} \end{bmatrix}$$

Id.; Ex. 1004 ¶ 67.[8] For each sub-block of $\mathbf{H^d}$, there is exactly "one element 1 per column and *kt/(n-k)* 1s per row." Ex. 1003, 38. This construction "increase[s] the recurrence distance of each bit in the encoding chain" and "reduces the correlation during the decoding process." *Id.*

Parity bits "$\mathbf{p} = \{p_i\}$ can easily be calculated from a given $\mathbf{d} = \{d_i\}$" using the following expressions:

$$p_1 = \sum_j h^d_{1j}\, d_j \quad \text{and} \quad p_i = p_{i-1} + \sum_j h^d_{ij}\, d_j \pmod 2$$

Ex. 1003, 38 (Equation (4)).[9]

Petitioner contends Ping "was published on January 7, 1999" and "is thus prior art to the '781 patent under 35 U.S.C. § 102(a) and (b)." 297 Pet. 24, 34–35; 423 Pet. 24. Ping appears to be included in a publication

---

[8] This particular representation of $\mathbf{H^d}$ is taken from Dr. Davis's testimony. Patent Owner's description of $\mathbf{H^d}$ is found at pages 8–9 of its Response.

[9] The reference to "mod 2" refers to modulo-2 addition. Modulo-2 addition corresponds to the exclusive-OR (XOR or ⊕) logical operation, which is defined as follows: 1⊕1=0, 1⊕0=1, 0⊕1=1, and 0⊕0=0. *See* 297 Pet. 11–12 & n.2; 423 Pet. 11–12 & n.2.

from the Institution of Electrical Engineers (IEE) bearing a "7th January 1999" date and a "JAN 25 1999" date stamp from "LINDA HALL LIBRARY." Ex. 1003. Patent Owner does not dispute the prior art status of Ping. The January 7, 1999, edition date and the January 25, 1999, date stamp provide some evidence of publication in a well-known IEE journal more than one year before the earliest possible effective filing date for the challenged claims of the '781 patent, which is May 18, 2000. *See* Ex. 1001, [60]; Ex. 1003. Thus, we determine that Ping qualifies as prior art under 35 U.S.C. § 102(b).

2. Claim 19

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.

Petitioner's anticipation analysis for claim 19 references its analysis for an obviousness ground based on Ping and Divsalar that is no longer part of this consolidated proceeding. *See* 297 Pet. 57; Paper 64, 3. For "receiving a block of data in the signal to be encoded, the block of data including information bits," Petitioner contends "Ping teaches block codes" wherein "Ping denotes the block of information bits to be encoded using the vector variable **d**." 297 Pet. 40 (citing Ex. 1003, 38). According to Petitioner, "Ping receives the information bits **d** and computes from them a codeword **c**." *Id.* at 41 (citing Ex. 1004 ¶ 109), 57 (citing Ex. 1004 ¶ 160). Petitioner contends Ping "provides equations from which the parity bits '$\mathbf{p} = \{p_i\}$ can easily be calculated from a given $\mathbf{d} = \{d_i\}$.'" *Id.* at 40–41 (citing Ex. 1003, 38); Pet. Reply 1–2. Petitioner also states that "Ping's code is binary, meaning that all of its coding operations are performed using binary arithmetic." 297 Pet. 41 (citing Ex. 1003, 38; Ex. 1004 ¶ 110).

Regarding the recited "encoding operation," Petitioner cites Ping's Equation (4):

$$p_1 = \sum_j h_{1j}^d \, d_j \quad \text{and} \quad p_i = p_{i-1} + \sum_j h_{ij}^d \, d_j \pmod 2$$

Id. at 41–42 (citing Ex. 1003, 38; Ex. 1004 ¶¶ 112–114), 57 (citing Ex. 1004 ¶ 161). For the recitation "the encoding operation including an accumulation of mod-2 or exclusive-OR sums of bits in subsets of the information bits," Petitioner cites the modulo-2 summation $\sum_j h_{ij}^d \, d_j$ and contends that these summations are sums of bits in a subset of the information bits, because each d_j is an information bit. *Id.* at 53 (citing

Ex. 1003, 38; Ex. 1004 ¶¶ 147–148), 57 (citing Ex. 1004 ¶ 161). Regarding the limitation "at least two of the information bits appear in three subsets of the information bits," Petitioner contends "[t]he number of subsets in which an information bit appears is given by the number of 1s in the column of $\mathbf{H}^{\mathbf{d}}$ corresponding to that information bit." *Id.* at 55, 57. Petitioner cites an example in Ping where $\mathbf{H}^{\mathbf{d}}$ has a column weight of four, meaning that every column of $\mathbf{H}^{\mathbf{d}}$ contains exactly four 1s. *See id.* at 55 (citing Ex. 1003, 39; Ex. 1004 ¶ 153). Accordingly, Petitioner contends every information bit "necessarily appears in at least 'three subsets of the information bits'" if it appears in four subsets. *Id.*

Patent Owner argues that Petitioner's analysis is flawed "because Ping is clear that **d** is a component of the codeword **c**, which is an *output* of the encoder, not its input." PO Resp. 50 (citing Ex. 1003, 38). Citing Dr. Mitzenmacher's testimony, Patent Owner further argues "Ping is silent as to whether data is received, generated internally for simulation purposes, or how [it is] received." *Id.* at 50 (citing Ex. 2004 ¶ 135).

Patent Owner's arguments would require us to overlook the context of Ping, namely, the known use of codewords and parity-check matrices to determine when there has been an error during transmission of information bits. *See* Ex. 1004 ¶¶ 46–47; Ex. 2004 ¶¶ 29, 32, 37. In particular, a codeword includes information bits and parity bits. *See* Ex. 1003, 38; Ex. 1004 ¶¶ 25–26; Ex. 2004 ¶ 29. A valid codeword, when multiplied with a parity check matrix, results in an output of 0. *See* Ex. 1003, 38 (equation 1); Ex. 1004 ¶ 47; Ex. 2004 ¶ 37. Consistent with this application, Ping's codeword **c** is described as including parity bits **p** and information bits **d**. *See* Ex. 1003, 38.

Petitioner identifies the information bits in vector **d** as the received block of data in the signal to be encoded. 297 Pet. 41 (citing Ex. 1004 ¶ 109). Although Patent Owner is correct that Ping details how the information bits in vector **d** of codeword **c** interact with parity check matrix **H** on the output side of the encoder (*see* PO Resp. 50), Ping also describes encoding. *See* Ex. 1003, 38 (referring to "LDPC encoding" and "the encoding process in eqn. 4," among other things). In particular, Ping describes how parity bits "can easily be calculated from a given **d**" in equation 4. 297 Pet. 40–41 (quoting Ex. 1004, 38). The "given **d**" referenced in Ping is a vector of information bits that is inputted into the encoding process. *See* Ex. 1004 ¶ 46 (describing the encoding process as "convert[ing] blocks of information bits into codewords" via "a linear transformation that maps *k*-dimensional [information] bit vectors to *n*-dimensional [codeword] bit vectors."); Ex. 2004 ¶ 33 ("[O]ne generates the codeword by multiplying the generator matrix by the input vector of bits.").

Thus, considering the cited teachings of Ping from the perspective of an ordinarily skilled artisan, we are satisfied that such an artisan would at once envisage that vector **d** is the "block of data in the signal to be encoded" with "the block of data including information bits." *See Kennametal*, 780 F.3d at 1381. The information bits in vector **d** are received insofar as Ping teaches how to compute from them codeword **c**. *See* 297 Pet. 41 (citing Ex. 1004 ¶ 109). Importantly, the Specification of the '781 patent does not describe any particular form of the input signal or particular process for receiving a block of data. Ping's references to encoding a "given **d**" are coextensive with the '781 patent's generic description of receiving data at

the input side of the encoding process. As such, we determine that the cited disclosures from Ping describe the "receiving" step of claim 19.

Based on the entire trial record, we are satisfied that Ping describes each limitation of claim 19, combined in the same way as in claim 19. Thus, we determine Petitioner has shown by a preponderance of the evidence that claim 19 is anticipated by Ping.

3. Claim 20

Petitioner's analysis for claim 20 references much of the same analysis for claim 19. *See* 297 Pet. 58. Petitioner additionally maps the calculation of Ping's first parity bit p_1 according to the summation $\sum_j h_{1j}^d d_j$ for the "first sum" limitation. *Id.* at 53, 58. Regarding the "second sum" limitation, Petitioner maps the calculation of Ping's second parity bit p_2 according to the equation

$$p_2 = p_1 + \sum_j h_{2j}^d d_j$$

Id. at 53, 58–59.

Based on the evidence and analysis presented in the Petition, Petitioner has established that Ping describes each limitation of claim 20, combined in the same way as in claim 20. Patent Owner relies on the same arguments discussed above with respect to claim 19. Thus, we determine Petitioner has shown by a preponderance of the evidence that claim 20 is anticipated by Ping.

4. Claim 21

Claim 21 recites, *inter alia*, a "first parity bit" and "second parity bit" rather than a "first sum" and "second sum" as in claim 20. Petitioner's analysis for claim 21 is similar to that for claim 20. *See* 297 Pet. 59–60. In addition, for the "outputting a codeword" limitation, Petitioner contends Ping describes an encoding process that "outputs a 'codeword **c** as **c** = **[p, d]**, where **p** and **d** contain the parity and information bits, respectively.'" *Id.* at 60 (quoting Ex. 1003, 38). Petitioner contends Ping's codeword includes all parity bits, including the "first parity bit" and "second parity bit" recited in the claim. *Id.* (citing Ex. 1004 ¶ 175).

Based on the evidence and analysis presented in the Petition, Petitioner has established that Ping describes each limitation of claim 21, combined in the same way as in claim 21. Patent Owner relies on the same arguments discussed above with respect to claim 19. Thus, we determine Petitioner has shown by a preponderance of the evidence that claim 21 is anticipated by Ping.

B. Obviousness Ground Based on Ping and MacKay (423 IPR)

Apple contends claims 13–15, 18, and 22 would have been obvious over Ping and MacKay. 423 Pet. 31–48; Pet. Reply 2–21. Patent Owner disputes Petitioner's contention. PO Resp. 15–49, 51–62; PO Sur-Reply 1–8.

1. MacKay

MacKay is a paper related to Gallager codes based on irregular graphs, which are "low-density parity check codes whose performance is

closest to the Shannon limit." Ex. 1002, 1449. According to MacKay, "[t]he best known binary Gallager codes are *irregular* codes whose parity check matrices have *nonuniform* weight per column." *Id.* A parity check matrix that "can be viewed as defining a bipartite graph with 'bit' vertices corresponding to the columns and 'check' vertices corresponding to the rows" where "[e]ach nonzero entry in the matrix corresponds to an edge connecting a bit to a check." *Id.* at 1450. As an example of an irregular code in a parity check matrix, MacKay describes a matrix that "has columns of weight 9 and of weight 3 [and] all rows hav[ing] weight 7." *Id.* at 1451.

2. Claims 13–15, 18, and 22

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.

In its obviousness analysis for claim 13, Petitioner cites the information bits in Ping denoted by vector **d** for the step of "receiving a block of data in the signal to be encoded." 423 Pet. 38 (citing Ex. 1003, 38). Petitioner contends "Ping receives the information bits **d** and computes from them an encoded codeword **c**." *Id.* (citing Ex. 1024 ¶ 100). For the limitation "performing an encoding operation using the information bits as an input, the encoding operation including an accumulation of mod-2 or exclusive-OR sums of bits in subsets of the information bits," Petitioner cites the modulo-2 summation $\sum_j h_{ij}^d d_j$ and contends that these summations are sums of bits in a subset of the information bits, because each d_j is an information bit. *Id.* at 38–39 (citing Ex. 1003, 38; Ex. 1024 ¶ 102). Petitioner contends "Ping's encoding operation also generates a codeword, so it must generate 'at least a portion of a codeword' as claimed." *Id.* at 39 (citing Ex. 1003, 38; Ex. 1024 ¶ 103).

Regarding "the information bits appear[ing] in a variable number of subsets," Petitioner cites Ping in view of MacKay. *See id.* at 39–40. As background for its analysis of this limitation, Petitioner states the following regarding Ping:

> Ping's outer code is regular because, in Ping, each information bit contributes to the same number of summations $\sum_j h_{ij}^d d_j$. Those summations are the "parity bits," produced by Ping's outer coder (and are distinct from the "parity bits" subsequently produced by Ping's inner coder, the accumulator). The number of outer coder parity bits to which each information bit contributes is determined by Ping's generator matrix $\mathbf{H^d}$ (which is, as explained above, also a portion of Ping's parity-check matrix **H**). (Ex. [1003], Equations (1), (3) and (4), p. 38.) Each column in matrix $\mathbf{H^d}$ corresponds to a single information bit, and the number of 1s in a column determines the number of summations, or outer coder parity bits, to which the

> corresponding information bit contributes. (*Id.*) Ping refers to the number of 1s per column as the "column weight" of matrix $\mathbf{H}^{\mathbf{d}}$, and uses the variable "t" to set this number for every column. (Ex. [1003], p. 38.) (Ex. [1024], ¶87.)

423 Pet. 32.

Petitioner contends "[e]ach column of Ping's matrix $\mathbf{H}^{\mathbf{d}}$ corresponds to an information bit, and each row of the matrix $\mathbf{H}^{\mathbf{d}}$ corresponds to a subset of information bits that are added together to form Ping's outer coder parity bits, the summations ($\sum_j h_{ij}^d d_j$)." *Id.* at 39 (citing Ex. 1024 ¶ 104). According to Petitioner, "[t]he number of subsets in which an information bit appears is given by the number of 1s in the column of $\mathbf{H}^{\mathbf{d}}$ corresponding to that information bit," which Ping teaches is "exactly '*t*' 1s." *Id.* at 34, 39. Petitioner further cites MacKay for teaching that "[t]he best known binary Gallager codes are *irregular* codes whose parity check matrices have *nonuniform* weight per column." *Id.* at 40 (quoting Ex. 1002, 1449) (emphasis in original).

Petitioner contends an ordinarily skilled artisan would have been motivated to incorporate the irregularity disclosed in MacKay into Ping's code based on MacKay's teaching that doing so would improve code performance. *Id.* at 33; Pet. Reply 7–8. Petitioner cites MacKay for the proposition that "irregular codes perform better than regular codes," so Petitioner proposes a modification to Ping's $\mathbf{H}^{\mathbf{d}}$ matrix (or "outer coder"), which Petitioner characterizes as being regular, to improve the performance of Ping's code. 423 Pet. 32–36; Pet. Reply 3–4. In particular, Petitioner proposes "chang[ing] Ping's generator $\mathbf{H}^{\mathbf{d}}$ matrix such that not all columns had the same weight – *e.g.*, setting some columns to weight 9 and others to weight 3, as taught by MacKay." 423 Pet. 36 (citing Ex. 1002, 1451).

According to Petitioner, an ordinarily skilled artisan would not have modified $\mathbf{H}^{p}$ because "it has only a single form and because doing so would have complicated a simple encoder." Pet. Reply 7. Thus, Petitioner contends an artisan "want[ing] to obtain the benefit of MacKay's irregularity in Ping would have had only one option—to incorporate MacKay's uneven column weights into $\mathbf{H}^{d}$." *Id.* at 7–8. Petitioner states that this would result in "some information bits . . . contribut[ing] to more summations ($\sum_j h_{ij}^{d} d_j$) than others, such that the information bits would appear in a variable number of subsets." 423 Pet. 40 (citing Ex. 1024 ¶ 105).

Patent Owner disputes Petitioner's rationale for combining Ping and MacKay on a number of bases. First, Patent Owner argues that Ping's parity check matrix **H** is already irregular. *See* PO Resp. 23–28. According to Patent Owner, "Ping's parity check matrix has three different column weights (t, 2, and 1), and two different row weights ($kt/(n-k)$ +1 and $kt/(n-k)$ + 2)." *Id.* at 25; *see also* Ex. 2004 ¶ 84 (same). As such, Patent Owner argues "Ping's parity-check matrix is at least as irregular, if not more irregular, as MacKay's," so ordinarily skilled artisans "would not have been motivated by MacKay's teachings that irregular codes are an improvement over regular codes." PO Resp. 27 (citing Ex. 2004 ¶¶ 87, 89–91).

Second, Patent Owner highlights that Petitioner's proposed modifications relate only to a portion of Ping's parity check matrix **H**, namely, sub-matrix $\mathbf{H}^{d}$. *Id.* at 27. Patent Owner argues "MacKay does not even consider, much less suggest, modifying only a sub-matrix within the larger parity-check matrix." *Id.* at 27–28. According to Patent Owner, "MacKay teaches that irregular parity-check matrices *as a whole* may define better codes than regular parity-check matrices *as a whole*—it does not teach

anything about irregular sub-matrices are an improvement over regular sub-matrices, or other types of matrices (*e.g.*, irregular generator matrices)." *Id.* at 28. Patent Owner argues MacKay does not "suggest that *additional* irregularity should be applied to individual portions or submatrices when the overall parity-check matrix is already irregular." *Id.*

Third, Patent Owner argues that Petitioner has not established that an ordinarily skilled artisan would have reasonably expected success from the Ping-MacKay combination. *See* PO Resp. 44–49. Patent Owner argues "the petition does not even attempt to explain how its proposed modification to Ping would have a reasonable expectation of success, and for that reason, it must be rejected as being incurably deficient." *Id.* at 44. As further evidence of the lack of anticipated success, Patent Owner emphasizes that constructing error-correction codes "was a highly unpredictable endeavor" that was subject to "extensive trial-and-error and experimentation to determine whether new codes led to an improvement." *Id.* at 5 (citing Ex. 2004 ¶ 46); *see also id.* at 44 (citing Ex. 2004 ¶¶ 118–120; Ex. 2033, 256:21–257:12) (same).

We are persuaded by Patent Owner's arguments. We agree with Patent Owner (*see* PO Resp. 27–29 & n.6) that, although Petitioner may explain how to modify Ping's $\mathbf{H}^{d}$ sub-matrix in light of MacKay, it does not address why such an ordinarily skilled artisan would have done this. Nor does Petitioner establish that such an artisan reasonably would have expected success from the modification. Based on the entire trial record, we determine that Petitioner has not established a persuasive rationale for modifying Ping in light of MacKay as suggested by Petitioner.

Petitioner's unpatentability contentions presuppose that an ordinarily skilled artisan would seek to modify a *sub-matrix* in Ping in light of MacKay. *See* Pet. Reply 7 ("Caltech's comparison of Ping's **H** matrix to MacKay's is improper. The proper comparison is between Ping's $\mathbf{H}^{d}$ matrix . . . and MacKay's matrix."). Yet even if MacKay touts improvements from irregularity in a parity check matrix (e.g., Ping's matrix **H**), MacKay does not suggest that these improvements would have been applicable to *portions* of a parity check matrix (e.g., Ping's sub-matrix $\mathbf{H}^{d}$). To reach its proposed modification, Petitioner characterizes Ping's sub-matrix $\mathbf{H}^{d}$ as a generator matrix (or "outer coder") and Ping's sub-matrix $\mathbf{H}^{p}$ as merely an accumulator (or "inner coder"). 423 Pet. 24–25, 32, 34, 36; Pet. Reply 9–13. We agree with Patent Owner (*see* PO Resp. 36–37), however, that Petitioner does not explain why labeling sub-matrix $\mathbf{H}^{d}$ as a generator matrix supports the proposed modification of $\mathbf{H}^{d}$ based on MacKay, which does not discuss generator matrices. Indeed, this label does not explain why an ordinarily skilled artisan considering MacKay would have chosen to modify $\mathbf{H}^{d}$ or any other portion of parity check matrix **H**.

Petitioner's further contentions do not fare better. Specifically, Petitioner contends $\mathbf{H}^{p}$ is an accumulator with only a single, fixed form, so an ordinarily skilled artisan would not have been motivated to modify $\mathbf{H}^{p}$ because "doing so would have complicated a simple encoder." Pet. Reply 7, 9. Yet this rationalization belies that fact that Ping also specifically defines a structure for sub-matrix $\mathbf{H}^{d}$, which simplifies a portion of the parity check matrix. According to Dr. Mitzenmacher, "the constraints on $\mathbf{H}^{d}$, including its regularity, were a deliberate design decision that contributes to the improved performance of Ping's code over fully random LDPC codes—it is

a fundamental part of its code." Ex. 2004 ¶ 96. Thus, choosing to modify *any* portion of Ping's matrix would have broken constraints in Ping that were intended to simplify encoding. *See* Ex. 1003, 38 (Ping describing the disclosed approach as a "new method [that] can achieve essentially the same performance as the standard LDPC encoding method with significantly reduced complexity"). This is a strong indication that an ordinarily skilled artisan would not have been motivated to reach within Ping's parity check matrix **H** and modify a sub-matrix.

We also agree with Patent Owner that Ping's parity check matrix **H** is already irregular, which undermines Petitioner's stated motivation for modifying Ping in view of MacKay. *See* PO Resp. 23–27. Citing Dr. Mitzenmacher, Patent Owner establishes that Ping's matrix **H** has three different column weights (t, 2, and 1). *Id.* at 25; Ex. 2004 ¶ 84; *see also* Ex. 2033, 231:11:14 (Dr. Davis acknowledging that Ping's parity check matrix **H** has "different weights for the columns"). We accept this as evidence of "irregularity" based on Petitioner's own acknowledgment that "irregularity" is associated with "uneven column weights." *See* Pet. Reply 12. Petitioner does not contest that Ping's parity check matrix **H** is irregular; rather, Petitioner contends that the appropriate comparison is between MacKay's parity check matrix and Ping's sub-matrix $\mathbf{H}^{\mathbf{d}}$. Pet. Reply 7. But MacKay is silent on the concept of sub-matrices, so Petitioner's association of MacKay's teaching with sub-matrix $\mathbf{H}^{\mathbf{d}}$ is not apt. Instead, we agree with Patent Owner that "MacKay's teachings are only applicable to full parity check matrices." PO Resp. 16. Thus, the record does not establish that an ordinarily skilled artisan would have sought to add

irregularity to Ping's parity check matrix **H**—or additional irregularity to a sub-matrix of **H**, such as $\mathbf{H}^d$—because **H** itself is already irregular.

Finally, we agree with Patent Owner that the 423 Petition is silent on whether a person of ordinary skill in the art would have expected success in combining MacKay with Ping. Although Petitioner cites an alleged "straightforward modification of Ping's $\mathbf{H}^d$ matrix" at page 36 of the Petition as supporting the expectation of success (Pet. Reply 14), the cited passage only describes the proposed modification, rather than addressing whether an ordinarily skilled artisan would have anticipated success from the modification. *See* 423 Pet. 36. In addition, Petitioner's argument that an ordinarily skilled artisan "would have needed no more specificity to attempt to use MacKay's irregularity in Ping" (Pet. Reply 14) only underscores the lack of evidence in the Petition regarding anticipated success.

Perhaps sensing this deficiency in the Petition, Petitioner introduces new testimony and a new simulation from Dr. Frey with its Reply in which Dr. Frey allegedly "demonstrate[s] the ease with which a[n ordinarily skilled artisan] could have added MacKay's irregularity to Ping." Ex. 1049 ¶ 41. According to Petitioner, the results of the simulation "outperform Ping's original code" and "confirm that a[n ordinarily skilled artisan] would have been motivated to use MacKay's uneven column weights in Ping's $\mathbf{H}^d$ matrix and . . . would have had a reasonable expectation of success when doing so." Pet. Reply 14–15. Yet, even if we were to deem the testimony and simulation to be within the proper scope of a reply brief,[10] they do not

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

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)).

Furthermore, as part of our obviousness analysis, we are charged to consider "the scope and content of the prior art." *See Graham*, 383 U.S. at 17–18. One important aspect of the art in this case is the relative unpredictability of developing error-correction codes. *See* PO Resp. 44 (citing Ex. 2004 ¶¶ 118–120; Ex. 2033, 256:21–257:12) ("New codes appeared from unexpected sources, and developing the precise parameters that could lead to incremental improvements often took a significant amount of time and experimentation."). In its Reply, Petitioner embraces the notion of unpredictability as supporting its combination; Petitioner contends that "rigorous mathematical analysis of codes is difficult, and, as a result, [ordinarily skilled artisans] routinely develop codes by experimentation." Pet. Reply 14. Petitioner further contends that "running experimental tests

on a version of Ping that incorporated MacKay's irregularity would have been routine[,] . . . straightforward[,] and would have taken very little time to implement." *Id.*

Yet 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.[11] *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)).

[11] Notably, Petitioner does not contend that its proposed combination should be analyzed under obvious-to-try case law. *Cf.* Tr., 14:1–6 (Petitioner acknowledging, for a related case, 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).

For these reasons, we are not persuaded that an ordinarily skilled artisan would have been motivated to combine the teachings of Ping and MacKay in the manner suggested by Petitioner. Thus, we determine Petitioner has not shown by a preponderance of the evidence that claim 13 would have been obvious over the combination of Ping and MacKay.

Petitioner relies on the same deficient rationale for combining Ping and MacKay with respect to its analysis for claims 14, 15, 18, and 22. Thus, we also determine Petitioner has not shown by a preponderance of the evidence that claims 14, 15, 18, and 22 would have been obvious over the combination of Ping and MacKay.

C. *Obviousness Ground Based on Ping, MacKay, and Coombes (423 IPR)*

Petitioner contends claim 16 would have been obvious over Ping, MacKay, and Coombes. 423 Pet. 48–50; Pet. Reply 17–21. Patent Owner disputes Petitioner's contention. PO Resp. 49, 51–62.

1. Coombes

Coombes is a U.S. patent directed to "resolving synchronization in an error correction encoded transmission." Ex. 1018, 1:7–10. Coombes teaches that N data bits are passed to conventional block code encoder 12. *Id.* at 3:1–2. Block code encoder 12 processes the N data bits and produces an output error correctable encoded bit stream comprised of the N data bits followed by K parity bits. *Id.* at 3:5–10.

2. Claim 16

Claim 16 depends from claim 13 via claims 14 and 15. Claim 16 recites "the parity bits follow the information bits in the codeword." According to Petitioner, "Coombes teaches that, in the output of an error-correcting encoder, the 'encoded bit stream . . . is comprised of the N data bits *followed by* K parity bits,' where the 'N data bits' are the information bits input into the encoder." 423 Pet. 50 (quoting Ex. 1018, 3:9–10) (emphasis added by Petitioner).

Building on its reasons for combining Ping and MacKay, Petitioner contends "it would have been obvious to use the output bit order taught by Coombes in the combination of Ping in view of MacKay." *Id.* at 48. Petitioner reasons "the information bits exist prior to creation of the parity bits and, accordingly, it is simple, and obvious to output the information bits from the encoder prior to the later created parity bits." *Id.* at 49 (citing Ex. 1003, 38; Ex. 1018, 3:5–10).

Because Petitioner's obviousness analysis for claim 16 relies on the same rationale for combining Ping and MacKay discussed above (*see id.* at 48), Petitioner's rationale for this ground incorporates the same deficiencies discussed above. For this reason, we determine Petitioner has not shown by a preponderance of the evidence that claim 16 would have been obvious over the combination of Ping, MacKay, and Coombes.

D. Patent Owner's Motion to Exclude

Patent Owner moves to exclude Exhibits 1027–1032, 1046, 1048, 1049, 1051, 1052, and portions of Exhibits 1045. Paper 49, 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.

E. 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 40, 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 44, 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 disposition of claims 13–16, 18, and 22 above. For these reasons, we deny Patent Owner's motion for sanctions.

III. CONCLUSION

Petitioner has demonstrated by a preponderance of the evidence that claims 19–21 of the '781 patent are anticipated by Ping. Petitioner has not demonstrated by a preponderance of the evidence that claims 13–15, 18, and 22 of the '781 patent would have been obvious over the combination of Ping

and MacKay. Petitioner also has not demonstrated by a preponderance of the evidence that claim 16 of the '781 patent would have been obvious over the combination of Ping, MacKay, and Coombes.

IV. ORDER

Accordingly, it is:

ORDERED that claims 19–21 of the '781 patent are 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.

PETITIONER:

Richard Goldenberg
Dominic Massa
Michael H. Smith
James M. Dowd
Mark D. Selwyn
Kelvin Chan
WILMER CUTLER PICKERING HALE AND DORR LLP
richard.goldenberg@wilmerhale.com
dominic.massa@wilmerhale.com
michaelh.smith@wilmerhale.com
james.dowd@wilmerhale.com
mark.selwyn@wilmerhale.com
kelvin.chan@wilmerhale.com

PATENT OWNER:

Michael Rosato
Matthew Argenti
Richard Torczon
WILSON SONSINI GOODRICH & ROSATI
mrosato@wsgr.com
margenti@wsgr.com
rtorczon@wsgr.com

Kevin P.B. Johnson
QUINN EMNUEL URQUHART & SULLIVAN LLP
kevinjohnson@quinnemanuel.com

MURGITROYD

16 June 2018

P163976.US.03/PHunter/Renewals

United States Patent & Trademark Office
Maintenance Division
USA

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.	12/165606		
Pub/Grant No.	7916781	Short Title:	
Year	2nd Maintenance Fee	TM Category:	
Due Date	29 September 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 7916781 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

PAMELA HUNTER
Pamela.Hunter@murgitroyd.com

PATENT
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Current Date: June 8, 2018

Application No.: 12/165606

Filed.: June 30, 2008

Patent No.: 7916781

Issued.: March 29, 2011

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,

Signature

California Institute of Technology
1200 E. California Blvd. M/C 6-32
Pasadena, CA 91125

Hannah Dvorak-Carbone
Printed Name

Title: Associate Director, Technology Transfer
OR
Reg. # if US Attorney_____

(12) **INTER PARTES REVIEW CERTIFICATE** (668th)
United States Patent
Jin et al.

(10) **Number: US 7,916,781 K1**
(45) **Certificate Issued: Feb. 14, 2018**

(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 Number:

IPR2015-00059 filed Oct. 14, 2014

Inter Partes Review Certificate for:

Patent No.: **7,916,781**
Issued: **Mar. 29, 2011**
Appl. No.: **12/165,606**
Filed: **Jun. 30, 2008**

The results of IPR2015-00059 are reflected in this inter partes review certificate under 35 U.S.C. 318(b).

INTER PARTES REVIEW CERTIFICATE
U.S. Patent 7,916,781 K1
Trial No. IPR2015-00059
Certificate Issued Feb. 14, 2018

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

Claims **1** and **2** are cancelled.

* * * * *

Trials@uspto.gov
571.272.7822

Paper No. 16
Entered: July 5, 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 IPR2017-00423
Patent 7,916,781 B2

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

HUDALLA, *Administrative Patent Judge*.

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

Petitioner, Apple, Inc. ("Apple"), filed a Petition (Paper 5, "Pet.") requesting an *inter partes* review of claims 13–22 of U.S. Patent No. 7,916,781 B2 (Ex. 1101, "the '781 patent") pursuant to 35 U.S.C. §§ 311–319. Apple proffered a Declaration of James A. Davis, Ph.D. (Ex. 1104) with its Petition. Patent Owner, California Institute of Technology ("Caltech"), filed a Preliminary Response (Paper 14, "Prelim. Resp.") to the Petition.

Under 35 U.S.C. § 314(a), the Director may not authorize an *inter partes* review unless the information in the petition and preliminary response "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." For the reasons that follow, we institute an *inter partes* review as to claims 13–16, 18, and 22 of the '781 patent on certain grounds of unpatentability presented.

I. BACKGROUND

A. Related Proceedings

The parties identify the following district court cases related to the '781 patent (Pet. 1; Paper 7, 1):

Cal. Inst. of Tech. v. Broadcom Ltd., No. 2:16-cv-03714 (C.D. Cal. filed May 26, 2016);[1]

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).

The parties also identify co-pending Case IPR2017-00297, in which Apple has filed a petition for *inter partes* review of claims 3–12 and 19–21 of the '781 patent. Pet. 2 n.1; Paper 7, 1. In addition, the '781 patent was previously subject to an *inter partes* review in Case IPR2015-00059 ("059 IPR"). Pet. 19; Ex. 1111; Paper 7, 1. In the Final Written Decision from the 059 IPR, which Apple filed as Exhibit 1111 in this proceeding, the

[1] Apple is a defendant in this case. *See* Pet. 1.

Board determined that claims 1 and 2 of the '781 patent are unpatentable as anticipated by the Divsalar reference, which is one of the asserted references in this case. *See* Ex. 1111, 43.

Apple additionally states that patents in the priority chain of the '781 patent were challenged in Cases IPR2015-00068, IPR2015-00067, IPR2015-00060, IPR2015-00061, and IPR2015-00081. Pet. 1. We additionally identify the following cases between the parties: Cases IPR2017-00210, IPR2017-00211, IPR2017-00219, IPR2017-00700, IPR2017-00701, IPR2017-00702, IPR2017-00703, and IPR2017-00728.

B. The '781 patent

The '781 patent describes the serial concatenation of interleaved convolutional codes forming turbo-like codes. Ex. 1101, Title. It explains some of the prior art with reference to its Figure 1, reproduced below.

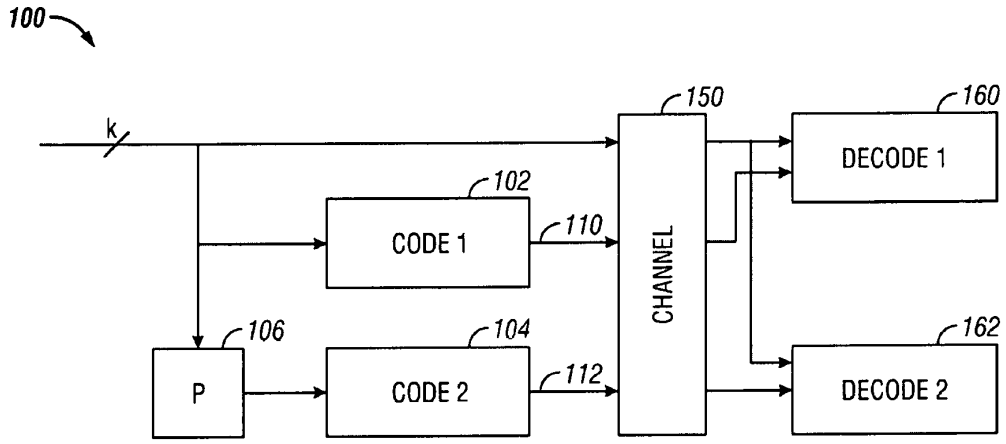


FIG. 1
(Prior Art)

Figure 1 is a schematic diagram of a prior "turbo code" system. *Id.* at 2:20–21. The '781 patent specification describes Figure 1 as follows:

> 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 1:44–60.

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

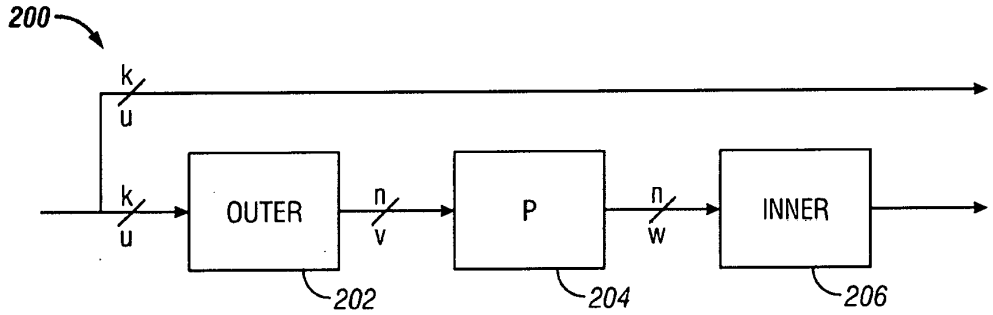


FIG. 2

Figure 2 of the '781 patent is a schematic diagram of coder 200.

> The coder 200 may include an outer coder 202, an interleaver 204, and inner coder 206. . . . The outer coder 202 receives the uncoded data [that] may be partitioned into blocks of fixed size, [e.g.] 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[2] 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 the n-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 2:40–3:2 (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.

---

[2] We understand that 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.

Figure 4 of the '781 patent is reproduced below.

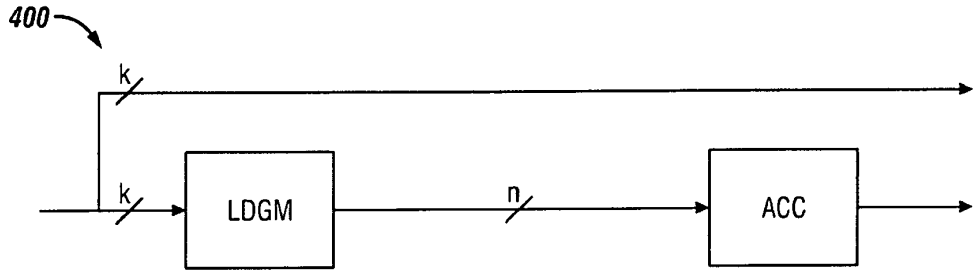


FIG. 4

Figure 4 shows an alternative embodiment in which the first encoding is carried out by a low density generator matrix. Low density generator matrix (LDGM)[3] 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 arrangement because the LDGM provides scrambling otherwise provided by the interleaver in the Figure 2 embodiment.

Apple notes (Pet. 3) that the '781 patent claims priority to a provisional application filed on May 18, 2000. Ex. 1101, at [60]. As discussed below, we determine for purposes of this Decision that Apple's asserted references qualify as prior art even when assuming that May 18, 2000, is the effective filing date for the challenged claims of the '781 patent.

[3] We understand that 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 Claim

Claims 13 and 19–21 of the '781 patent are independent. Claims 14–18 depend directly or indirectly from claim 13, and claim 22 depends from claim 21. Claim 13 is illustrative of the challenged claims and recites:

> 13. A method of encoding a signal, comprising:
>
> receiving a block of data in the signal to be encoded, the block of data including information bits; and
>
> performing an encoding operation using the information bits as an input, the encoding operation including an accumulation of mod-2 or exclusive-OR sums of bits in subsets of the information bits, the encoding operation generating at least a portion of a codeword,
>
> wherein the information bits appear in a variable number of subsets.

Id. at 8:7–17.

D. The Prior Art

Apple relies on the following prior art:

> MacKay et al., "Comparison of Constructions of Irregular Gallager Codes," IEEE TRANSACTIONS ON COMMUNICATIONS, Vol. 47, No. 10, pp. 1449–54, October 1999 (Ex. 1102, "MacKay");
>
> Ping et al., "Low Density Parity Check Codes with Semi-Random Parity Check Matrix," IEE ELECTRONICS LETTERS, Vol. 35, No. 1, pp. 38–39, Jan. 7, 1999 (Ex. 1103, "Ping"); and
>
> Coombes et al., U.S. Patent No. 4,271,520, filed June 25, 1979, issued June 2, 1981 (Ex. 1118, "Coombes").

E. The Asserted Grounds

Apple challenges claims 13–22 of the '781 patent on the following grounds (Pet. 31–32, 48):

References	Basis	Claims Challenged
Ping and MacKay	35 U.S.C. § 103(a)	13–15 and 17–22
Ping, MacKay, and Coombes	35 U.S.C. § 103(a)	16

F. Claim Interpretation

In an *inter partes* review, we construe claims by applying the broadest reasonable interpretation in light of the specification. 37 C.F.R. § 42.100(b); *see Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). Under the broadest reasonable interpretation standard, and absent any special definitions, 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. *See In re Translogic Tech. Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Any special definitions for claim terms or phrases must be set forth "with reasonable clarity, deliberateness, and precision." *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

Based on the current record, we determine that no terms require explicit construction at this time. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) ("[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy").

II. ANALYSIS

We now consider Apple's asserted grounds and Caltech's arguments in the Preliminary Response to determine whether Apple has met the

"reasonable likelihood" threshold standard for institution under 35 U.S.C. § 314(a).

A. Obviousness Ground Based on Ping and MacKay

Apple contends claims 3, 5–8, 10, and 12 are would have been obvious over Ping and MacKay. Pet. 31–48. Caltech disputes Apple's contention. Prelim. Resp. 8–26.

1. Ping

Ping is an article directed to "[a] semi-random approach to low density parity check [LDPC] code design." Ex. 1103, 38. In this approach, "[a]n LDPC code is defined from a randomly generated parity check matrix **H**." *Id.* The size of matrix **H** is $(n–k) \times n$ where k is the information length and n is the coded length. *Id.* A codeword **c** is decomposed "as $\mathbf{c} = [\mathbf{p}, \mathbf{d}]$, where **p** and **d** contain the parity and information bits, respectively." *Id.* Parity check matrix **H** can be decomposed into two parts corresponding to **p** and **d** as "$\mathbf{H} = [\mathbf{H}^p, \mathbf{H}^d]$." *Id.* $\mathbf{H}^p$ is defined as follows:

$$\mathbf{H}^p = \begin{pmatrix} 1 & & & 0 \\ 1 & 1 & & \\ & \ddots & \ddots & \\ 0 & & 1 & 1 \end{pmatrix}$$

Id. $\mathbf{H}^d$ is created such that it "has a column weight of t and a row weight of $kt/(n–k)$ (the weight of a vector is the number of 1s among its elements)" such that

$$\mathbf{H^d} = \begin{bmatrix} h^d_{1,1} & h^d_{1,2} & h^d_{1,3} & \cdots & h^d_{1,k} \\ h^d_{2,1} & h^d_{2,2} & h^d_{2,3} & \cdots & h^d_{2,k} \\ h^d_{3,1} & h^d_{3,2} & h^d_{3,3} & \cdots & h^d_{3,k} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ h^d_{n-k,1} & h^d_{n-k,2} & h^d_{n-k,3} & \cdots & h^d_{n-k,k} \end{bmatrix}$$

Id.; Ex. 1104 ¶ 67.[4]

Parity bits "$\mathbf{p} = \{p_i\}$ can easily be calculated from a given $\mathbf{d} = \{d_i\}$" using the following expressions:

$$p_1 = \sum_j h^d_{1j}\, d_j \quad \text{and} \quad p_i = p_{i-1} + \sum_j h^d_{ij}\, d_j \pmod 2$$

Ex. 1103, 38 (equation (4)).[5]

Apple contends Ping "was published in January 1999" and "is thus prior art to the '781 patent under 35 U.S.C. § 102(a) and (b)." Pet. 24. Ping appears to be included in a publication from the Institution of Electrical Engineers bearing a "7th January 1999" date and a "JAN 25 1999" date stamp from "LINDA HALL LIBRARY." Ex. 1103. Caltech does not dispute the prior art status of Ping. For purposes of this Decision, we

[4] This particular representation of $\mathbf{H^d}$ is taken from Dr. Davis's testimony. Caltech does not dispute this representation. *Cf.* Prelim. Resp. 10–11 & n.10.

[5] The reference to "mod 2" refers to modulo-2 addition. Modulo-2 addition corresponds to the exclusive-OR (XOR or ⊕) logical operation, which is defined as follows: 1⊕1=0, 1⊕0=1, 0⊕1=1, and 0⊕0=0. *See* Pet. 11–12 & n.2.

determine that Ping qualifies as prior art under 35 U.S.C. § 102(b)[6] because the January 7, 1999, edition date and the January 25, 1999, date stamp provide some evidence of publication more than one year before the earliest possible effective filing date for the challenged claims of the '781 patent, which is May 18, 2000. *See* Ex. 1101, at [60]; Ex. 1103.

2. MacKay

MacKay is a paper related to Gallager codes based on irregular graphs, which are "low-density parity check codes whose performance is closest to the Shannon limit." Ex. 1102, 1449. According to MacKay, "[t]he best known binary Gallager codes are *irregular* codes whose parity check matrices have *nonuniform* weight per column." *Id.* A parity check matrix that "can be viewed as defining a bipartite graph with 'bit' vertices corresponding to the columns and 'check' vertices corresponding to the rows" where "[e]ach nonzero entry in the matrix corresponds to an edge connecting a bit to a check." *Id.* at 1450. As an example of an irregular code in a parity check matrix, MacKay describes a matrix that "has columns of weight 9 and of weight 3 [and] all rows hav[ing] weight 7." *Id.* at 1451.

Apple contends MacKay "was published in October 1999" and therefore "qualifies as prior art under 35 U.S.C. § 102(a) and (b)." Pet. 29, 32. MacKay appears to be taken from a publication of the Institute of Electrical and Electronics Engineers bearing an "October 1999" date and a

[6] The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) ("AIA"), amended 35 U.S.C. §§ 102 and 103. Because the priority date of the '781 patent is before the effective date of the applicable AIA amendments, the pre-AIA versions of 35 U.S.C. §§ 102 and 103 apply.

"NOV 02 1999" date stamp from "LINDA HALL LIBRARY." Ex. 1102, 1449. Caltech does not dispute the prior art status of MacKay. For purposes of this Decision, we determine that MacKay qualifies as prior art under 35 U.S.C. § 102(a) because the October 1999 edition date and the November 2, 1999, date stamp provide some evidence of publication before the earliest possible effective filing date for the challenged claims of the '781 patent, which is May 18, 2000. *See* Ex. 1101, at [60]; Ex. 1102, 1449.

3. Claims 13–15 and 18

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 Apple's obviousness grounds with the principles identified above in mind.

In its obviousness analysis for claim 13, Apple cites the information bits in Ping denoted by vector **d** for the step of "receiving a block of data in

the signal to be encoded." Pet. 38 (citing Ex. 1103, 38). Apple contends "Ping receives the information bits **d** and computes from them an encoded codeword **c**." *Id.* (citing Ex. 1104 ¶ 100). For the limitation "performing an encoding operation using the information bits as an input, the encoding operation including an accumulation of mod-2 or exclusive-OR sums of bits in subsets of the information bits," Apple cites the modulo-2 summation $\sum_j h_{ij}^d d_j$ and contends that these summations are sums of bits in a subset of the information bits, because each d_j is an information bit. *Id.* at 38–39 (citing Ex. 1103, 38; Ex. 1104 ¶ 102). Apple contends "Ping's encoding operation also generates a codeword, so it must generate 'at least a portion of a codeword' as claimed." *Id.* at 39 (citing Ex. 1103, 38; Ex. 1104 ¶ 103).

Regarding "the information bits appear in a variable number of subsets," Apple cites Ping in view of MacKay. *See id.* at 39–40. As background for its analysis of this limitation, Apple states the following regarding Ping:

> Ping's outer code is regular because, in Ping, each information bit contributes to the same number of summations $\sum_j h_{ij}^d d_j$. Those summations are the "parity bits," produced by Ping's outer coder (and are distinct from the "parity bits" subsequently produced by Ping's inner coder, the accumulator). The number of outer coder parity bits to which each information bit contributes is determined by Ping's generator matrix $\mathbf{H^d}$ (which is, as explained above, also a portion of Ping's parity-check matrix **H**). (Ex. 1103, Equations (1), (3) and (4), p. 38.) Each column in matrix $\mathbf{H^d}$ corresponds to a single information bit, and the number of 1s in a column determines the number of summations, or outer coder parity bits, to which the corresponding information bit contributes. (*Id.*) Ping refers to the number of 1s per column as the "column weight" of matrix $\mathbf{H^d}$, and uses the variable "t" to set this number for every column. (Ex. 1103, p. 38.) (Ex. 1104, ¶87.)

Id. at 32.

Apple contends "[e]ach column of Ping's matrix $\mathbf{H}^{\mathbf{d}}$ corresponds to an information bit, and each row of the matrix $\mathbf{H}^{\mathbf{d}}$ corresponds to a subset of information bits that are added together to form Ping's outer coder parity bits, the summations ($\sum_j h_{ij}^d d_j$)." *Id.* at 39 (citing Ex. 1104 ¶ 104). According to Apple, "[t]he number of subsets in which an information bit appears is given by the number of 1s in the column of $\mathbf{H}^{\mathbf{d}}$ corresponding to that information bit," which Ping teaches is "exactly 't' 1s." *Id.* at 34, 39. Apple further cites MacKay for teaching that "[t]he best known binary Gallager codes are *irregular* codes whose parity check matrices have *nonuniform* weight per column." *Id.* at 40 (quoting Ex. 1102, 1449) (emphasis in original).

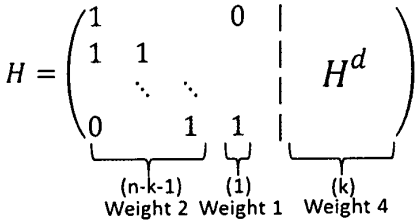
Apple contends it would have been obvious to an ordinarily skilled artisan "to incorporate the non-uniform column weight of MacKay into the LDPC-accumulate codes of Ping, thus making Ping's information bits contribute to different numbers of summations ($\sum_j h_{ij}^d d_j$)." *Id.* at 40 (citing Ex. 1104 ¶ 105). Apple states that this would result in "some information bits . . . contribut[ing] to more summations ($\sum_j h_{ij}^d d_j$) than others, such that the information bits would appear in a variable number of subsets." *Id.* Based on MacKay's teaching that "irregular codes perform better than regular codes," Apple contends an ordinarily skilled artisan would have been motivated to incorporate irregularity into Ping's "generator" matrix $\mathbf{H}^{\mathbf{d}}$. *Id.* at 34–36. Apple notes that Ping credits a reference written by the author of MacKay as having creating "revived interest in the low density parity check (LDPC) codes originally introduced in 1962 by Gallager." *Id.* at 33 (quoting Ex. 1103, 38).

Considering Apple's analysis and submitted evidence, and the arguments presented in Caltech's Preliminary Response, we are satisfied there is a reasonable likelihood that Apple would prevail in showing claim 13 would have been obvious over the combination of Ping and MacKay. We add the following for additional explanation.

Caltech argues "Ping does not provide any disclosure of receiving data in a signal to be encoded, let alone receiving the data in a block format." Prelim. Resp. 24. Caltech contends Ping's "codeword **c**" is already encoded, and vector **d** "is merely a mathematical representation of the information bits in the codeword **c** . . . and provides no indication as whether information bits were ever received at all." *Id.* In this instance, however, we understand the received "block of data to be encoded" to be commensurate with the information bits in vector **d** that are encoded in Ping's described process. The Specification of the '781 patent does not describe any particular form of the input "signal" or particular process for "receiving" a block of data. Thus, we are satisfied on the current record with Apple's mapping of Ping's inputted information bits from vector **d** to the recited "receiving a block of data in a signal to be encoded."

Caltech also argues Apple's "analysis is flawed in that it incorrectly addresses only a portion of Ping's parity check matrix $\mathbf{H}^{\mathbf{d}}$, rather than the parity check matrix **H**." Prelim. Resp. 9. Accordingly, Caltech argues "Ping's parity check matrix **H** already includes nonuniform weight per column—*i.e.*, the 'irregularity' of MacKay." *Id.* Based on Caltech's interpretation of the "particular structure" of parity check matrix **H** as being $[\mathbf{H}^{\mathbf{p}}, \mathbf{H}^{\mathbf{d}}]$, and Caltech's allegation regarding $\mathbf{H}^{\mathbf{d}}$ that "[t]he only value of t disclosed by Ping is 4" (Prelim. Resp. 10–12), Caltech contends that matrix

H has column weights as shown in a diagram from page 12 of the Preliminary Response, which is reproduced below.



Id. at 12, 18. Caltech concludes "Ping discloses a parity check matrix with different numbers of ones per column—*i.e.*, different column weights . . . (weight 2, weight 1, and weight $t = 4$)." *Id.* at 12, 19. Thus, Caltech argues that there would be no motivation to modify Ping to include "irregularity" when Ping "already includes the aspects identified in MacKay." *Id.* at 14, 17–20. For similar reasons, Caltech argues Apple "has failed to show that Ping in view of MacKay discloses 'wherein the information bits appear in a variable number of subsets.'" *Id.* at 20.

Yet Caltech misapprehends Apple's mapping of the teachings from Ping to the language of claim 13. Apple does not utilize Ping's entire parity check matrix **H** in its analysis; rather, Apple maps Ping's "series of summations $\sum_j h_{ij}^d d_j$" to the recited "encoding operation" of claim 13. Pet. 38–39. Apple correctly notes that Ping's matrix $\mathbf{H}^d$, rather than entire parity check matrix **H**, is utilized in forming these summations. *See id.* at 32, 34, 36–40. Because each "subset" of claim 13 is a column of the matrix (*see id.* at 32, 34–36, 39–40; Prelim. Resp. 9–12), Apple's mapping results in a "regular" number of 1s, denoted by the variable *t*, in each subset. *See* Pet. 33–34. As such, we do not agree that matrix $\mathbf{H}^d$ from Ping, as cited by Apple, already includes "irregularity" in the manner suggested by Caltech.

We understand Apple's combination as relating to the specific application of MacKay's "non-uniform column weight" to Ping's matrix $\mathbf{H}^d$ (*see* Pet. 40), not a generic application of "irregularity" (which is not a limitation in claim 13) to Ping's teachings as a whole. As established by Apple, such a modification would result in "some information bits would contribute to more summations ($\sum_j h_{ij}^d d_j$) than others, such that the information bits would appear in a variable number of subsets, as required by claim 13." *Id.* Accordingly, Caltech's arguments do not undermine Apple's stated motivation to combine MacKay with Ping. Nor do they undermine Apple's analysis of the "variable number of subsets" limitation in claim 13.

Caltech additionally argues MacKay is "devoid of any teaching of modifying only a specific portion of a parity check matrix [i.e., $\mathbf{H}^d$], including why or how it would be attempted." Prelim. Resp. 15. Nevertheless, Apple shows persuasively that MacKay "teaches how to make LDPC matrices 'irregular' by implementing a '*nonuniform* weight per column.'" Pet. 35, 40 (both quoting Ex. 1102, 1449). Apple cites a specific example in MacKay where a matrix "has columns of weight 9 and of weight 3." *Id.* (quoting Ex. 1102, 1451). In light of this evidence, we agree that an ordinarily skilled artisan would have known how to add nonuniform column weights from MacKay to the uniform column weights in Ping's matrix $\mathbf{H}^d$.

Finally, Caltech argues that we should deny institution under 35 U.S.C. § 325(d) based on certain alleged similarities between the instant ground and the challenge of claims 13–15 in the 059 IPR based on Ping and another reference called Luby (U.S. Patent No. 6,081,909), among other things. *See* Prelim. Resp. 2–8. We note that MacKay was not asserted in the

059 IPR, so we decline to exercise our authority under § 325(d) as to claims 13–15.[7]

Having considered Apple's evidence and Caltech's arguments in its Preliminary Response, we determine Apple has established sufficiently at this stage that Ping and MacKay teach every limitation of claim 13. Apple has also provided a sufficient rationale for its proposed combination. Thus, for the foregoing reasons, Apple demonstrates a reasonable likelihood of prevailing in showing that claim 13 would have been obvious over Ping and MacKay. Caltech does not address separately Apple's explanations and supporting evidence regarding claims 14, 15, and 18. Based on the record before us, Apple has demonstrated a reasonable likelihood that it would prevail on its assertion that claims 14, 15, and 18 would have been unpatentable over Ping and MacKay. *See* Pet. 40–41, 42–43.

4. Claim 17

Claim 17 depends from claim 13 and recites "each of the subsets of the information bits includes a constant number of the information bits." Apple cites Ping for teaching that "'$\mathbf{H}^d$ has … a row weight of $kt/(n-k)$,' meaning that every row of $\mathbf{H}^d$ contains exactly $kt/(n-k)$ 1s." *Id.* at 41 (quoting Ex. 1103, 38). Relative to the language of claim 17, Apple explains that "[t]he number of information bits in a subset is given by the number of 1s in the row of $\mathbf{H}^d$ corresponding to that subset" meaning that "there are

[7] For similar reasons, we decline to deny institution of the Ping-MacKay-Coombes obviousness ground based on § 325(d).

kt/(*n*-*k*) information bits in each and every subset." *Id.* (citing Ex. 1104 ¶ 111).

Caltech notes that Apple's analysis for claim 13 depends on Ping's matrix $\mathbf{H}^d$ as modified by MacKay's non-uniform column weights. Prelim. Resp. 21. Caltech argues that, in an apparent contradiction, Apple relies on an unmodified version of Ping's $\mathbf{H}^d$ for teaching the "constant number of information bits" limitation in claim 17. *Id.* Caltech provides an example of how a matrix having constant row weights (like $\mathbf{H}^d$) would no longer have constant weights after modification of the column weights to introduce non-uniformity. *Id.* at 22.

We are persuaded by Caltech's arguments. Apple's analysis for claim 17 is inconsistent with its analysis for claim 13, which relies on a version of Ping's $\mathbf{H}^d$ that has been modified according to the teachings of MacKay. *See* Pet. 39–40. Apple has not persuasively shown that this modified version of $\mathbf{H}^d$ would still have constant row weights of *kt*/(*n*-*k*) as in the unmodified version of $\mathbf{H}^d$. Indeed, Apple's analysis for claim 17 makes no mention of MacKay or its teachings. Accordingly, Apple has not shown a reasonable likelihood that it would prevail with respect to claim 17 as obvious over Ping and MacKay.

5. Claims 19–21

Apple's analysis for each of claims 19–21 states:

> Petitioner does not contend that [this claim] requires irregularity, as the Board decided in IPR2015-00059. In the event that the Board now finds that [this claim] requires irregularity, the combination of Ping and MacKay teaches every limitation of [this claim].

Pet. 43–45. The analysis for each claim then cites Ping exclusively except that "MacKay teaches irregularity if the Board finds that irregularity is required." *Id.* at 44–45, 47.

Apple's generalized allegations about the concept of "irregularity" in claims 19–21 do not fulfill Apple's requirement to "identif[y], in writing and *with particularity* . . . the grounds on which the challenge to each claim is based. 35 U.S.C. § 312(a)(3) (emphasis added). Instead of citing MacKay for teaching particular claim limitations in each of claims 19–21, Apple would have us use MacKay to fill potential breaches in Apple's analysis "[i]n the event that the Board now finds that [claims 19–21] require[] irregularity." *See* Pet. 43–45. We agree with Caltech (Prelim. Resp. 5 n.1) that this general invocation of MacKay fails to "specify *where each element of the claim* is found in the prior art patents or printed publications." 37 C.F.R. § 42.104(a)(4) (emphasis added). We have considered the entirety of Apple's analysis for claims 19–21, including its many references to the analysis for limitations appearing in earlier claims. *See* Pet. 43–47. Apple's analysis fails to map precisely MacKay's teachings to the particular language of claims 19–21. In the absence of such a particularized showing, we determine Apple has failed to demonstrate a reasonable likelihood that it would prevail on its assertion that claims 19–21 would have been unpatentable over Ping and MacKay.

6. Claim 22

Claim 22 depends from claim 21.[8] For the reasons that follow, we determine that Apple's analysis for claim 22 cures the deficiencies mentioned above regarding claim 21. In discussing claim 22, we incorporate Apple's analysis for claim 21.

Apple cites the information bits in Ping denoted by vector **d** for the step of "receiving a block of data in the signal to be encoded." Pet. 38, 46 (citing Ex. 1103, 38). Apple contends "Ping receives the information bits **d** and computes from them an encoded codeword **c**." *Id.* at 38 (citing Ex. 1104 ¶ 100). Apple additionally maps the calculation of Ping's first parity bit p_1 according to the summation $\sum_j h_{1j}^d d_j$ for the "first parity bit" limitation. *Id.* at 42–43, 46. Regarding the "second parity bit" limitation, Apple maps the calculation of Ping's second parity bit p_2 according to the equation

$$p_2 = p_1 + \sum_j h_{2j}^d d_j$$

Id. at 42–43, 46–47.

For the "outputting a codeword" limitation, Apple contends Ping describes an encoding process that "outputs a 'codeword **c** as **c** = **[p, d]**, where **p** and **d** contain the parity and information bits, respectively.'" *Id.* at 47 (quoting Ex. 1103, 38). Apple contends Ping's codeword includes all parity bits, including the "first parity bit" and "second parity bit" recited in the claim. *Id.* (citing Ex. 1104 ¶ 132).

---

[8] In co-pending Case IPR2017-00297, we determine there is a reasonable likelihood that Apple would prevail in showing that claim 21 is anticipated by Ping.

Claim 22 further recites "mod-2 or exclusive-OR adding additional subsets of information bits in the collection and parity bits to yield additional parity bits." Referencing its analysis for, *inter alia*, claims 13 and 18, Apple contends "Ping computes every parity bit, p_i, where 'i' is greater than one, by summing the previous parity bit and a summation ($\sum_j h_{ij}^d d_j$)." *Id.* at 48. Apple also references its analysis for claim 13 and contends the combination of Ping in view of MacKay teaches that 'the information bits in the collection appear in a variable number of subsets.'" *Id.* Just as above, Apple contends an ordinarily skilled artisan would have been motivated to incorporate irregularity into Ping's "generator" matrix $\mathbf{H}^d$ based on MacKay's teaching that "irregular codes perform better than regular codes." *Id.* at 34–36.

Caltech does not address separately Apple's explanations and supporting evidence regarding claim 22. Apple's analysis includes a precise mapping of MacKay's teachings to the particular language of claim 22, which cures the deficiency mentioned above with respect to claim 21. Thus, based on the record before us, Apple has demonstrated a reasonable likelihood that it would prevail on its assertion that claims 22 would have been unpatentable over Ping and MacKay. *See* Pet. 47–48.

B. Obviousness Ground Based on Ping, MacKay, and Coombes

Apple contends claim 16 would have been obvious over Ping, MacKay, and Coombes. Pet. 48–50. Caltech disputes Apple's contention. Prelim. Resp. 26.

1. Coombes

Coombes is a U.S. patent directed to "resolving synchronization in an error correction encoded transmission." Ex. 1118, 1:7–10. Coombes teaches that N data bits are passed to conventional block code encoder 12. *Id.* at 3:1–2. Block code encoder 12 processes the N data bits and produces an output error correctable encoded bit stream comprised of the N data bits followed by K parity bits. *Id.* at 3:5–10.

Apple contends, *inter alia*, that Coombes qualifies as prior art under 35 U.S.C. § 102(e). Pet. 30. We agree, because Coombes's filing date of June 25, 1979, is before the earliest possible priority date for the '781 patent, which is May 18, 2000. *See* Ex. 1101, at [60]; Ex. 1118, at [22].

2. Claim 16

Claim 16 depends from claim 13 via claims 14 and 15. Claim 16 recites "the parity bits follow the information bits in the codeword." According to Apple, "Coombes teaches that, in the output of an error-correcting encoder, the 'encoded bit stream . . . is comprised of the N data bits *followed by* K parity bits,' where the 'N data bits' are the information bits input into the encoder." Pet. 50 (quoting Ex. 1118, 3:9–10) (emphasis added by Apple).

Building on its reasons for combining Ping and MacKay, Apple contends "it would have been obvious to use the output bit order taught by Coombes in the combination of Ping in view of MacKay." Pet. 48. Apple reasons "the information bits exist prior to creation of the parity bits and, accordingly, it is simple, and obvious to output the information bits from the encoder prior to the later created parity bits." *Id.* at 49 (citing Ex. 1103, 38).

Caltech does not present separate substantive arguments directed to claim 16. In addition, for the same reasons mentioned above with respect to claims 13–15, we decline to deny institution based on 35 U.S.C. § 325(d). *See* Prelim. Resp. 2–8. Having considered Apple's evidence, we determine Apple has established sufficiently at this stage that Ping, MacKay, and Coombes teach every limitation of claim 16 and that there is a sufficient rationale for its proposed combination. Thus, for the foregoing reasons, Apple demonstrates a reasonable likelihood of prevailing in showing that claim 16 would have been obvious over Ping, MacKay, and Coombes.

III. CONCLUSION

Based on the grounds asserted and discussed above (and detailed in the Order below), Apple has demonstrated a reasonable likelihood of prevailing with respect to claims 13–16, 18, and 22 challenged in this Petition. At this stage of the proceeding, we have not made a final determination as to the patentability of these challenged claims.

IV. ORDER

Accordingly, it is:

ORDERED that pursuant to 35 U.S.C. § 314, *inter partes* review is instituted as to claims 13–16, 18, and 22 of the '781 patent on the following grounds of unpatentability:

Claims 13–15, 18, and 22 as obvious over Ping and MacKay pursuant to 35 U.S.C. § 103(a);

Claim 16 of the '781 patent as obvious over Ping, MacKay, and Coombes pursuant to 35 U.S.C. § 103(a);

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;

FURTHER ORDERED that the instant case is consolidated with Case IPR2017-00297, the trial is limited to the grounds of unpatentability listed above and those listed in the institution decision of Case IPR2017-00297 (Paper 16), and all further filings in the consolidated proceeding shall be made in Case IPR2017-00297;

FURTHER ORDERED that the case caption of all future filings shall be changed to reflect the consolidation in accordance with the attached example;

FURTHER ORDERED that a copy of this Decision be entered into the files of Cases IPR2017-00297 and IPR2017-00423; and

FURTHER ORDERED that, within five business days of this Decision, the parties shall refile any exhibits filed only in this Case IPR2017-00423 (but not filed in Case IPR2017-00297) in the consolidated proceeding, using unique sequential numbers as required by 37 C.F.R. § 42.63(c), and file an updated exhibit list pursuant to 37 C.F.R. § 42.63(e).

Trials@uspto.gov
Tel: 571-272-7822

Paper ____
Entered: ___

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

CALIFORNIA INSTITUTE OF TECHNOLOGY,
Patent Owner.

Case IPR2017-00297[9]
Patent 7,916,781 B2

---

[9] Case IPR2017-00423 has been consolidated with this proceeding.

PETITIONER:

Richard Goldenberg
Brian Seeve
WILMER, CUTLER, PICKERING, HALE AND DORR, LLP
goldenberg@wilmerhale.com
brian.seeve@wilmerhale.com

PATENT OWNER:

Michael T. Rosato
Matthew A. Argenti
Richard Torczon
WILSON SONSINI GOODRICH & ROSATI
mrosato@wsgr.com
margenti@wsgr.com
rtorczon@wsgr.com

Trials@uspto.gov
Tel: 571-272-7822

Paper 16
Entered: July 5, 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 IPR2017-00297
Patent 7,916,781 B2

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

HUDALLA, *Administrative Patent Judge*.

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

Petitioner, Apple, Inc. ("Apple"), filed a Petition (Paper 5, "Pet.") requesting an *inter partes* review of claims 3–12 and 19–21 of U.S. Patent No. 7,916,781 B2 (Ex. 1001, "the '781 patent") pursuant to 35 U.S.C. §§ 311–319. Apple proffered a Declaration of James A. Davis, Ph.D. (Ex. 1004) with its Petition. Patent Owner, California Institute of

Technology ("Caltech"), filed a Preliminary Response (Paper 14, "Prclim. Resp.") to the Petition.

Under 35 U.S.C. § 314(a), the Director may not authorize an *inter partes* review unless the information in the petition and preliminary response "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." For the reasons that follow, we institute an *inter partes* review as to claims 19–21 of the '781 patent on one ground of unpatentability presented.

I. BACKGROUND

A. Related Proceedings

The parties identify the following district court cases related to the '781 patent (Pet. 1; Paper 7, 1):

Cal. Inst. of Tech. v. Broadcom Ltd., No. 2:16-cv-03714 (C.D. Cal. filed May 26, 2016);[1]

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).

The parties also identify co-pending Case IPR2017-00423, in which Apple has filed a petition for *inter partes* review of claims 13–22 of the '781 patent. Pet. 2 n.1; Paper 7, 1. In addition, the '781 patent was previously subject to an *inter partes* review in Case IPR2015-00059 ("059 IPR"). Pet. 19; Ex. 1011; Paper 7, 1. In the Final Written Decision

[1] Apple is a defendant in this case. *See* Pet. 1.

from the 059 IPR, which Apple filed as Exhibit 1011 in this proceeding, the Board determined that claims 1 and 2 of the '781 patent are unpatentable as anticipated by the Divsalar reference, which is one of the asserted references in this case. *See* Ex. 1011, 43.

Apple additionally states that patents in the priority chain of the '781 patent were challenged in Cases IPR2015-00068, IPR2015-00067, IPR2015-00060, IPR2015-00061, and IPR2015-00081. Pet. 1. We additionally identify the following cases between the parties: Cases IPR2017-00210, IPR2017-00211, IPR2017-00219, IPR2017-00700, IPR2017-00701, IPR2017-00702, IPR2017-00703, and IPR2017-00728.

B. The '781 patent

The '781 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.

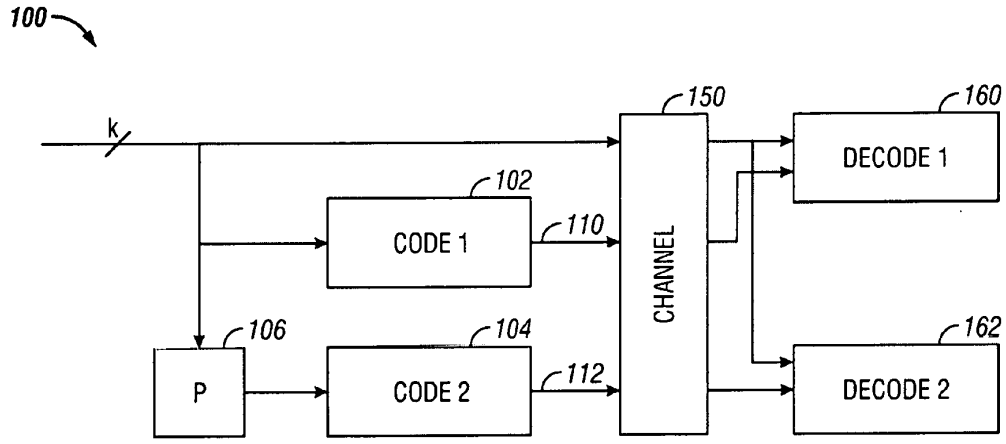


FIG. 1
(Prior Art)

Figure 1 is a schematic diagram of a prior "turbo code" system. *Id.* at 2:20–21. The '781 patent specification describes Figure 1 as follows:

> 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 1:44–60.

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

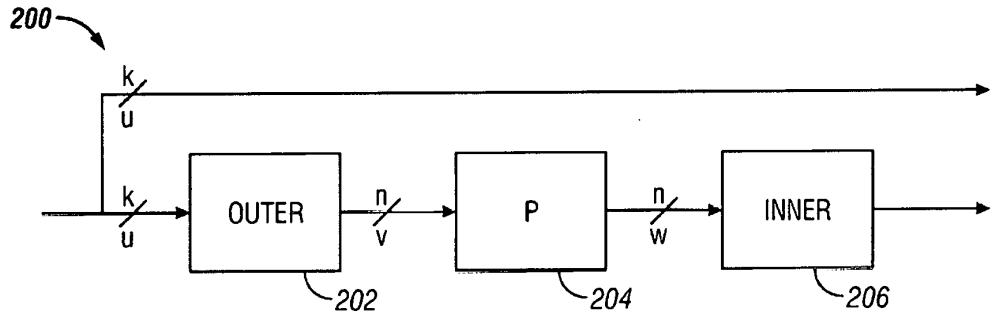


FIG. 2

Figure 2 of the '781 patent is a schematic diagram of coder 200.

> The coder 200 may include an outer coder 202, an interleaver 204, and inner coder 206. . . . The outer coder 202 receives the uncoded data [that] may be partitioned into blocks of fixed size,

> [e.g.] 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[2] 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 the n-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 2:40–3:2 (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

---

[2] We understand that 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.

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

Figure 4 of the '781 patent is reproduced below.

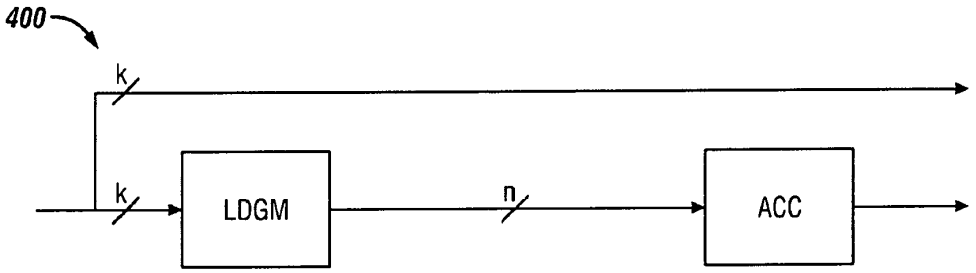


FIG. 4

Figure 4 shows an alternative embodiment in which the first encoding is carried out by a low density generator matrix. Low density generator matrix (LDGM)[3] 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 arrangement because the LDGM provides scrambling otherwise provided by the interleaver in the Figure 2 embodiment.

Apple notes (Pet. 3) that the '781 patent claims priority to a provisional application filed on May 18, 2000. Ex. 1001, at [60]. As discussed below, we determine for purposes of this Decision that one of Apple's asserted references qualifies as prior art even when assuming that

[3] We understand that 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.

May 18, 2000, is the effective filing date for the challenged claims of the '781 patent.

C. Illustrative Claims

Claims 1 (not challenged here) and 19–21 of the '781 patent are independent. Claims 3–12 depend directly or indirectly from claim 1. Claims 1–3 are illustrative of the challenged claims and recite:

> 1. A method of encoding a signal, comprising:
>
> receiving a block of data in the signal to be encoded, the block of data including information bits;
>
> performing a first encoding operation on at least some of the information bits, the first encoding operation being a linear transform operation that generates L transformed bits; and
>
> performing a second encoding operation using the L transformed bits as an input, the second encoding operation including an accumulation operation in which the L transformed bits generated by the first encoding operation are accumulated, said second encoding operation producing at least a portion of a codeword, wherein L is two or more.
>
> 2. The method of claim 1, further comprising:
>
> outputting the codeword, wherein the codeword comprises parity bits.
>
> 3. The method of claim 2, wherein outputting the codeword comprises:
>
> outputting the parity bits; and
>
> outputting at least some of the information bits.

Id. at 7:25–45.

D. The Prior Art

Apple relies on the following prior art:

MacKay et al., "Comparison of Constructions of Irregular Gallager Codes," IEEE TRANSACTIONS ON COMMUNICATIONS, Vol. 47, No. 10, pp. 1449–54, October 1999 (Ex. 1002, "MacKay");

Ping et al., "Low Density Parity Check Codes with Semi-Random Parity Check Matrix," IEE ELECTRONICS LETTERS, Vol. 35, No. 1, pp. 38–39, Jan. 7, 1999 (Ex. 1003, "Ping");

Divsalar et al., "Coding Theorems for 'Turbo-Like' Codes," PROCEEDINGS 36TH ALLERTON CONFERENCE ON COMMUNICATION, CONTROL & COMPUTING, Allerton, Illinois, pp. 201–10, September 1998 (Ex. 1017, "Divsalar"); and

Coombes et al., U.S. Patent No. 4,271,520, filed June 25, 1979, issued June 2, 1981 (Ex. 1018, "Coombes").

E. The Asserted Grounds

Apple challenges claims 3–12 and 19–21 of the '781 patent on the following grounds (Pet. 34, 57, 60, 66):

References	Basis	Claims Challenged
Ping and Divsalar	35 U.S.C. § 103(a)	3, 5–8, 10, and 12
Ping	35 U.S.C. § 102(b)	19–21
Ping, Divsalar, and MacKay	35 U.S.C. § 103(a)	9
Ping, Divsalar, and Coombes	35 U.S.C. § 103(a)	4 and 11

F. Claim Interpretation

In an *inter partes* review, we construe claims by applying the broadest reasonable interpretation in light of the specification. 37 C.F.R. § 42.100(b);

see Cuozzo Speed Techs., LLC v. Lee, 136 S. Ct. 2131, 2144–46 (2016). Under the broadest reasonable interpretation standard, and absent any special definitions, 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. *See In re Translogic Tech. Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Any special definitions for claim terms or phrases must be set forth "with reasonable clarity, deliberateness, and precision." *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

Apple proposes that we construe the limitation "linear transform" in claim 1 consistent with the 059 IPR to mean a transform that

> obeys the laws of linear algebra including distributive and associative properties, *e.g.* the transform of vectors a+b is equal to the transform of a + the transform of b. The transform of x (a scalar) times a vector y is equivalent to x times the transform of vector y.

Pet. 23–24 (citing Ex. 1004 ¶ 93–94; Ex. 1014, 9–10); *see also* Ex. 1014, 13. Caltech does not propose any claim interpretations. For the same reasons mentioned in the 059 IPR, and based on Dr. Davis's testimony, we adopt this construction of "linear transform" for purposes of this Decision. *See* Ex. 1004 ¶ 93–94; Ex. 1014, 9–10 & n.11; Ex. 1014, 13.

On the current record, we determine that no further terms require explicit construction at this time. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) ("[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy").

II. ANALYSIS

We now consider Apple's asserted grounds and Caltech's arguments in the Preliminary Response to determine whether Apple has met the "reasonable likelihood" threshold standard for institution under 35 U.S.C. § 314(a).

A. Obviousness Ground Based on Ping and Divsalar

Apple contends claims 3, 5–8, 10, and 12 would have been obvious over Ping and Divsalar. Pet. 34–57. Caltech disputes Apple's contention. Prelim. Resp. 12–26.

1. Ping

Ping is an article directed to "[a] semi-random approach to low density parity check [LDPC] code design." Ex. 1003, 38. In this approach, "[a]n LDPC code is defined from a randomly generated parity check matrix **H**." *Id.* The size of matrix **H** is $(n–k) \times n$ where k is the information length and n is the coded length. *Id.* A codeword **c** is decomposed "as **c** = [**p**, **d**], where **p** and **d** contain the parity and information bits, respectively." *Id.* Parity check matrix **H** can be decomposed into two parts corresponding to **p** and **d** as "$\mathbf{H} = [\mathbf{H}^p, \mathbf{H}^d]$." *Id.* $\mathbf{H}^p$ is defined as follows:

$$\mathbf{H}^p = \begin{pmatrix} 1 & & & 0 \\ 1 & 1 & & \\ & \ddots & \ddots & \\ 0 & & 1 & 1 \end{pmatrix}$$

Id. $\mathbf{H}^d$ is created such that it "has a column weight of t and a row weight of $kt/(n–k)$ (the weight of a vector is the number of 1s among its elements)" such that

$$\mathbf{H^d} = \begin{bmatrix} h^d_{1,1} & h^d_{1,2} & h^d_{1,3} & \cdots & h^d_{1,k} \\ h^d_{2,1} & h^d_{2,2} & h^d_{2,3} & \cdots & h^d_{2,k} \\ h^d_{3,1} & h^d_{3,2} & h^d_{3,3} & \cdots & h^d_{3,k} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ h^d_{n-k,1} & h^d_{n-k,2} & h^d_{n-k,3} & \cdots & h^d_{n-k,k} \end{bmatrix}$$

Id.; Ex. 1004 ¶ 67.[4]

Parity bits "$\mathbf{p} = \{p_i\}$ can easily be calculated from a given $\mathbf{d} = \{d_i\}$" using the following expressions:

$$p_1 = \sum_j h^d_{1j}\, d_j \quad \text{and} \quad p_i = p_{i-1} + \sum_j h^d_{ij}\, d_j \pmod 2$$

Ex. 1003, 38 (Equation (4)).[5]

Apple contends Ping "was published on January 7, 1999" and "is thus prior art to the '781 patent under 35 U.S.C. § 102(a) and (b)." Pet. 24, 34–35. Ping appears to be included in a publication from the Institution of Electrical Engineers bearing a "7th January 1999" date and a "JAN 25 1999" date stamp from "LINDA HALL LIBRARY." Ex. 1003. Caltech does not dispute the prior art status of Ping. For purposes of this Decision, we determine that Ping qualifies as prior art under 35 U.S.C. § 102(b)[6] because

---

[4] This particular representation of $\mathbf{H^d}$ is taken from Dr. Davis's testimony. Caltech does not dispute this representation. *Cf.* Prelim. Resp. 33–34 & n.9.

[5] The reference to "mod 2" refers to modulo-2 addition. Modulo-2 addition corresponds to the exclusive-OR (XOR or ⊕) logical operation, which is defined as follows: 1⊕1=0, 1⊕0=1, 0⊕1=1, and 0⊕0=0. *See* Pet. 11–12 & n.2.

[6] The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) ("AIA"), amended 35 U.S.C. §§ 102 and 103. Because the priority

January 7, 1999, edition date and the January 25, 1999, date stamp provide some evidence of publication more than one year before the earliest possible effective filing date for the challenged claims of the '781 patent, which is May 18, 2000. *See* Ex. 1001, at [60]; Ex. 1003.

2. Divsalar

Divsalar is a paper directed to "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 transfer function $1/(1 + D)$." Ex. 1017, 1. Figure 3 of Divsalar is reproduced below.

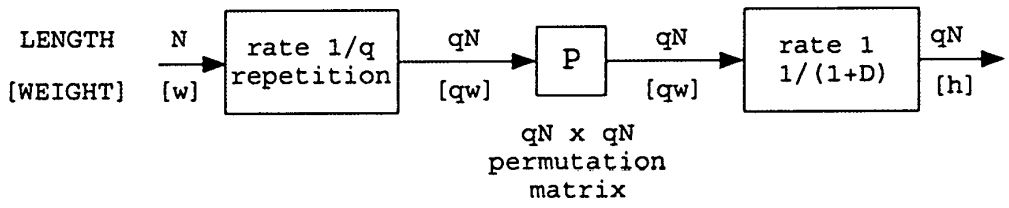


Figure 3. Encoder for a (qN, N) repeat and accumulate code. The numbers above the input-output lines indicate the length of the corresponding block, and those below the lines indicate the weight of the block.

Figure 3 depicts an encoder for a repeat and accumulate code. "An information block of length N is repeated q times, scrambled by an interleaver of size qN, and then encoded by a rate 1 *accumulator*." *Id.* at 5.

Apple makes arguments attempting to qualify Divsalar as a prior art printed publication under 35 U.S.C. § 102(b). Pet. 31, 35. Caltech contends Apple has failed to establish that Divsalar is a prior art printed publication.

---

date of the '781 patent is before the effective date of the applicable AIA amendments, the pre-AIA versions of 35 U.S.C. §§ 102 and 103 apply.

Prelim. Resp. 10. Because we deny institution on the grounds containing Divsalar based on the merits of Apple's challenges, we need not make a determination in the instant Decision regarding the prior art status of Divsalar.

2. Claims 1–3 and 8–10

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 Apple's obviousness grounds with the principles identified above in mind.

Claim 3 depends from claim 1 via claim 2. Thus, Apple's obviousness analysis of claim 3 includes all of the limitations of claims 1 and 2. Regarding claim 1, Apple cites the information bits in Ping denoted by vector **d** for the step of "receiving a block of data in the signal to be encoded." Pet. 40 (citing Ex. 1003, 38). Apple contends "Ping receives the

information bits **d** and computes from them a codeword **c**." *Id.* at 41 (citing Ex. 1004 ¶ 109). Apple contends Ping's computation of $\sum_j h_{ij}^d d_j$ in Ping's Equation (4) "teaches 'performing a first encoding operation on at least some of the information bits' as claimed." *Id.* at 37, 42 (citing Ex. 1003, 38; Ex. 1004 ¶ 114). Citing testimony from Dr. Davis, Apple contends this computation is "a linear transform operation" because it satisfies the distributive and associative properties. *Id.* at 43–44 (citing Ex. 1004 ¶¶ 117–118). Apple further contends this calculation generates L (i.e., two or more[7]) transformed bits. *Id.* at 44. Apple explains "Ping states that its codeword contains 'n' total bits, comprised of 'k' information bits and 'n-k' ('n' minus 'k') parity bits." *Id.* (citing Ex. 1003, 38). Apple cites an example in Ping with "k=30,000 and a code rate of 1/3, meaning that the codeword has 30,000 information bits, 60,000 parity bits and 90,000 total bits." *Id.* at 45 (citing Ex. 1003, 39, Fig. 1; Ex. 1004 ¶ 124). Thus, Apple contends the "n-k" summations ($\sum_j h_{ij}^d d_j$) correspond to the generation of "L transformed bits." *Id.* at 44–45 (citing Ex. 1004 ¶¶ 120–124).

For the "second encoding operation including an accumulation operation" of claim 1, Apple cites Ping's teaching in Equation (4) on "adding '$\sum_j h_{ij}^d d_j$' to the previously-computed parity bit, 'p_{i-1}'" using modulo-2 addition. *Id.* at 42, 46, 48–49. Citing Dr. Davis's testimony, Apple likens this operation to the accumulation operation described in the '781 patent. *Id.* at 48–49 (citing Ex. 1004 ¶¶ 130–133). Apple contends the "L transformed bits generated by the first encoding operation are

[7] A later recitation in claim 1 specifies that "L is two or more."

accumulated" because Ping accumulates the "n-k" summations ($\sum_j h_{ij}^d d_j$) to produce the parity bits. *Id.* at 49 (citing Ex. 1004 ¶ 133). Apple further contends this operation produces "at least a portion of a codeword" because the parity bits p_i produced are part of Ping's codeword **c** where "**c**=[**p**, **d**]." *Id.* at 50 (citing Ex. 1004 ¶ 135).

Apple contends an ordinarily skilled artisan would have recognized Ping as disclosing two distinct encoding steps for several reasons. *See id.* at 37–38. First, Apple argues "Ping discloses a generator matrix $\mathbf{H}^d$ that computes only the summations ($\sum_j h_{ij}^d d_j$), leaving the accumulation as a second distinct step." *Id.* at 37. Second, Apple argues that Ping teaches storing $\mathbf{H}^d$ in the encoder's memory, and "Ping would not teach storing $\mathbf{H}^d$ in the encoder's memory unless [the memory] were used." *Id.* Accordingly, Apple argues an ordinarily skilled artisan "would have understood that the summations, $\sum_j h_{ij}^d d_j$, are actually computed as the first step before the accumulation step of Ping's Equation (4)." *Id.* at 38. Third, Apple argues that combining both steps of Ping's Equation (4) into a single step would require significantly more memory than the "very little memory" Ping states is necessary for storing $\mathbf{H}^d$. *Id.* (citing Ex. 1003, 38; Ex. 1004 ¶ 101).

Apple also provides parallel citations to Divsalar for most limitations in claim 1. The most pertinent of these citations relate to the separateness of the "first" and "second encoding operation[s]." Apple contends "Divsalar's 'rate 1/q repetition' block in Figure 3 is a first encoding operation on the N information bits." *Id.* at 43 (citing Ex. 1004 ¶ 116; Ex. 1017, 5). For the "second encoding operation," Apple cites Divsalar's "'rate 1 1/(1+D)' block shown in Figure 3 [as] an accumulator." *Id.* at 49 (citing Ex. 1004 ¶ 134; Ex. 1017, 5). Apple argues that, "to the extent that Ping is found not to

teach two-stage encoding that includes a 'first encoding operation' . . . , it would have been obvious to one of ordinary skill to implement Ping's Equation (4) in two distinct steps in view of Divsalar's teaching of distinct encoding steps." *Id.* at 42–43 (citing Ex. 1004 ¶ 115).

Apple provides several different reasons why it contends an ordinarily skilled artisan would have combined Ping and Divsalar. First, Apple contends Ping and Divsalar both encode data in two steps, so "[i]n view of Divsalar's teaching encoding in two distinct steps, one of ordinary skill would have implemented Ping's encoder using two steps." *Id.* at 37 (citing Ex. 1004 ¶ 100). Second, Apple contends Divsalar and Ping are both directed to improving the performance of error-correcting codes. *Id.* at 38–39 (citing Ex. 1003, 38–39; Ex. 1004 ¶ 103; Ex. 1017, 2). Third, Apple notes Ping's and Divsalar's common use of modulo-2 addition "to implement accumulation as a step in the encoding process." *Id.* at 39 (citing Ex. 1003, 38; Ex. 1004 ¶ 104; Ex. 1017, 2, 5). Fourth, Apple notes how both references "teach how randomness in an encoding process improves error-correcting codes." *Id.* at 39–40 (citing Ex. 1003, 38; Ex. 1004 ¶ 105; Ex. 1017, 1). Fifth, Apple contends "the combinability of Ping and Divsalar is demonstrated by the number of claim limitations they both teach." *Id.* at 40 (Ex. 1004 ¶ 106).

We are not persuaded that Apple is reasonably likely to prevail in showing claim 1 would have been obvious over Ping and Divsalar. As an initial matter, we agree with Caltech (Prelim. Resp. 14–15) that Ping's computation of $\sum_j h_{ij}^d d_j$ as the alleged "first encoding operation" only produces a single bit because this summation applies modulo-2 addition. Apple and Dr. Davis admit as much. *See* Pet. 45 ("Ping is clear that each

summation ($\sum_j h_{ij}^d d_j$) produces a 'bit' as claimed . . . . 'Mod 2' operations are binary operations that produce binary results (*i.e.*, a 1 or 0)."); Ex. 1004 ¶ 123 (same). Notwithstanding, Apple cites an example resulting from the application of Ping's entire Equation (4) expression, namely $p_i = p_{i-1} + \sum_j h_{ij}^d d_j$, in an attempt to establish that Ping "generates a transformed bit (*i.e.*, a summation $\sum_j h_{ij}^d d_j$) for each of the 60,000 inner coder parity bits, p_i." Pet. 45. Yet it is inconsistent for Apple to map Ping's computation of one bit in $\sum_j h_{ij}^d d_j$ as the "first encoding operation" and then cite the result of the repeated application of $p_i = p_{i-1} + \sum_j h_{ij}^d d_j$ as evidence that $\sum_j h_{ij}^d d_j$ generates two or more transformed bits. Based on this inconsistency, we are not persuaded that Ping teaches or suggests "a first encoding operation . . . that generates L transformed bits," as recited in claim 1.[8]

We also agree with Caltech that the Petition provides no description of how to combine the teachings of Ping and Divsalar. *See* Prelim. Resp. 19. Instead, the Petition includes parallel citations to Divsalar for most limitations in claim 1. *See* Pet. 40–50. But those citations and Apple's discussion of the alleged motivation to combine the references do not

[8] We acknowledge that Apple includes a parallel citation to Divsalar for teaching this limitation. *See* Pet. 45 (citing Ex. 1004 ¶ 125; Ex. 1017, 5) ("Divsalar's repetition block in Figure 3 receives N information bits and produces qN repeated bits."). Nevertheless, Apple's brief mention of Divsalar does not indicate how or why an ordinarily skilled artisan would have modified Ping to include Divsalar's repetition block. As we discuss below, Apple's Petition does not identify precisely the combination of elements on which its obviousness case relies.

indicate how an ordinarily skilled artisan would have combined the teachings of Ping and Divsalar. For example, Caltech notes the differences between Ping's "summation and accumulation" and Divsalar's "repetition and accumulation" coding operations. *See* Prelim. Resp. 19. Even though Apple relies on the two distinct encoding steps in Divsalar to modify Ping (*see* Pet. 38), Apple provides no indication of how the references' coding operations would be merged or modified. In this way, Apple fails to satisfy the statutory requirement that a petitioner must identify, "in writing and *with particularity*, each claim challenged, the grounds on which the challenge to each claim is based, and the evidence that supports the grounds for the challenge to each claim." 35 U.S.C. § 312(a)(3) (emphasis added); *see also* 37 C.F.R. §§ 42.22(a), 42.104(b)(4)–(5). Simply invoking Divsalar as an exemplar of a two-step process is insufficient to establish how the combination of Ping and Divsalar would work.

We further agree with Caltech (Prelim. Resp. 17–24) that Apple's rationale for combining Ping and Divsalar lacks articulated reasoning with some rational underpinning. First, although Apple contends an ordinarily skilled artisan would have combined Ping and Divsalar because both references teach two encoding steps (Pet. 37–38), Caltech is correct that Apple's rationale is "circular and self-defeating" for the following reasons:

> It is entirely unclear why there would be a motivation to modify Ping to include two distinct steps if Ping already includes two distinct steps as argued in the petition. Conversely, if Ping does not teach encoding in two distinct steps, the stated motivation of both references teaching two-step encoding is factually incorrect.

Prelim. Resp. 18. Second, Apple contends that the combination of Ping and Divsalar would "simplify the encoder's implementation" (Pet. 38 (citing

Ex. 1004 ¶ 102)), but we agree with Caltech that is contention is unsupported by any evidentiary support aside from a conclusory statement in Dr. Davis's testimony. Prelim. Resp. 20–21. And, as stated before, the Petition does not identify precisely the "implementation" combining Ping and Divsalar that is allegedly simplified. Third, Apple cites certain similarities between Ping and Divsalar—namely, purported "align[ment]" of encoding techniques and common teachings on "error-correcting codes," "mod-2 summing," and "randomness"—as motivating the combination of these references. Pet. 38–40. Had Apple articulated which elements from Ping and Divsalar were to be combined, then these purported commonalities might have provided some evidence of combinability. In the absence of such an articulation, however, such commonalities cannot cure this fatal deficiency in Apple's analysis. Accordingly, we agree with Caltech that Apple's rationale for the combination is insufficient.

Thus, Apple's analysis does not establish a reasonable likelihood that claim 1 would have been obvious over Ping and Divsalar. Because claim 3 depends from claim 1 via claim 2, and because Apple's arguments directed to the additional limitations of claims 2 and 3 (*see id.* at 51) do not cure the deficiencies in Apple's showing with respect to claim 1, we determine that Apple has not established a reasonable likelihood of prevailing in showing that claim 3 would have been obvious over Ping and Divsalar. Furthermore, because claims 5–8, 10, and 12 also depend, directly or indirectly, from claim 1, we likewise determine Apple has not established a reasonable likelihood of prevailing in showing that claims 5–8, 10, and 12 would have been obvious over Ping and Divsalar.

B. Anticipation Ground Based on Ping

Apple contends that claims 19–21 are anticipated by Ping. Pet. 57–59. Caltech disputes Apple's contention. Prelim. Resp. 26–30.

1. Claim 19

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)).

Apple's anticipation analysis for claim 19 references its obviousness analysis for claims 1, 6, and 8 in the Ping-Divsalar ground. For "receiving a block of data . . . including information bits," Apple again cites Ping's vector **d** and contends "Ping receives the information bits **d** and computes from them a codeword **c**." Pet. 40–41 (citing Ex. 1003, 38; Ex. 1004 ¶ 109), 57 (citing Ex. 1004 ¶ 160). Regarding the recited "encoding operation," Apple cites Ping's Equation (4):

$$p_1 = \sum_j h_{1j}^d \, d_j \quad \text{and} \quad p_i = p_{i-1} + \sum_j h_{ij}^d \, d_j \pmod 2$$

Id. at 41–42 (citing Ex. 1003, 38; Ex. 1004 ¶¶ 112–114), 57 (citing Ex. 1004 ¶ 161). For the recitation "the encoding operation including an accumulation of mod-2 or exclusive-OR sums of bits in subsets of the information bits," Apple cites the modulo-2 summation $\sum_j h_{ij}^d \, d_j$ and contends that these summations are sums of bits in a subset of the information bits, because each d_j is an information bit. *Id.* at 53 (citing

Ex. 1003, 38; Ex. 1004 ¶¶ 147–148), 57 (citing Ex. 1004 ¶ 161). Regarding the limitation "at least two of the information bits appear in three subsets of the information bits," Apple contends "[t]he number of subsets in which an information bit appears is given by the number of 1s in the column of $\mathbf{H}^d$ corresponding to that information bit." *Id.* at 55, 57. Apple cites an example in Ping where $\mathbf{H}^d$ has a column weight of four, meaning that every column of $\mathbf{H}^d$ contains exactly four 1s. *See id.* at 55 (citing Ex. 1003, 39; Ex. 1004 ¶ 153). Accordingly, Apple contends every information bit "necessarily appears in at least 'three subsets of the information bits'" if it appears in four subsets. *Id.*

Considering Apple's analysis and submitted evidence, and the arguments presented in Caltech's Preliminary Response, we are satisfied there is a reasonable likelihood that Apple would prevail in showing claim 19 is anticipated by Ping. We add the following for additional explanation.

Caltech argues that the Ping-based anticipation ground for claim 19 from the 059 IPR "has been recycled completely here as an anticipation ground against claims 19–21." Prelim. Resp. 4. In particular, Caltech argues Apple "does not explain how its challenge is meaningfully different compared to the challenge advanced [in the 059 IPR] and rejected by the Board." *Id.* As such, Caltech argues we should exercise our authority under 35 U.S.C. § 325(d) and deny this ground. *Id.* at 2, 5.

We observe that 35 U.S.C. § 325(d) includes permissive language indicating that we may consider a petition that presents the same prior art or arguments previously presented to the Office. *See* 35 U.S.C. § 325(d) ("In determining whether to institute or order a proceeding under . . . chapter 31

[Inter Partes Review], 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." (emphasis added)). This case involves a different petitioner than that in the 059 IPR, and, as discussed in this section, we determine Apple's analysis relative to claim 19 has merit. Under these circumstances, we decline to deny institution of the instant ground under § 325(d).[9]

Caltech also argues Apple "provides no citations or arguments in support of the 'receiving' element[]." Prelim. Resp. 27. In particular, Caltech takes issue with Apple's references to analysis from the Ping-Divsalar obviousness ground in support of its Ping anticipation ground. *See id.* Nevertheless, we had no trouble discerning the citations on which Apple relies, as discussed above.

Caltech additionally argues "Ping does not provide any disclosure of receiving data in a signal to be encoded, let alone receiving the data in a block format." *Id.* at 28. Caltech contends Ping's "codeword **c**" is already encoded, and vector **d** "is merely a mathematical representation of the information bits in the codeword **c** . . . and provides no indication as whether information bits were ever received at all." *Id.* at 28–29. In this instance, however, we understand the received "block of data to be encoded" to be commensurate with the information bits in vector **d** that are encoded in Ping's described process. The Specification of the '781 patent does not describe any particular form of the input "signal" or particular process for "receiving" a block of data. Thus, we are satisfied on the current record

[9] We likewise decline to apply § 325(d) with respect to claims 20 and 21.

with Apple's mapping of Ping's inputted information bits from vector **d** to the recited "receiving a block of data in a signal to be encoded."

Caltech further argues claim 19 "does not recite that at least two of the information bits appear in 'at least three subsets' of the information bits." Prelim. Resp. 26, 30. Caltech questions how Ping's column weight of 4 establishes the recited "three subsets," or how Ping could be modified "to have information bits appear in 'three subsets' instead of in 'four subsets.'" *Id.* at 26. Yet Apple presents some evidence from Ping establishing that three subsets are expressly described by or are otherwise necessarily present in Ping's column weight of 4. *See* Pet. 55 (citing Ex. 1003, 39; Ex. 1004 ¶ 153). For example, such evidence could support a determination that the "three subsets" limitation is inherently described in Ping. *See, e.g.*, *Cont'l Can Co. USA v. Monsanto Co.*, 948 F.2d 1264, 1268 (Fed. Cir. 1991) (stating that inherent anticipation can be established where "the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill."). Thus, at this stage of the proceeding, we are satisfied by Apple's showing based on four subsets, but we expect that this issue will be more completely evaluated in the context of a trial when the ultimate determination on anticipation is made.

Having considered Apple's evidence and Caltech's arguments in its Preliminary Response, we determine Apple has established sufficiently at this stage that Ping describes expressly or inherently every limitation of claim 19. Thus, for the foregoing reasons, Apple demonstrates a reasonable likelihood of prevailing in showing that claim 19 is anticipated by Ping.

2. Claims 20 and 21

Apple's analysis for claim 20 references much of the same analysis for claim 19. *See* Pet. 58. Apple additionally maps the calculation of Ping's first parity bit p_1 according to the summation $\sum_j h_{1j}^d d_j$ for the "first sum" limitation. *Id.* at 53, 58. Regarding the "second sum" limitation, Apple maps the calculation of Ping's second parity bit p_2 according to the equation

$$p_2 = p_1 + \sum_j h_{2j}^d d_j$$

Id. at 53, 58–59.

Claim 21 recites, *inter alia*, a "first parity bit" and "second parity bit" rather than a "first sum" and "second sum" as in claim 20. Accordingly, Apple's analysis for claim 21 is similar to that for claim 20. In addition, for the "outputting a codeword" limitation, Apple contends Ping describes an encoding process that "outputs a 'codeword **c** as **c** = **[p, d]**, where **p** and **d** contain the parity and information bits, respectively.'" *Id.* at 60 (quoting Ex. 1003, 38). Apple contends Ping's codeword includes all parity bits, including the "first parity bit" and "second parity bit" recited in the claim. *Id.* (citing Ex. 1004 ¶ 175).

Caltech does not make separate arguments directed to claims 20 and 21. On this record, we are satisfied at this stage that Apple has established sufficiently at this stage that Ping describes expressly or inherently every limitation of claims 20 and 21. Thus, for the foregoing reasons, Apple demonstrates a reasonable likelihood of prevailing in showing that claims 20 and 21 are anticipated by Ping.

C. Obviousness Ground Based on Ping, Divsalar, and MacKay

Apple contends that claim 9 would have been obvious over Ping, Divsalar, and MacKay. Pet. 60–66. Caltech disputes Apple's contention. Prelim. Resp. 30–39.

Claim 9 depends from claim 1 via claims 6, 5, and 2. Apple's obviousness analysis for claim 9 builds on its analysis for claim 1, which we determine above is not reasonably likely to show that claim 1 would have been obvious over Ping and Divsalar. Indeed, Apple's rationale for combining Ping, Divsalar, and MacKay relies on its rationale for combining Ping and Divsalar (*see* Pet. 60–61), which we find insufficient above. Nor does Apple's analysis for claim 9 cure the deficiencies noted above for claim 1. Accordingly, we determine that Apple fails to establish a reasonable likelihood that claim 9 would have been obvious over Ping, Divsalar, and MacKay.

D. Obviousness Ground Based on Ping, Divsalar, and Coombes

Apple contends that claims 4 and 11 would have been obvious over Ping, Divsalar, and Coombes. Pet. 66–69. Caltech disputes Apple's contention. Prelim. Resp. 39–40.

Claims 4 and 11 both ultimately depend from claim 1. Apple's rationale for combining Ping, Divsalar, and Coombes relies on its rationale for combining Ping and Divsalar (*see* Pet. 67–68), which we find insufficient above. Furthermore, Apple's analysis for claims 4 and 11 does not cure the deficiencies noted above for claim 1. Accordingly, Apple has failed to establish a reasonable likelihood that claims 4 and 11 would have been obvious over Ping, Divsalar, and Coombes.

III. CONCLUSION

Based on the grounds asserted and discussed above (and detailed in the Order below), Apple has demonstrated a reasonable likelihood of prevailing with respect to claims 19–21 challenged in this Petition. At this stage of the proceeding, we have not made a final determination as to the patentability of these challenged claims.

IV. ORDER

Accordingly, it is:

ORDERED that pursuant to 35 U.S.C. § 314, *inter partes* review is instituted as to claims 19–21 of the '781 patent on the following ground of unpatentability:

Claims 19–21 of the '781 patent as anticipated by Ping pursuant to 35 U.S.C. § 102(b);

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.

PETITIONER:

Richard Goldenberg
Brian Seeve
WILMER, CUTLER, PICKERING, HALE AND DORR, LLP
goldenberg@wilmerhale.com
brian.seeve@wilmerhale.com

PATENT OWNER:

Michael T. Rosato
Matthew A. Argenti
Richard Torczon
WILSON SONSINI GOODRICH & ROSATI
mrosato@wsgr.com
margenti@wsgr.com
rtorczon@wsgr.com

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.	DATE FILED	U.S. DISTRICT COURT
CV13-07245	10/01/2013	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., 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

FILED
2013 OCT -1 AM 10:21
CLERK U.S. DISTRICT COURT
CENTRAL DIST. OF CALIF.
LOS ANGELES
BY

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:	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.	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
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

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. 2:15-CV-01108-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

Trials@uspto.gov
571.272.7822

Paper 42
Entered: April 21, 2016

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 IPR2015-00059
Patent 7,916,781 B2

Before KALYAN K. DESHPANDE, GLENN J. PERRY, and TREVOR M. JEFFERSON, *Administrative Patent Judges*.

PERRY, *Administrative Patent Judge.*

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

I. INTRODUCTION

A. Procedural History

Hughes Network Systems, LLC and Hughes Communications, Inc.[1] (collectively "Petitioner" or "Hughes") filed a Petition requesting an *inter partes* review of claims 1–7, 13–16, and 19 of U.S. Patent No. 7,916,781 B2 (Ex. 1005, "the '781 Patent"). Paper 4 ("Pet.").[2] California Institute of Technology ("Patent Owner" or "CIT") timely filed a Preliminary Response. Paper 13 ("Prelim. Resp."). We instituted trial as to claims 1 and 2 of the '781 Patent as being anticipated by Divsalar[3] and did not authorize trial as to the other grounds of unpatentability alleged in the Petition. Paper 18 ("Dec."). Following institution of trial, Patent Owner filed its formal response. Paper 24 ("PO Resp."). Petitioner replied. Paper 29 ("Pet. Reply"). Patent Owner moved to "strike" and to "exclude" various Petitioner exhibits. Paper 32 ("Mot."). Petitioner opposed. Paper 35 ("Mot. Opp."). We heard oral argument on February 10, 2016. Paper 39 ("Tr.").

B. Related Proceedings

Petitioner states that the '781 Patent is involved in a pending lawsuit titled *California Institute of Technology v. Hughes Communications, Inc.*, No. 13-CV-07245 (C.D. Cal.). Pet. 1 (citing Ex. 1015). In that lawsuit the following patents are asserted: (i) U.S. Patent No. 7,116,710; (ii) U.S. Patent No. 7,421,032; (iii) U.S. Patent No. 7,916,781; and (iv) U.S. Patent

---

[1] EchoStar Corporation is named in the Petition as the parent of Hughes Satellite Systems Corporation, which is the parent of Hughes Communications, Inc. Pet. 1.

[2] "Pet." refers to the corrected Petition filed October 30, 2014 (Paper 4).

[3] Dariush Divsalar, et al., *Coding Theorems for "Turbo-Like" Codes*, THIRTY-SIXTH ANNUAL ALLERTON CONFERENCE ON COMMUNICATION, CONTROL, AND COMPUTING 201–209 (1998) (Ex. 1011, "Divsalar").

No. 8,284,833. Petitioner has filed additional Petitions for *inter partes* review challenging other patents of the patent family. Pet. 1.

C. The '781 Patent

1. Background and Context

Error correcting codes are used to communicate information across a noisy communication channel. They enable recovery of a transmitted message that may have become distorted by noise on the communication channel. To error correction encode a message for transmission, its bits are parsed into groups of message bits that are "encoded" into "codewords" that include additional redundant information.[4] Thus, the encoded codewords have more information than the original message had prior to encoding. The codewords are transmitted over the communication channel and are received at another location, where the codewords are "decoded" into the original message. No single coding scheme is optimal for all communication channels. There are design tradeoffs between the use of complex codes, which permit better error correction, and less complex codes, which are easier to decode. This has led to the development of many different encoding/decoding schemes. The '781 Patent describes one such scheme.

2. Disclosed Invention

The '781 Patent describes the serial concatenation of interleaved convolutional codes forming turbo-like codes. Ex. 1005, Title. It explains some of the prior art with reference to its Figure 1, reproduced below.

[4] For example, message bits "10011" may be encoded into a codeword "100111" by adding a "parity" bit "1" to the original message.

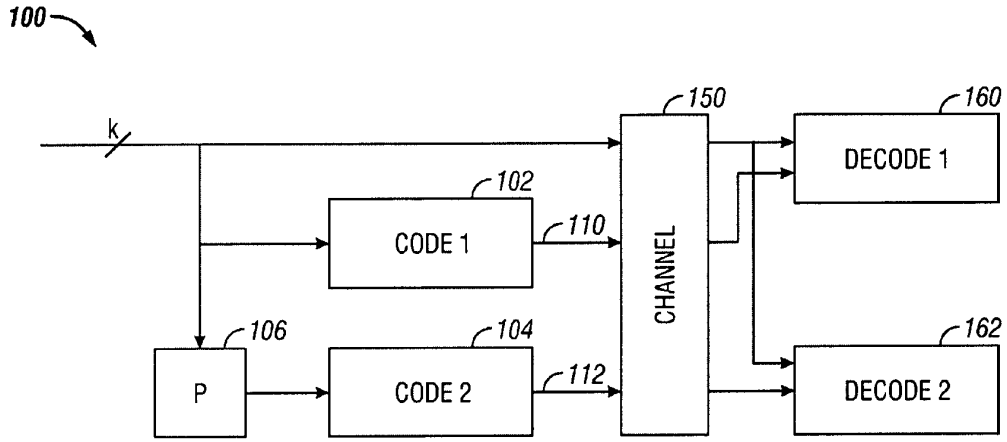


FIG. 1
(Prior Art)

Figure 1 is a schematic diagram of a prior "turbo code" system. Ex. 1005, 2:20–21. The '781 Patent specification describes Figure 1 as follows:

> 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.

Ex. 1005, 1:44–60.

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

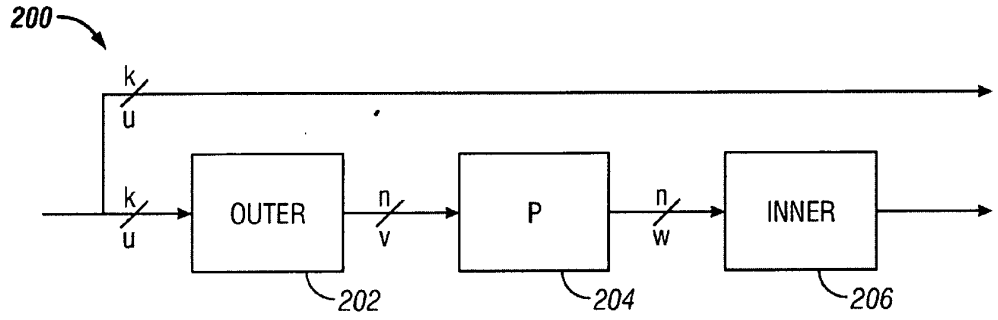


FIG. 2

Figure 2 of the '781 Patent is a schematic diagram of coder 200.

> The coder 200 may include an outer coder 202, an interleaver 204, and inner coder 206. . . . The outer coder 202 receives the uncoded data [that] may be partitioned into blocks of fixed size, [e.g.] 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 nxk matrix, and the rate[5] 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 the n-bit output block x can be written as $x=T_Iw$, where T_I is a nonsingular n x n matrix. The inner coder 210 can have a

[5] We understand that 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.

rate that is close to 1, e.g., within 50%, more preferably 10% and perhaps even more preferably within 1% of 1.

Ex. 1005, 2:40–3:2. 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 '781 Patent is reproduced below.

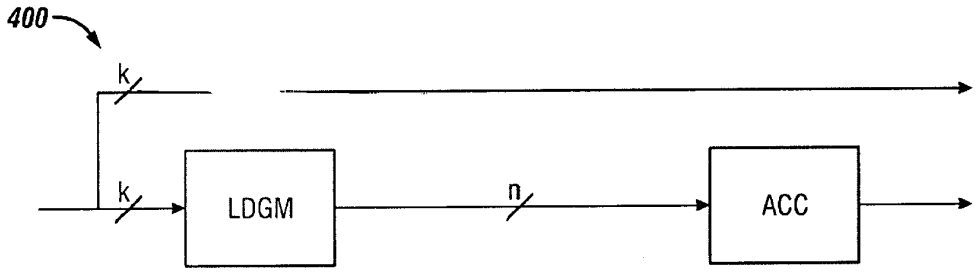


FIG. 4

Figure 4 shows an alternative embodiment in which the first encoding is carried out by a low density generator matrix. Low density generator matrix (LDGM)[6] codes are a special class of low density parity check codes that allow for less encoding and decoding complexity. LDGM codes are

[6] We understand that 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.

systematic linear codes generated by a "sparse" generator matrix. No interleaver (as in the Figure 2 embodiment) is required in the Figure 4 arrangement because the LDGM provides scrambling otherwise provided by the interleaver in the Figure 2 embodiment.

3. Illustrative Claim

Independent claim 1 is reproduced below.

1. A method of encoding a signal, comprising:

[a] receiving a block of data in the signal to be encoded, the block of data including information bits;

[b] performing a first encoding operation on at least some of the information bits, the first encoding operation being a linear transform operation that generates L transformed bits; and

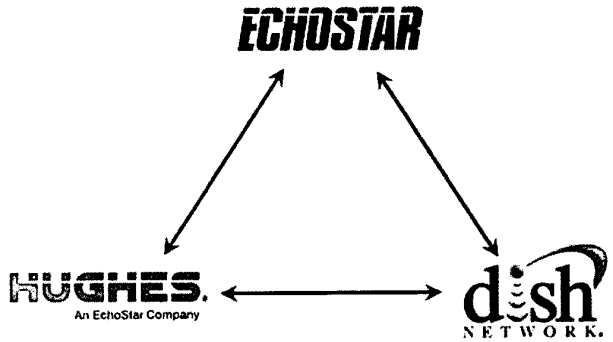
[c] performing a second encoding operation using the L transformed bits as an input, the second encoding operation including an accumulation operation in which the L transformed bits generated by the first encoding operation are accumulated, said second encoding operation producing at least a portion of a codeword, wherein L is two or more.

(bracketed alphabetic references are added to the claim limitations).

II. ANALYSIS OF PETITIONER'S CHALLENGES

A. *Real Parties in Interest*

Patent Owner argues that Petitioner failed to name all Real Parties-in-Interest (RPI) including EchoStar Corporation ("EchoStar") and the "DISH" entities. Paper 16, PO Resp. 5–18. We held a conference call on Feb. 25, 2015 to discuss Patent Owner's allegation of unnamed real parties-in-interest. The following figure is reproduced from page 9 of Patent Owner's Preliminary Response.

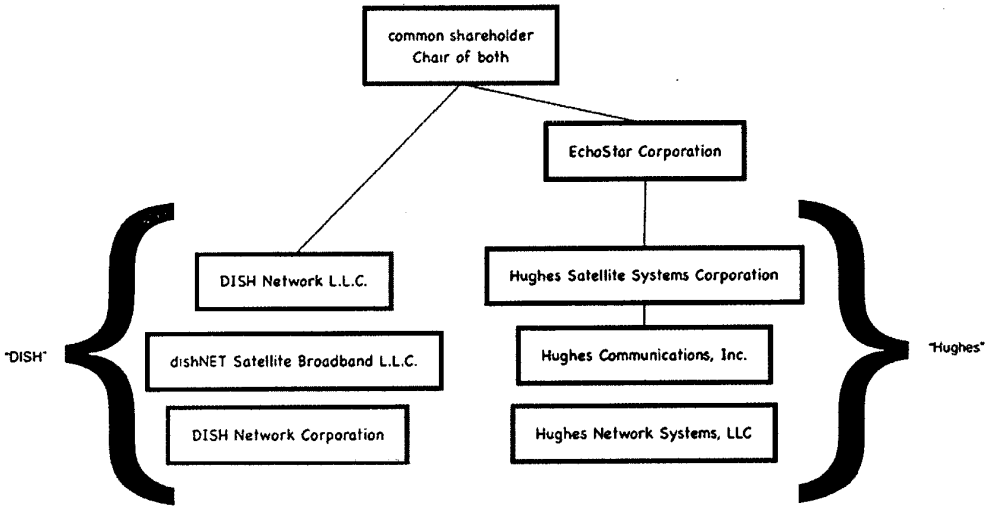


The figure purports to portray relationships among EchoStar, Hughes, and Dish entities.

We authorized additional briefing on the issue of potential unnamed real parties-in-interest. Petitioner (Paper 15) and Patent Owner (Paper 16) filed briefs directed to this issue. Petitioner also filed, without authorization and in support of Paper 15, a Declaration of T. Jezek, in house Intellectual Property Counsel of Hughes Network Systems, LLC. Ex. 1070.

The Petition names Hughes Network Systems, LLC and Hughes Communications, Inc. (collectively "Hughes") as real parties-in-interest. The Petition further states that EchoStar Corporation is the parent of Hughes Satellite Systems Corporation which is the parent of Hughes Communications, Inc. Pet. 1.

Patent Owner argues that Petitioner failed to name EchoStar Corporation ("EchoStar") and the "DISH" entities as real parties in interest in the Petition. We held a conference call on Feb. 25, 2015 to discuss this issue. The following diagram sets forth our understanding of relationships among various corporate entities.



1. EchoStar

Petitioner acknowledges that Hughes is wholly owned by EchoStar. Petitioner identified EchoStar in the Petition under the heading "Real Party-in-interest." Pet. 1. During the conference call held on Feb. 25, 2015, Petitioner argued that the identification of EchoStar was in accordance with the PTO's published guidance at 69 Fed. Reg. 49,960, 49,975 (Aug. 12, 2004). It argued that no "magic words" are required to identify a RPI and that its identification set forth in accordance with USPTO published guidance is sufficient.

Patent Owner argues that EchoStar should have been specifically named as a real party-in-interest. PO Resp. 5–8.

The evidence of record indicates that EchoStar is the parent company of Hughes. Petitioner identified EchoStar in the "Real Parties in Interest" section of the Petition as the parent of Hughes. There is no evidence that EchoStar controls this *inter partes* review.

Patent Owner notes that aside from Mr. Jezek's declaration, Hughes has not provided evidentiary support for its contention that it properly named the real parties-in-interest beyond a single exhibit containing a portion of a motion for summary judgment filed by Hughes and DISH in one of the related district court cases.

We find that Petitioner has identified EchoStar in accordance with the Board of Patent Appeals and Interferences guidance of August 12, 2004. As such, we are not persuaded that Petitioner has failed to name EchoStar as a real party in interest.

2. Dish Entities

Dish is not identified in the Petition as a real party-in-interest. During the conference call of February 25, 2015 Petitioner indicated that Dish is a spinout of EchoStar.

Patent Owner argues that public documents describe EchoStar as "calling the shots" for its subsidiaries. Paper 16, 1. Patent Owner recounts various activities with respect to the District Court litigation that suggest Dish is a real party-in-interest. Paper 16, 2. In particular, Patent Owner refers to the voting power of Charles W. Ergen, SEC documents indicating "common control," R. Stanton Dodge being both Dish General Counsel and an EchoStar Director, EchoStar V.P. Roger J. Lynch being responsible for technology that is important to EchoStar and Dish, and Dish and Hughes having common counsel in the District Court proceeding. *Id.*

Patent Owner argues that as a result of this "evidence," the burden has shifted to Petitioner to demonstrate that Dish is not a real party-in-interest. We disagree.

Although Petitioner has the ultimate burden of persuasion in an *inter partes* review, once the Petitioner has represented what it believes to be a proper identification of the real parties-in-interest, Patent Owner has the burden of production in establishing that a real party-in-interest has not been named. Patent Owner has not carried that burden with respect to establishing that Dish is an unnamed real party-in-interest.

Petitioner persuasively argues that Patent Owner failed to show that the Petition was filed at the behest of Dish. Paper 15, 1. The key to a real party-in-interest inquiry is the relationship between the potential unnamed real party-in-interest and the proceeding, not the relationship between parties. For example, "[a] common consideration is whether the non-party exercised or could have exercised control over a party's participation in a proceeding." 77 Fed. Reg. at 48,759.

There is no persuasive evidence of record that Dish controls or even had an opportunity to control Hughes' decision to file or maintain this *inter partes* review.

3. Conclusion

Patent Owner has not met its burden of production in establishing that Petitioner has failed to name a real party-in-interest.

B. Claim Construction

In an *inter partes* review, claim terms of an unexpired patent are given their 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. 48,756, 48,766 (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. *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 with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

In this case, our construction discussed below would be the same using the broadest reasonable construction or the claim construction standard required by *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc).

1. "linear transformation"(claim 1)

Petitioner argues that Divsalar teaches linear transformation within its broadest reasonable construction. However, it does not propose a formal construction for the term "linear transformation." Pet. 11–14.

Patent Owner argues that when the claims are properly construed, Divsalar fails to teach a "first encoding operation being a linear transform operation that generates L transformed bits," and "the second encoding operation including an accumulation operation in which the L transformed bits generated by the first encoding operation are accumulated." PO Resp. 2.

According to Patent Owner, it is clear from the context of the '781 Patent that the first encoding operation is not so broad as to encompass any linear transformation. Rather, read in view of the specification, the first encoding operation must involve irregular repetition and scrambling of bits. PO Resp. 31–32 (citing Ex. 1005 at 1:63-2:10). Patent Owner provides declaration testimony of Dr. Solomon Golomb (Ex. 2024), who explains that the specification consistently refers to the invention as comprising two main aspects—an "outer coder" and an "inner coder" (Ex. 2024 ¶ 21)—and that a person of ordinary skill, upon reading the specification, would understand

that the outer coder must include irregular repetition of input bits. Ex. 2024 ¶ 22.

We construe the term "linear transformation" in order to apply the Divsalar reference. The term "linear transformation" is used in the context of a transformation between two vector spaces. We adopt a linear algebra definition[7] that a linear transformation is one that obeys the laws of linear algebra including distributive and associative properties, e.g., the transform of vectors a+b is equal to the transform of a + the transform of b. The linear transform of x (a scalar) times a vector y is equivalent to x times the transform of vector y. We decline to read into the claim limitation the requirement of an irregular repeat.

2. Additional Claim Terms

We find it unnecessary to construe additional claim terms.

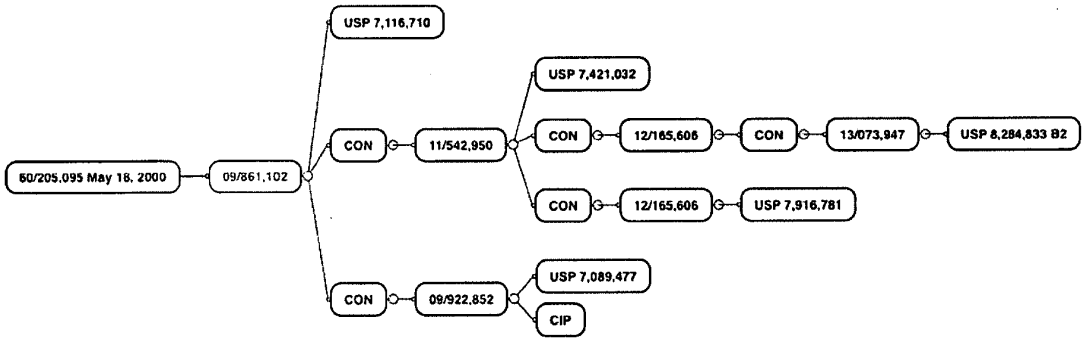
C. Divsalar (Ex. 1011) as a Publication

The Petition relies upon Divsalar (Ex. 1011) being a printed publication citable against the '781 Patent. Divsalar is an article written by Dariush Divsalar, Hui Jin, and Robert J. McEliece. Robert J. McEliece is listed as a co-inventor of the '781 Patent at issue. The authorship of Divsalar is different from the inventorship of the '781 Patent because only Robert J. McEliece is common to both.

Patent Owner argues that Petitioner has not established that Divsalar is a printed publication within the meaning of 35 U.S.C. § 311(b) that can be relied upon to anticipate the claims of the '781 Patent. PO Resp. 20–28.

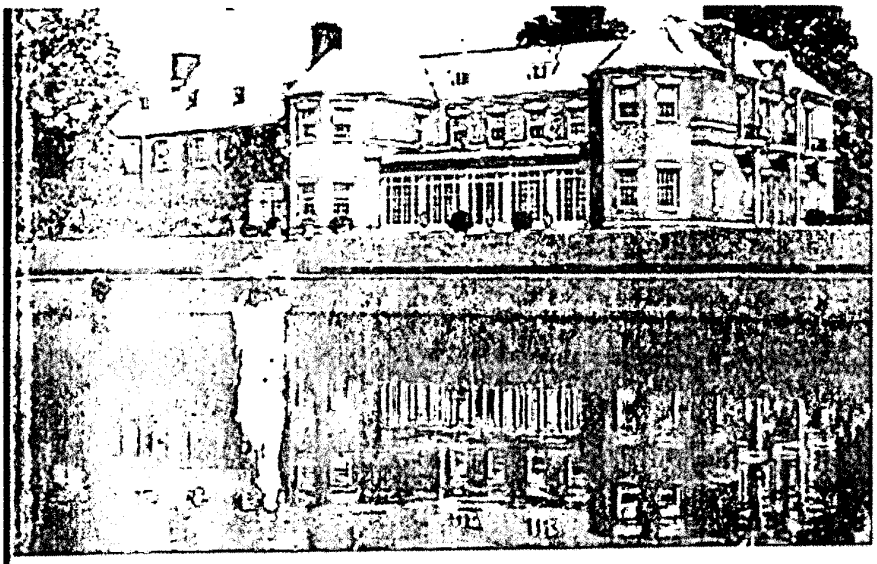
[7] This definition is explained by "Wolfram MathWorld" at http://mathworld.wolfram.com/lineartransformation.html (Ex. 3000).

The '781 Patent is part of a family of applications and patents as illustrated in the following diagram.



We prepared the above diagram based on related cases data found on the cover page of the '781 Patent. The '781 Patent derives an earliest effective filing date, through a series of continuation applications, from the filing date of Provisional Application 60/205,095 which was filed on May 18, 2000. Petitioner does not challenge the May 18, 2000 effective filing date for the '781 Patent.

The cover page of Divsalar (Exhibit 1011) is reproduced below.



Proceedings

THIRTY-SIXTH ANNUAL ALLERTON CONFERENCE
ON COMMUNICATION, CONTROL AND COMPUTING

September 23 - 25, 1998

Allerton House, Monticello, Illinois
Sponsored by the
Coordinated Science Laboratory and the
Department of Electrical and Computer Engineering of the
University of Illinois at Urbana-Champaign

Hughes, Exh. 1011, p. 1

The above image is taken directly from Exhibit 1011. The hallmark of whether a document is a printed publication within the meaning of the

America Invents Act is whether it has been made available to those of ordinary skill in the art in a manner such that those seeking it can find it. *See e.g., SRI Int'l, Inc. v. Internet Sec. Sys., Inc.*, 511 F.3d 1186, 1194 (Fed. Cir. 2008).The record includes sufficient evidence that Divsalar is a "printed publication" within the meaning of 35 U.S.C. § 311(b) and that it predates the earliest effective filing date of the '781 Patent.

The Petition states that Divsalar was "published at least by April 30, 1999." Pet. 2. Petitioner provides a Declaration by Robin Fradenburgh (Ex. 1064), Librarian at the University of Texas ("UT"). The Fradenburgh Declaration includes an "acquisition record" pasted into an email. Ex. 1064, 4–6. Fradenburgh states that the exact date of acquisition of Divsalar by the UT library is unknown. *Id.* at ¶ 5. However, the acquisition record states at the bottom "UT Created 1999-04-30." *Id.* at 6. We take this to mean that the acquisition record was created April 30, 1999. We infer from this date that Divsalar was received at the library no later than April 30, 1999. Patent Owner correctly notes that there are no details in the declaration or acquisition record concerning how Divsalar was treated at the library after the acquisition record was created; e.g., there are no details concerning its shelving and cataloging.

Based on the cover page of Divsalar, we find that it is a print-out of a paper from a collection of papers in the Proceedings of the Allerton Conference that occurred September 23–25, 1998, about 20 months before the earliest effective filing date of the '781 Patent. There is no evidence in the record suggesting otherwise.

Petitioner further presents Declaration testimony of Henry D. Pfister, Ph.D. (Ex. 1010) stating that

> [t]he Allerton Conference is generally regarded as one of the main conferences in the field of information theory and communications and generally occurs in September. In 1999, the conference occurred from September 22-24, 1999 with the paper being published on the author's websites in October of 1999. The proceedings were published later.

Ex. 1010 ¶ 29.

Petitioner further provides the Declaration testimony (Ex. 1060) of David J.C. Mackay, Ph.D. generally describing that he was active in the community of those engaged in error correction coding and in the period of 1991 to present published papers, software, abstracts and other information on his own website regarding publications that he made available to others on his own website. Ex. 1060 ¶¶ 13–33. Dr. Mackay states that he attended talks given by Dr. Robert McEliece including those given in 1998 and 1999 at the Allerton Conferences held by the University of Illinois. Ex. 1060 ¶ 11. He describes his process for publishing papers in detail in paragraph 21 of his Declaration. Dr. Mackay further states that "more commonly final articles summarizing all or part of the conference presentation were completed *immediately* after the conference and sent to the organizers for publication." *Id.* ¶ 21. Dr. Mackay does not provide testimony specifically directed to Allerton's publication of its papers from its 1998 Allerton Conference. *See id.* However, he testifies (verified by Wayback Machine) that he placed a copy of his own paper, "Comparison of Constructions of Irregular Gallager Codes" on his website as of May 7, 1999. Ex. 1060 ¶ 27. *See* Tr. 13–14. His own paper cites Divsalar (see table below). We find, based on Dr. Mackay's testimony, that Divsalar had been distributed to him prior to his posting of his own paper on his website in May, 1999.

Petitioner asserts that the "at least as early" publication date (i.e., April 30, 1999) is based on the acquisition record of the UT library. Pet. 2 (citing Ex. 1064). According to Patent Owner, the Fradenburgh Declaration fails to establish that Divsalar was published by the alleged publication date. PO Resp. 24–25. Patent Owner argues that the Fradenburgh Declaration does not explain the acquisition record and does not explain the circumstances of Divsalar having been cataloged and shelved, such that it would have been made available to one of ordinary skill exercising reasonable diligence. *Id.*

However, paragraph 7 of the Fradenburgh Declaration states: "The library's records reflect that this reference was made available to members of the public on ___ 1999-04-30_____." Paragraph 8 of the Fradenburgh Declaration states: "[If made-available date not available:]] [a]t the time of the acquisition of this reference, the library typically made newly acquired items available to the public with ___ days of acquisition." There is no number filled in the blank before "days" and the paragraph begins with a double bracketed phase suggesting that it is an optional portion of a form.

Petitioner argues that Divsalar is not an "obscure paper." Tr. 45. Rather, it was an important paper to the field because it "proved that the IGE conjecture was true." *Id.* As discussed below, there is evidence in the record that a significant portion of this "target" audience was actually aware of the Divsalar paper, indicating not only its availability, but its actual distribution.

The Divsalar paper was co-authored by Robert McEliece, Ph.D., who is also a co-inventor of the patent at issue. Reply 15 (citing Ex. 1011). Dr. McEliece lists Divsalar as a "publication" in his C.V. Ex. 1075 ¶ 228. Further, David MacKay published several papers prior to the earliest

effective filing date of the '781 Patent. Those papers cite to Divsalar. *See, e.g.*, Ex. 1041, 2, 11 (citing Divsalar); Ex. 1042, 1, 3 (citing Divsalar); Ex. 1060 ¶¶ 30–33.

Finally, we note that Divsalar is listed as being of record among the "References Cited" in the '781 Patent itself. It was not of record in the prosecution of its grandparent application, which issued as the '710 Patent.[8]

The following table summarizes evidence of record regarding Divsalar including citations to the Divsalar paper suggesting to us that Divsalar's peers had actual knowledge of the paper and considered it in preparing their own work.

Date	Evidence	Comment
April 29, 1999	Fradenburgh Declaration	States "[t]he UT library's records reflect that Divsalar was made available to the public on 1999-04-30."
1999	David MacKay, *Gallager Codes – Recent Results* (1999)(Ex. 1041, 2, 11); MacKay Decl., Ex. 1060 ¶ 30 (testifying that MacKay placed a copy of this paper on his website by July 16, 1999).	Cites to "Divsalar, D., Jin, H., and McEliece, R.J., (1998) Coding theorems for 'turbo like' codes, In Proceedings of the 36th Allerton Conference on Communication, Control, and Computing, Sept. 1998, pp. 201-210, Monticello, Illinois. Allerton House." Ex. 1041, 2, 11

[8] The Board understands that citation in an Information Disclosure Statement does not constitute an admission that the cited reference qualifies as prior art as of a particular date. Its mention here, however, is one more piece of circumstantial evidence which, taken with others, suggests public accessibility of the document. We weigh it accordingly.

1999	David MacKay, *Gallager Codes – Recent Results*, Abstract (1999) (Ex. 1042, 1, 3); MacKay Decl., Ex. 1060 ¶ 31 (testifying that MacKay placed a copy of this abstract on websites on June 2, 1999 and that paper copies of the abstract with a link to his website were distributed at a conference in July 1999) .	Cites to "Divsalar, D., Jin, H., and McEliece, R. J., (1998) Coding theorems for 'turbo like' codes." Ex. 1042, 1, 3.
	David MacKay Declaration (Ex. 1060) explains MacKay papers. Par 30–33	
1999	Henry D. Pfister and Paul H. Siegel, *The Serial Concatenation of Rate-1 Codes Through Uniform Random Interleavers*, Proceedings from the Thirty-Seventh Allerton Conference on Communication, Control, and Commuting, Sept. 22–24, 1999 (Ex. 1057, 1, 11) (cited at Pfister Decl., Ex. 1010 ¶ 32 n.22).	Dr. Pfister's paper presented at 1999 Allerton Conference cites to Divsalar presented at the previous year's Allerton Conference. Ex. 1057, 1, 11 (Ref. [4]).
1999	Audrey M. Viterbi & Andrew J. Viterbi, *New results on serial concatenated and accumulated-convolutional turbo code performance*, 54 Ann. Telecomms., 173–182 (1999). Ex. 1031 at 1, 10 (cited at Pfister Decl., Ex. 1010 ¶ 32 n.22).	Cites "Divsalar et al." (Ex. 1031, 1 (Abstract)) and "DIVSALAR (D.), JIN (H.), MCELIECE (R.), Coding theorems for turbo-like codes, *Jet Propulsion Laboratory*, Pasadena, CA, (September 1998)" (*id.* at 10 (Reference [5]).

Copyright 2000[9]	CODING, COMMUNICATIONS AND BROADCASTING (2000) (Ex. 1043, 1 (showing copyright date), 9).	Cites to "Divsalar, D., Jin, H., and McEliece, R.. J. (1998) Coding theorems for 'turbo-like' codes. In *Proceedings of the 36th Allerton Conference on Communication, Control, and Computing, Sept. 1998*, pp. 201-210, Monticello, Illinois. Allerton House." Ex. 1043, 9.
	File History of '781 Patent (Ex. 1006) includes an IDS dated June 30, 2008 which lists reference BD.	Citing as "BD": "Divsalar, D., et al., "Coding Theorems for 'Turbo-Like' Codes," *Proceedings of the 36th Annual Allerton Conference on Communication, Control, and Computing*, Monticello, Illinois, pp. 201–210, September 1998." Ex. 1006, 4.

The various citations, in the table above, by others of skill in the error correction coding art demonstrate that they acknowledged the contributions of Divsalar and built upon them during the relevant time period.

Based on the same named authors that appear in bibliographic citations in the 1998–1999 time frame, we find that the evidence of record supports that a relatively small community of artisans worked in error correction coding, several of whom referenced the Divsalar paper. Under

[9] The presence of the citation in a book copyrighted in 2000 suggests that the author of that portion of the book (here, David Mackay) would have received the article prior to the book's publication.

these circumstances, we find that the Divsalar paper was published to the relevant community of skilled artisans well before the earliest effective filing date of the patent at issue.

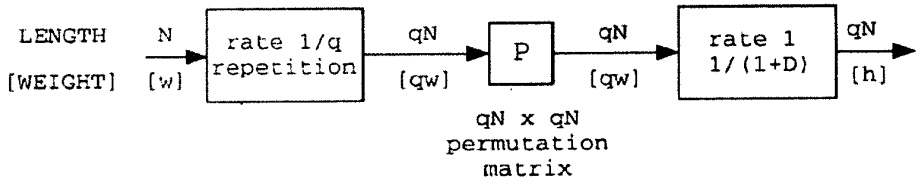
We determine, based on the totality of the evidence discussed above, that Divsalar is prior art with respect to the '781 Patent. We conclude that the preponderance of evidence establishes that Divsalar is a printed publication available as prior art against the '781 Patent as required by 35 U.S.C. § 311(b).

D. Challenge to Claims 1 and 2 based on Divsalar

1. Claim 1

a. Limitation [a]

Petitioner argues that Divsalar describes limitation [a] because Divsalar's Figure 3, reproduced below, describes an 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. Pet 13 (citing Ex. 1011, 7).



Divsalar Fig. 3 shows an encoderfor 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. Ex. 1011, 7. Divsalar encodes information block of length N, which is a block of data obtained from a signal to be encoded. *See* Divsalar Fig. 3

and Ex. 1010 ¶ 142. Petitioner argues that the subject of Divsalar is the encoding and decoding of error-correcting codes, and it would be clear to a person having ordinary skill in the art that all block encoding methods necessarily perform this step. *Id.* ¶ 143.

Patent Owner argues that Divsalar does not explicitly describe "receiving a block of data in the signal to be encoded." PO Resp. 46. We do not find this argument to be persuasive. Reading Divsalar as a whole, one of ordinary skill would recognize that the encoding described by Divsalar would be operable on a block of data from a signal to be encoded. If one describes adding a cup of water to a pot as part of a cooking recipe, it is not necessary to describe taking a measuring cup to the faucet and filling that cup to its one cup marker.

b. Limitation [b]

Petitioner argues that Divsalar describes limitation [b] (first encoding). Divsalar's Figure 3 shows "[a]n information block of length N is repeated q times, scrambled by an interleaver of size qN, and then encoded by a rate 1 accumulator." Pet. 14 (citing Ex. 1011, 5). According to Petitioner, "[t]he combination of Divsalar's repetition and permutation constitute a linear transform operation that generates L transformed bits." Pet. 14 (citing Ex. 1010 ¶ 144). According to Petitioner, as shown in Figure 3, these steps produce qN bits. Petitioner argues that Divsalar discloses the use of q=3 and q=4. Ex. 1011, 9.

Patent Owner disagrees, arguing that Petitioner has not demonstrated why this is so. Prelim. Resp. 23–27. Patent Owner argues that the claimed "first encoding operation is not so broad as to encompass *any* linear transformation. . . . [Rather,] the first encoding operation must involve irregular repetition and scrambling of bits." PO Resp. 31.

Patent Owner draws a distinction between the '781 Patent being directed to "irregular" repeat codes and Divsalar being directed to "regular" repeat codes, noting that Divsalar does not disclose an encoding operation utilizing irregular repetition. *Id.* at 47–48. Patent Owner argues "[n]othing in the '781 patent would indicate to a person of skill in the art that the encoder in Figure 2 could be a 'regular repeat accumulate' code." *Id.* at 49.

We agree with Patent Owner that the specification explains how irregular coding is achieved. However, we do not read limitation [a] of claim 1 as being limited to irregular repeat coding, as discussed above in our claim construction. Claim 1 requires "performing a first encoding operation on at least some of the information bits, the first encoding operation being a linear transform operation that generates L transformed bits." The first encoding can be on "at least some" of the information bits. Thus, it could also be on all of the information bits. Also, according to the claim, the first encoding operation must produce "L" transformed bits. There is no explanation in the claim as to the relationship of "L" to the incoming block of bits being transformed. All that claim 1 recites, at the end of the claim, is that L is 2 or more. Thus, claim 1 could produce a regular repeat code by repeating all of the information bits to generate L (more than 2) transformed bits. Although Patent Owner argues that claim 1 is limited to producing irregular codes, there is no language in the claim that so limits it. Claim 1 is in contrast to claims 9 and 22 (not at issue) which require information bits to appear in a "variable number of subsets."

If limitation [a] were limited to "irregular" codes, Patent Owner's position would have merit. However, claim 1 embraces more than just "irregular" repeat codes. It includes first and second encoding operations that may produce regular and irregular repeat codes. Thus, on the full

record, Patent Owner's argument is not commensurate in scope with the actual language of claim 1.

Petitioner cross-examined Patent Owner's expert, Dr. Solomon W. Golomb, and asked whether "linear transformation" requires irregular repetition of the k input bits." His answer was "no." Ex. 1073, 29:9–21; Pet. Reply 4.

The family of patents including the '781 Patent includes multiple continuation patents. Thus far, five patents have issued in this family. We have reviewed a number of claims of other patents of the family (not at issue) and find clear references to "irregular repeats" and "scramble the repeated bits." Ex. 1003, 7:61–8:20; Ex. 1001, 8:1–6; Pet. Reply 6. Claim 9 of the '781 Patent (not at issue) recites "information bits [that] appear in a variable number of subsets." Thus, claim 9 is limited to an irregular repeat, but Patent Owner did not similarly limit claim 1 in this way.

Given the evidence discussed above, we are unwilling to read into limitation [b] a requirement that it produce irregular codes. As such, we find that Divsalar describes limitation [b]. *See* Divsalar Fig. 3.

c. Limitation [c]

Petitioner argues that Divsalar describes limitation [c]. Pet. 15. According to Petitioner, Divsalar's accumulator performs an accumulate operation on the qN bits that are input to the accumulator and output as a codeword. Pet. 15 (citing Ex. 1011, 5; Ex. 1010 ¶ 145). The transformed bits that are input to Divsalar's accumulator are qN in size. Ex. 1011, 5; Ex. 1010 ¶ 146. Divsalar discloses the use of q=3 and q=4. Ex. 1011, 9. Therefore, even for a trivial block length of a single bit, Divsalar discloses that more than two transformed bits are generated. Ex. 1010 ¶ 146.

Patent Owner argues that the claimed "second encoding operation" corresponds to the "inner coder" described in the specification. PO Resp. 24, 41. Thus, according to Patent Owner, the claimed "second encoding operation" should be read to require a specific type of accumulation operation. PO Resp. 40–41.

Specifically, Patent Owner argues it should be read to require addition of a previously generated parity bit and more than one input bit in order to generate a second parity bit and that therefore Divsalar would not meet the claim limitation. PO Resp. 45.

The specification describes an accumulator embodiment of the inner coder.

> 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
>
> $$y_1 = x_1$$
>
> $$y_2 = x_1 \oplus x_2$$
>
> $$y_3 = x_1 \oplus x_2 \oplus x_3$$
>
> $$y_n = x_1 \oplus x_2 \oplus x_3 \oplus \ldots \oplus x_n.$$
>
> where "$\oplus$" 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.

Ex. 1005, 3:3–23; *see also* Pet. Reply, 9–10. We do not read this embodiment as requiring addition of a previously generated parity bit and more than one input bit in order to generate a second parity bit. Furthermore, this embodiment is identical to the inner coder described in Divsalar. Ex. 1011, 7.

Given the evidence discussed above, we are unwilling to read limitation [c] as requiring any specific type of accumulation operation. As such, Divsalar meets the requirements of limitation [c].

We conclude that Petitioner has established by a preponderance of the evidence that Divsalar anticipates claim 1.

2. Applying Divsalar to Claim 2

Claim 2 depends from claim 1 and further requires that a codeword resulting from the claim 1 encoding process include parity bits. Divsalar adds parity bits by outputting more bits than are input. *See* Ex. 1011, Figure 3 (showing a first encoding having a rate less than 1). Nothing in claim 2 limits it to producing irregular repeat codewords.

Petitioner argues that bits output by Divsalar's accumulator are parity bits. Pet. 16 (citing Ex. 1010 ¶ 148); Ex. 1011, 5. We agree with Petitioner that Divsalar therefore meets the broadest reasonable interpretation of "outputting the codeword, wherein the codeword comprises parity bits." Ex. 1010 ¶ 148.

Patent Owner does not separately argue claim 2 and relies only upon its arguments made with respect to claim 1. As discussed above, we did not find those arguments persuasive. We conclude that Petitioner has shown by a preponderance of the evidence that Divsalar anticipates claim 2.

E. Motion to Strike and Exclude

Patent Owner moves to "strike" and to "exclude" evidence. Paper 32 ("Mot."). In particular, Patent Owner moves to strike Ex. 1064 (Fradenburgh Declaration) (Mot. 2–6), Petitioner's "new theory" of unpatentability (Mot. 6–9), and Exhibit 1076 (Jezek Declaration) (Mot. 9–11). Patent Owner moves to exclude exhibits 1001–1004, 1007–1009, 1012, 1013, 1017–1021, 1023, 1030, 1032–1036, 1038–1040, 1043–1044, 1046–1056, 1058, 1059, 1060 (¶¶ 13–29, 34–38 and 40–83), 1061–1063, 1065, and 1066 for failing to meet the admissibility requirements of the Federal Rules of Evidence. 37 C.F.R. § 42.64(c); Mot. 11–13.

1. Strike Fradenburgh Declaration

Patent Owner asks that we strike the Fradenburgh Declaration because Petitioner "refused to make Ms. Fradenburgh available for cross-examination." Mot. 2. We understand the series of events surrounding the potential cross-examination of Ms. Fradenburgh as follows:

Patent Owner asked to cross-examine Ms. Fradenburgh by sending an email dated June 12, 2015 to Petitioner's Counsel requesting availability dates for cross-examination of Ms. Fradenburgh. Mot. 3 (citing Ex. 2025). Petitioner responded on July 7, 2015 by email stating that Ms. Fradenburgh would not appear voluntarily and informed Patent Owner that it would have to seek a subpoena to compel her to appear for cross examination. *Id.* (citing Ex. 2026). Petitioner sent a further email to Counsel for Patent Owner on July 9, 2015 indicating that Petitioner had learned "late last week" that Ms. Fradenburgh would not appear voluntarily. *Id.* (citing Ex. 2027). Patent Owner immediately requested that Petitioner take the necessary steps to make Ms. Fradenburgh available for cross-examination or formally

withdraw her testimony. *Id.* (citing Ex. 2028). Petitioner remained silent on the issue until after Patent Owner filed its Patent Owner Response (Paper 24). In that Response, Patent Owner again pointed out what it considered to be flaws in the Fradenburgh declaration and argued Petitioner's failure to make Ms. Fradenburgh available for cross-examination. PO Resp. 24–27; Mot. 4.

During a teleconference with the Board on September 4, 2015 related to a Petitioner request for discovery, Petitioner admitted that it could have taken the steps necessary to obtain the required subpoena:

> Could we have subpoenaed [Ms. Fradenburgh] or requested leave from the Board to subpoena her? I think the answer is yes, but, again, we already have her direct testimony by declaration, which does establish a publication date of this document that's, you know, well within the critical time period.

Ex. 2030, 18:17–22. Petitioner's position is that it was capable of producing Ms. Fradenburgh for cross-examination, but did not do so because it saw no benefit to itself. In Petitioner's view, if Patent Owner wanted to cross-examine Ms. Fradenburgh, compelling her to appear was Patent Owner's burden. *Id.* at 19:1–7.

Patent Owner argues that because Petitioner did not meet its obligation to make Ms. Fradenburgh available, that we should strike the Fradenburgh Declaration.

Petitioner argues that Patent Owner has waived this issue. Petitioner argues that the first time Patent Owner formally raised this issue in its briefing was in its Patent Owner Response, where it argued that "Petitioner should . . . be precluded from relying on" the Fradenburgh Declaration. PO Resp. 21, 27–29. Prior to that, the parties had exchanged emails regarding the deposition of Ms. Fradenburgh, but no formal papers had been filed and

no conference call had been conducted. According to Petitioner, the exchange of emails demonstrates that Petitioner followed the procedure established by the Board in *Marvell Semiconductor, Inc. v. Intellectual Ventures I LLC*, IPR2014-00553 (PTAB April 8, 2015) (Paper 28). Specifically, Petitioner attempted to obtain the voluntary appearance of Ms. Fradenburgh. When it was unable to do so, Petitioner suggested to Patent Owner that if a deposition was necessary (which seemed unlikely in this case given the apparent lack of a dispute over Divsalar's availability as prior art), Patent Owner could subpoena Ms. Fradenburgh. Patent Owner made no attempt to seek that subpoena and made no formal objection to Ms. Fradenburgh's testimony. Indeed, no objection to the testimony of Ms. Fradenburgh was ever filed in this proceeding. *See* Ex. 2032 (Patent Owner's objections).

Petitioner further argues that, prior to receiving the Patent Owner Response, Petitioner believed the dispute over Ms. Fradenburgh had been resolved. According to Petitioner, Patent Owner falsely suggests that Petitioner "remained silent on the issue [of whether Ms. Fradenburgh's testimony would be withdrawn] until after [Patent Owner] filed its Patent Owner Response." Paper 32, 4. Petitioner argues it made clear in an email to Patent Owner's counsel—well before Patent Owner's response was due—that Ms. Fradenburgh's testimony was not being withdrawn, and proposed that a subpoena be issued if her deposition was still being requested:

> As to Ms. Fradenburgh, we will not be withdrawing her testimony. As I previously indicated, we understand that she will appear in response to a subpoena. Accordingly, if CalTech remains interested in taking her deposition, we suggest that you request the Board's approval to issue such a subpoena.

Ex. 1078 (email dated July 9, 2015). However, Petitioner never received a response to this email.

We find that if Patent Owner intended to strike Ms. Fradenburgh's testimony, it should have timely objected to it, or requested a call with the Board to move to strike her testimony during the discovery period in this *inter partes* review, when Petitioner could have sought a subpoena. We find Patent Owner is not permitted to raise this issue after the close of discovery.

Petitioner further argues that even if this issue had not been waived, Patent Owner's motion fails on the merits.

In light of the circumstances, Petitioner suggested the proper procedure would be for the Patent Owner to simply seek a subpoena to compel the deposition. In response to Petitioner's suggestion, Patent Owner took no further action to compel Ms. Fradenburgh's testimony, and sat on this issue until its Response. Furthermore, Patent Owner has made no showing that such a deposition would have been helpful to its position

Patent Owner cites to the Trial Practice Guide's discussion of "Witness Expenses" to support its assertion that Petitioner was required to take every possible action to make Ms. Fradenburgh available. Paper 32 (citing Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,761 ("TPG") (§ I(F)(1)(b))). Petitioner suggests that this section relates to "witness expenses," not the procedure to be followed when a third-party witness is unwilling to sit for a deposition voluntarily. We find that while that section might entitle Patent Owner to shift any expenses associated with Ms. Fradenburgh's deposition to Petitioner, no such expenses were incurred because Patent Owner did not proceed with efforts to compel her deposition, and never notified Petitioner that it intended to seek to strike her testimony, which would have prompted Petitioner to seek Board authorization to

compel her testimony.

Moreover, even if this section of the TPG were to apply to compelling witness testimony, and it does not, it would still not support Patent Owner's contention that the testimony should be struck. First, the portion of the TPG cited by Patent Owner does not set forth a mandatory requirement. The TPG simply states that the party presenting a witness's testimony "should arrange to make the witness available for cross-examination." TPG at 48,761 (emphasis added). Such aspirational language cannot support the drastic measure of striking evidence, particularly when, as here, the party seeking to strike the evidence did not timely object to it.

Second, the "Witness Expenses" portion of the TPG cited by Patent Owner is silent on the issue of compelling involuntary testimony and only mentions expenses associated with "non-party witnesses." TPG at 48,761. Instead, the issue of obtaining involuntary testimony is addressed three paragraphs later under the heading "Compelled Testimony." *Id.* If the TPG was intended to require that Petitioner must compel involuntary cross-examination testimony, it would have set out such a requirement in the section addressed to that issue.

We conclude that the burden to make Ms. Fradenburgh available was on Petitioner. However, Patent Owner did not avail itself of appropriate remedies when it could have done so. If Patent Owner was not satisfied with the exchange of emails between counsel related to arranging the Fradenburgh deposition, it should have simply requested a conference call with the Board. Had such a call been timely conducted, we would have instructed Counsel that the burden was on Petitioner to obtain the subpoena. However, Patent Owner did not do so. Rather, it simply abandoned its efforts to cross-examine Ms. Fradenburgh and chose instead to argue the

insufficiency of Petitioner's proof in its Response. Given the long delays in dealing with this issue and Patent Owner's failure to seek an appropriate remedy from the Board, its now requested remedy of striking the Declaration is not appropriate. We deny Patent Owner's requested relief.

2. "New Theory"

Patent Owner argues (Mot. 6–9) that Petitioner has shifted its theory of unpatentability from Divsalar constituting § 102(b) prior art to Divsalar constituting § 102(a) prior art. Patent Owner asks us to strike this new argument. Mot. 6–9 (citing Pet. Reply 14-16)

Petitioner's Reply states that "Divsalar was presented and published in connection with the Allerston Conference held in September 1998 and was publically available to interested members of the public by at least April 30, 1999." *Id.*

Patent Owner argues that Petitioner, for the first time, cites to four exhibits (Ex. 1031, 1041, 1042, 1057) and contends that these exhibits "corroborate[] the publication of Divsalar before the effective filing date of the '781 patent." *Id.* at 15–16. None of these exhibits, or the corresponding provisions of Dr. McKay's declaration, were ever cited in the Petition. Further, none of these exhibits, or the testimony of Petitioner's declarant, Dr. McKay, comport with Petitioner's original § 102(b) theory of unpatentability. Instead, each of these exhibits is newly advanced by Petitioner as admittedly post-dating the "April 30, 1999" publication date originally asserted in the petition. *See* Ex. 1060 (MacKay) ¶ 30 (asserting Ex. 1041 was posted to a website on July 16, 1999), ¶ 31 (asserting Ex. 1042 was posted to a website on June 2, 1999); Ex. 1057 (bearing May 11, 2000 stamp); Ex. 1031 (stating on its face only "1999" and citing to unknown "Divsalar" reference). Petitioner's Reply at this stage pivots to an entirely

new § 102(a) theory of unpatentability, a theory never previously advanced, and is untimely and improper.

Patent Owner argues that Petitioner never contended Divsalar was § 102(a) prior art in the Petition, and so Patent Owner has been denied the chance to scrutinize the exhibits specifically, or to explore the new § 102(a) issue generally, to pursue relevant discovery, and respond to the new contention. For example, Exhibit 1031 provides no specific publication date and cites to a "Divsalar" reference making no mention of the Allerton Conference (Ex. 1031, 10). Exhibits 1041 and 1042 are unpublished manuscripts purportedly posted on Dr. McKay's personal webpage. Patent Owner had no opportunity to explore the sufficiency of Dr. MacKay's testimony, which was not cited or discussed in the Petition and our institution decision. Exhibit 1057 includes a stamp listing the date "11 May 2000," but that stamp is largely illegible and of unknown origin and significance. Additionally, Exhibit 1057 is incomplete—the document is partially redacted and missing several pages. Even if the date "11 May 2000" in Exhibit 1057 was demonstrated as a publication date for the Divsalar reference (which it has not been), the uncontested priority date for the '781 Patent (i.e., May 18, 2000) is only days later. Ex. 1005, 1. To the extent it would have been necessary, Patent Owner was denied the chance to present evidence antedating any § 102(a) publication date.

In fact, Patent Owner argues, even in its Reply, Petitioner never identifies any particular asserted date of publication for its new § 102(a) contention. Thus, in addition to being belated and untimely, Petitioner's new theory lacks the requisite specificity. Patent Owner would be unable to meaningfully respond to Petitioner's new and amorphous theory of unpatentability even if the schedule in this proceeding allowed it.

We conclude that there is no "new theory" that must be barred from this proceeding. According to 35 U.S.C. § 311(b), a petitioner in an *inter partes* review may request to cancel as unpatentable 1 or more claims of a patent only on a ground that could be raised under § 102 or § 103 and only on the basis of prior art consisting of patents or printed publications. The Petition clearly alleged that Divsalar is a publication citable against the '781 Patent and is relied upon. Note the excerpt from Petition page 2 reprinted below.

> **A. Publications Relied Upon**
>
> Petitioner relies upon the following patents and publications:
>
> Exhibit 1011 - "Coding Theorems for "Turbo-like" Codes" by D. Divsalar, H. Jin, and R. J. McEliece ("*Divsalar*"), published at least by April 30, 1999 and available as prior art under 35 U.S.C. § 102(b); *see also* Ex. 1064.

The quoted Petition passage placed Patent Owner on notice that the petitioned challenge was based on Divsalar and that Petitioner considered Divsalar to be a citable printed publication *at least* by virtue of its publication date and the operation of 35 U.S.C. § 311(b).

Exhibits 1031, 1041, 1042 and 1057 are listed in the Petition itself at pages v–viii. Our records reflect that these exhibits were uploaded to its PRPS system on the day the Petition was uploaded.

We conclude that the issue has not changed. The issue, has, from the beginning, been whether or not Divsalar is a "printed publication" within the meaning of 35 U.S.C. § 311(b) and whether its publication date is early enough that it is citable against the '781 Patent. As set forth above, there is substantial evidence that we find to be persuasive that Divsalar qualifies as a "printed publication" in accordance with 35 U.S.C. § 311(b). Furthermore,

we conclude, based on a preponderance of evidence of record that the Divsalar was published prior to the earliest effective date of the '781 Patent. Divsalar is therefore citable as a "printed publication" against the '781 Patent.

Petitioner correctly notes that the Decision to Institute did not limit Petitioner to arguing any particular portion of § 102. Our Decision to Institute (Paper 18) orders a trial to be conducted based on the challenge: "claims 1 and 2 as anticipated by Divsalar." Patent Owner has had clear notice as to the basis for challenge. Accordingly, Patent Owner's requested relief is denied.

3. Strike Jezek Declaration

Exhibit 1076 is a declaration submitted by Timothy Jezek, identified as in-house counsel for Petitioner Hughes Network Systems, LLC. The Declaration was filed on October 28, 2015 along with Petitioner's Reply to Patent Owner's Response. Patent Owner asks that we expunge Exhibit 1076 as being untimely, thereby providing no opportunity for Patent Owner to challenge it. Mot. 9–11.

According to Patent Owner, Petitioner should have sought authorization to submit the Jezek Declaration prior to the filing of Patent Owner's last formal briefing. Petitioner earlier presented (March 18, 2015) an identical declaration as Exhibit 1070 in support of Petitioner's Reply Brief Regarding Identification of Real Parties-in-Interest. Paper 15. After the original submission of the Jezek Declaration, Patent Owner asked the Board to expunge the unauthorized exhibit or to authorize cross examination of Mr. Jezek. The Board expunged Exhibit 1070. Paper 21.

Patent Owner argues that its Preliminary Response put Petitioner on notice that it disputes that the Petition properly identifies all real parties-in-

interest. Prelim. Resp. 3–14. According to Patent Owner, Petitioner should have understood as early as March 2015, well before institution, that the Jezek Declaration might have been required to rebut Patent Owner's argument in its Preliminary Response. *See* Paper 15, 5 (citing Ex. 1070). Yet Patent Owner argues, once trial was instituted, Petitioner never requested authorization to file a motion to submit supplemental information pursuant to 37 C.F.R. § 42.123, which would have allowed Patent Owner to address the Jezek Declaration in its last substantive paper, the Patent Owner response. Rather, Patent Owner argues Petitioner filed the Jezek Declaration after Patent Owener could no longer respond with its own argument or evidence.

Patent Owner argues that there was ample opportunity earlier for Petitioner to submit the Jezek Declaration – twice. Petitioner could have requested authorization to file the Jezek Declaration in March 2015. It did not. After the declaration was expunged, Petitioner could have timely filed a request to submit supplemental information. It did not. Patent Owner argues that Petitioner's inclusion of the Jezek Declaration with its Reply avoids the sanction of the Board's previous ruling (Paper 21), and Patent Owner asks that we not endorse Petitioner's abuse of process and instead should strike the exhibit. 37 C.F.R. § 42.12(a)(6) & (b)(2). Alternatively, Patent Owner asks the Board to expunge the Jezek declaration as an unauthorized motion pursuant to 37 C.F.R. § 42.123.

Petitioner argues that in its Patent Owner Response to the Petition, Patent Owner continued to assert that the Petition did not name all real parties-in-interest. Now, Petitioner argues Patent Owner seeks to exclude the only direct evidence offered on this issue by either party—a declaration by Timothy Jezek, in-house counsel for Petitioner, which responds to the

Patent Owner's unfounded assertion that Dish is an unnamed real party-in-interest. Mot. 9 (citing Exhibit 1076 ("Jezek Declaration")).

We find that Petitioner is allowed to fully reply to Patent Owner's arguments made in response to the Petition. 37 C.F.R. § 42.23(b) (The reply may "respond to arguments raised in the corresponding opposition or patent owner response."). The submission of rebuttal evidence with Petitioner's reply is both permitted and customary. *See Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1078 (Fed. Cir. 2015) (affirming denial of motion to exclude declaration in support of petitioner's reply brief that responds to the patent owner's response to the petition).

Notably, Patent Owner does not allege that the Jezek Declaration raises any new issue. For example, there is no allegation that the Jezek Declaration was necessary to establish a prima facie case of unpatentability. Petitioner correctly identified each RPI in the Petition as required—the rebuttal evidence submitted in response to Patent Owner's allegations to the contrary merely confirms this fact. We note that Patent Owner seems to agree that the content of the Jezek Declaration "might rebut" its argument related to identification of the real party-in-interest. Paper 32, 10.

Patent Owner's only complaint appears to be that it cannot respond to Petitioner's Reply "with its own argument or evidence." *Id.* This is specious. First, Patent Owner did not even attempt to cross-examine or submit observations on that cross-examination, as permitted by the Scheduling Order and TPG. *See* Paper 19, 5 ("A motion for observation on cross-examination provides the parties with a mechanism to draw the Board's attention to relevant cross-examination testimony of a reply witness because no further substantive paper is permitted after the reply."). Second, if such argument or evidence were likely to be fruitful, Patent Owner could

have sought leave for a sur-reply. *See* Belden at 1081 ("[A]lthough no rule provides patent owners the right to file surreplies to a petitioner's Reply, the Board has allowed such surreplies in *inter partes* reviews.").

Finally, the substance of the Jezek Declaration was no surprise. As Patent Owner admits, the Jezek Declaration mirrors the declaration that it moved to expunge from the record prior to institution. Paper 32, 9. Patent Owner was well aware of Petitioner's position, which it had the opportunity to address as part of its response to the Petition. However, Patent Owner chose to simply reassert the same arguments already rejected by the Board in the Institution Decision.

Therefore, Patent Owner has failed to carry its burden on its motion to strike.

The record shows that Petitioner submitted the Jezek Declaration along with its Reply to respond directly to the Patent Owner argument that not all RPIs were initially named by the Petitioner. Patent Owner's relief is therefore denied.

4. Exclude Exhibits 1001-1004, 1007–1009, 1012, 1013, 1017–1021, 1023, 1030, 1032–1036, 1038–1040, 1043-1044, 1046–1056, 1058, 1059, 1061–1063, 1065, and 1066, and Paragraphs 13–29, 34–38, and 40–83 of Exhibit 1060.

Patent Owner requests that we exclude Exhibits 1001–1004, 1007–1009, 1012, 1013, 1017–1021, 1023, 1030, 1032–1036, 1038–1040, 1043-1044, 1046–1056, 1058, 1059, 1061–1063, 1065, and 1066, as well as paragraphs 13–29, 34–38, and 40–83 of Exhibit 1060. According to Patent Owner, these exhibits and paragraphs 1) are not discussed, relied upon, or cited in the petition or anywhere else in the record; and 2) are irrelevant and

unduly prejudicial. Mot. 11–12 (citing Ex. 2032, 1–3).

Petitioner argues that contrary to Patent Owner's assertion, the listed exhibits are all discussed, relied upon and cited either in the Petition, Reply or supporting declarations. Paper 35 lists examples of citation. *See, e.g.*, Pet. 5 (citing prosecution histories and related patents in the '781 Patent family); Pet. 23 (citing Ex. 1038); Pet. Reply 16 (citing Exs. 1042, 1060); Ex. 1010 (Pfister Decl.) ¶ 2 (citing prosecution histories and related patent family); *id.* ¶ 24 (citing. Ex. 1061); *id.* ¶ 26 (citing. Ex. 1062); *id.* ¶ 29 (citing Exs. 1012, 1066); *id.* ¶ 30 (citing. Ex. 1032, 1063); *id.* ¶ 40 (citing Ex. 1018); *id.* ¶ 41 (citing Exs. 1013, 1017, 1019, 1033, 1043, 1047); *id.* ¶ 106 (citing Ex. 1023). Additionally, Exhibits 1021, 1036, and 1060 are actually cited in Patent Owner's filings. Prelim. Resp. 3 n.3, 39.

We note that each of these Exhibits was listed as such in the Petition. Pet. iii–viii. We fail to see how the Board would be prejudiced by these exhibits which appear to be mostly file histories and patents related to the '781 Patent at issue.

As to paragraphs 13–29, 34–38, and 40–83 of Exhibit 1060, Patent Owner has not provided persuasive reasoning as to why the Board would be confused or prejudiced by those paragraphs.

Therefore, we deny Patent Owner's requested relief as to these exhibits.

5. Exclude Exhibits 1031, 1041, 1042, 1057, and Paragraphs 30–33 of Exhibit 1060

Patent Owner moves that we exclude exhibits 1031, 1041, 1042, and 1057, and paragraphs 30–33 of Exhibit 1060. We summarize these exhibits in the following table.

Exhibit	Content
1031	"New results on serial concatenated and accumulated-convolutional turbo code performance" by Audrey M. Viterbi and Andrew J. Viterbi
1041	McKay "Recent Results"
1042	"Sparse Graph Codes" by McKay
1057	Pfister paper citing Divsalar
1060 ¶¶ 30–33	Dr. McKay Declaration describing his and other authored papers posted to his website.

According to Patent Owner, these exhibits were filed with the Petition but were not cited, discussed, or otherwise relied on in the Petition. The record reflects that these exhibits are among those listed in the Petition at pages iii–viii (Exhibit List).

Patent Owner states that it timely objected to the exhibits within ten business days of institution, based on Federal Rules of Evidence ("FRE") 401 and 403. Mot. 12. Patent Owner filed a copy of its objection as Exhibit 2032. Exhibit 2032 states that

> [e]ach of the exhibits listed is not cited in the petition that initiated this proceeding. As such, each of these exhibits is not relevant to the instituted ground of review or any other aspect of this proceeding as it has no tendency to make a fact more or less probable than it would be without the evidence. Moreover, each of these exhibits is additionally not relevant to the instituted ground because any asserted facts to which the exhibit relates are of no consequence in determining this proceeding.

According to Patent Owner, Petitioner relied on the exhibits for the first time in its reply (Pet. Reply 16). Patent Owner indicates that it timely renewed its objections to these exhibits, based on FRE 401 and 403, to

provide updated reasoning for the objections in view of Petitioner's new reliance on them. Paper 30, 2–3.

Patent Owner argues that Petitioner relies on Exhibits 1031, 1041, 1042, 1057 and 1060 (¶¶ 30–33) in its reply to support its improper and belated argument that Divsalar is § 102(a) prior art. Pet. Reply, 16. According to Patent Owner, because the Petition does not assert Divsalar as § 102(a) prior art, these exhibits do not support the asserted April 30, 1999 publication date, so each of these exhibits cannot be relevant to the instituted ground of review as they have no tendency to make a fact more or less probable than it would be without the evidence. Furthermore, according to Patent Owner, Exhibits 1031, 1041, 1042, 1057 and 1060 (¶¶ 30–33) are untimely relied upon and unreliable, and more likely to mislead or confuse than have probative value. Patent Owner argues each of these exhibits should also additionally be excluded pursuant to FRE 403, which reads as follows.

> Rule 403. Excluding Relevant Evidence for Prejudice, Confusion, Waste of Time or Other Reasons. The court *may* exclude relevant evidence if its probative value is substantially outweighed by a danger of one or more of the following: unfair prejudice, confusing the issues, misleading the jury, undue delay, wasting time, or needlessly presenting cumulative evidence.

We do not find these exhibits to be prejudicial or confusing and decline to exercise our discretion to exclude them. In fact, we find these exhibits to be helpful in understanding background and context related to the advances described in the '781 Patent and in understanding the community of those who might be considered to be skilled in the art to which the '781 Patent pertains.

The dangers guarded against by FRE 403 are not present in this case. There is no jury that might be prejudiced or confused. Nor has significant time been wasted in reading and understanding these exhibits. Therefore Patent Owner's requested relief is denied.

III. CONCLUSION REGARDING PATENTABILITY

For the foregoing reasons, we determine that Petitioner has established by a preponderance of the evidence that claims 1 and 2 of the '781 Patent are anticipated by Divsalar.

IV. ORDER

For the reasons given, it is

ORDERED that Patent Owner's Motion to Strike and Exclude is DENIED.

FURTHER ORDERED that claims 1 and 2 are unpatentable as anticipated by Divsalar;

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

IPR2015-00059
Patent 7,916,781 B2

PETITIONER:

Eliot D. Williams
eliot.williams@bakerbotts.com

G. Hopkins Guy III
hop.guy@bakerbotts.com

Baker Botts, LLP

PATENT OWNER:

Michael T. Rosato
mrosato@wsgr.com

Matthew A. Argenti
margenti@wsgr.com

Wilson Sonsini Goodrich & Rosati

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.	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
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

Trials@uspto.gov
571.272.7822

IPR2015-00059; 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 IPR2015-00059
Patent 7,916,781 B2

Before KALYAN K. DESHPANDE, GLENN J. PERRY, and TREVOR M. JEFFERSON, *Administrative Patent Judges*.

PERRY, *Administrative Patent Judge*.

DECISION
Institution of *Inter Partes* Review
37 C.F.R. § 42.108

INTRODUCTION

A. Background

Hughes Network Systems, LLC and Hughes Communications, Inc.[1] (collectively "Petitioner") filed a Petition requesting an *inter partes* review of claims 1–7, 13–16, and 19 of U.S. Patent No. 7,916,781 B2 (Ex. 1005, "the '781 patent"). Paper 4 ("Pet.")[2]. California Institute of Technology ("Patent Owner") timely filed a Preliminary Response. Paper 13 ("Prelim. Resp."). We have authority to determine whether to institute an *inter partes* review under 35 U.S.C. § 314; 37 C.F.R. § 42.4(a). Upon consideration of the Petition and the Preliminary Response, we determine that Petitioner has established a reasonable likelihood of prevailing as to claims 1 and 2 as challenged in the Petition. Accordingly, we institute an *inter partes* review of claims 1 and 2 of the '781 patent.

B. Related Proceedings

Petitioner states that the '781 Patent (Ex. 1005) is involved in a pending lawsuit titled *California Institute of Technology v. Hughes Communications, Inc.*, No. 13-CV-07245 (CACD) ("the Lawsuit"). *See* Ex. 1015. The Lawsuit includes the following patents: (i) U.S. Patent No. 7,116,710; (ii) U.S. Patent No. 7,421,032; (iii) U.S. Patent No. 7,916,781; and (iv) U.S. Patent No. 8,284,833.

---

[1] EchoStar Corporation is named in the Petition as the parent of Hughes Satellite Systems Corporation, which is the parent of Hughes Communications, Inc. Pet. 1. Both EchoStar Corporation and Hughes Satellite Systems Corporation are real parties in interest. The record is still being developed as to whether Dish is an unnamed real party in interest.

[2] "Pet." refers to the corrected petition filed October 30, 2014 (Paper 4).

Petitioner filed additional Petitions for Inter Partes review challenging other patents of the patent family. Pet. 1.

THE '781 PATENT

A. Background and Context

We understand that error correcting codes are used to communicate information across a noisy communication channel. They enable the recovery of a transmitted message that may have become distorted by channel noise. To prepare a message for transmission, it is parsed into groups of message bits that are "encoded" into "codewords" by adding redundant information to them.[3] The codewords are transmitted over the communication channel and are received at another location, where the codewords are "decoded" into the original message. No single coding scheme is optimal for all communication channels. Also, there are design tradeoffs between the use of complex codes, which permit better error correction, and less complex codes, which are easier to decode. This has led to the development of many different encoding/decoding schemes. The '781 patent describes one such scheme.

B. The '781 Patent Invention

The '781 patent describes the serial concatenation of interleaved convolutional codes forming turbo-like codes. Ex. 1005, Title. It explains some of the prior art with reference to its Figure 1, reproduced below.

[3] For example, a message bits "10011" may be encoded into a codeword "100111" by adding a "parity" bit "1" to the original message.

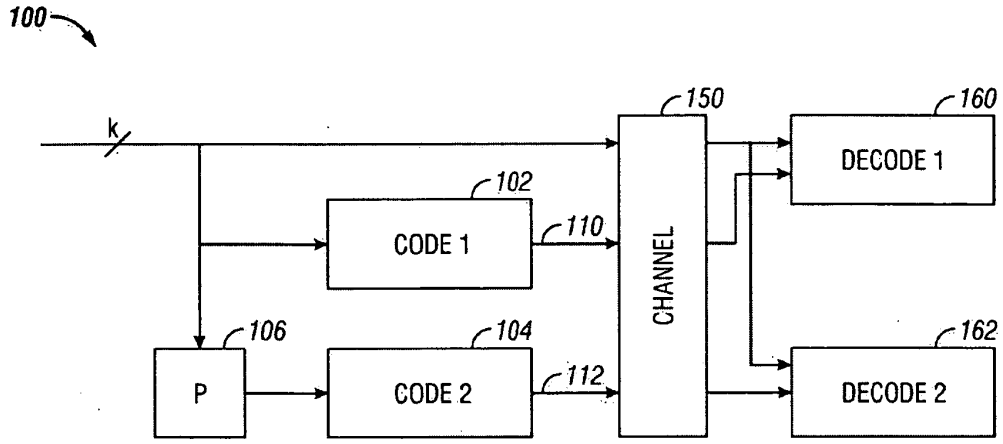


FIG. 1
(Prior Art)

Figure 1 is a schematic diagram of a prior "turbo code" system. Ex. 1005, 2:20–21. The '781 patent specification describes Figure 1 as follows:

> 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.

Ex. 1005, 1:44–60.

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

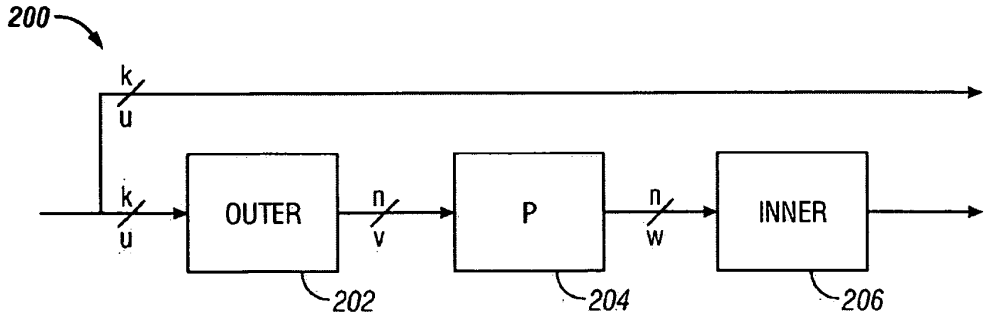


FIG. 2

Figure 2 of the '781 patent is a schematic diagram of coder 200.

> The coder 200 may include an outer coder 202, an interleaver 204, and inner coder 206. . . . The outer coder 202 receives the uncoded data [that] may be partitioned into blocks of fixed size, [e.g.] 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 nxk matrix, and the rate[4] 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 the n-bit output block x can be written as $x=T_Iw$, where T_I is a nonsingular nxn matrix. The inner coder 210 can have a

[4] 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.

> rate that is close to 1, e.g., within 50%, more preferably 10% and perhaps even more preferably within 1% of 1.

Ex. 1005, 2:40–3:2. 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 '781 patent is reproduced below.

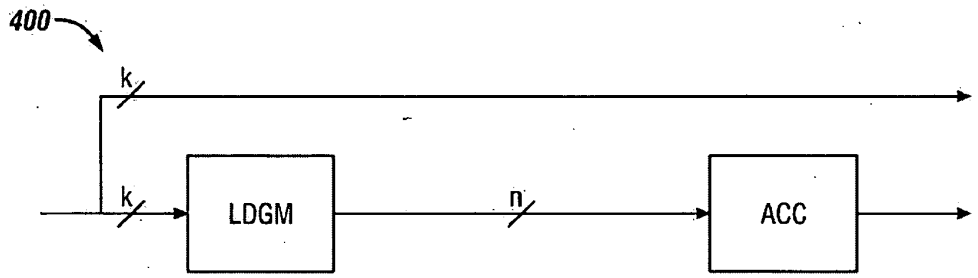


FIG. 4

Figure 4 shows an alternative embodiment in which the first encoding is carried out by a low density generator matrix. Low density generator matrix (LDGM)[5] codes are a special class of low density parity check codes that allow for less encoding and decoding complexity. LDGM codes are

[5] We understand that 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.

systematic linear codes generated by a "sparse" generator matrix. No interleaver (as in the Figure 2 embodiment) is required in the Figure 4 arrangement because the LDGM provides scrambling otherwise provided by the interleaver in the Figure 2 embodiment.

C. Illustrative Claim

All of the claims of the '781 patent are directed to methods of coding. Among the challenged claims, claims 1, 13, and 19 are independent. Claim 13 and its dependent claims are directed to encoding methods that produce irregular repeat accumulate codes. Claim 1, which does not require irregularity, is illustrative and is reproduced below.

> 1. A method of encoding a signal, comprising:
>
> [a] receiving a block of data in the signal to be encoded, the block of data including information bits;
>
> [b] performing a first encoding operation on at least some of the information bits, the first encoding operation being a linear transform operation that generates L transformed bits; and
>
> [c] performing a second encoding operation using the L transformed bits as an input, the second encoding operation including an accumulation operation in which the L transformed bits generated by the first encoding operation are accumulated,
>
> [d] said second encoding operation producing at least a portion of a codeword, wherein L is two or more.

(bracketed claim limitation references added)

ALLEGED GROUNDS OF UNPATENTABILITY

Petitioner contends that the challenged claims are unpatentable on the following specific grounds.[6]

Reference(s)	Basis	Claim(s) challenged
Divsalar[7]	35 U.S.C. § 102	1–2
Ping[8]	35 U.S.C. § 102	1–3, 5–7, and 19
Ping and Patterson[9]	35 U.S.C. § 103	4
Ping and Luby[10]	35 U.S.C. § 103	2, 3, 5–7, and 13-15
Ping, Luby, and Patterson	35 U.S.C. § 103	4 and 16

ANALYSIS OF CLAIM CHALLENGES

A. *Claim Construction*

Claim constructions presented in this Decision are preliminary in that they are based on the record developed thus far, prior to Patent Owner's

[6] Petitioner supports its challenge with Declaration of Henry D. Pfister, Ph.D. (Ex. 1010) ("Pfister Decl."). *See infra.*
[7] Dariush Divsalar, et al., *Coding Theorems for "Turbo-Like" Codes*, 1998 THIRTY-SIXTH ANNUAL ALLERTON CONFERENCE ON COMMUNICATION, CONTROL, AND COMPUTING201–209 (Ex. 1011, "Divsalar").
[8] Li Ping et al., *Low Density Parity Check Codes with Semi-Random Parity Check Matrix*, 35 IEEE ELECTRONICS LETTERS, 38–39 (1999) (Ex. 1014, "Ping").
[9] Patterson, U.S. Patent No. 4,623,999, application filed June 4, 1984 (Ex. 1027, "Patterson").
[10] Luby et al., U.S. Patent 6,081,909, application filed November 6, 1997 (Ex. 1016, "Luby").

formal response. Constructions may change as the record more fully develops.

In an *inter partes* review, claim terms of an unexpired patent are given their 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. 48,756, 48,766 (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. *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 with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

1. "linear transformation"(claim 1)

Petitioner states that Divsalar demonstrates linear transformation within its broadest reasonable construction, but does not construe the term. Patent Owner asserts that Petitioner did not construe the term, but does not offer its own construction. We construe the term in order to apply the references.

The term "linear transformation" is used in the context of a linear transformation between two vector spaces. For purposes of this decision, we adopt a linear algebra definition[11] as follows:

A linear transformation is one that obeys the laws of linear algebra including distributive and associative properties, e.g. the transform of vectors a+b is equal to the transform of a + the transform of b. The

[11] This definition is explained by "Wolfram MathWorld" at http://mathworld.wolfram.com/lineartransformation.html.

transform of x (a scalar) times a vector y is equivalent to x times the transform of vector y.

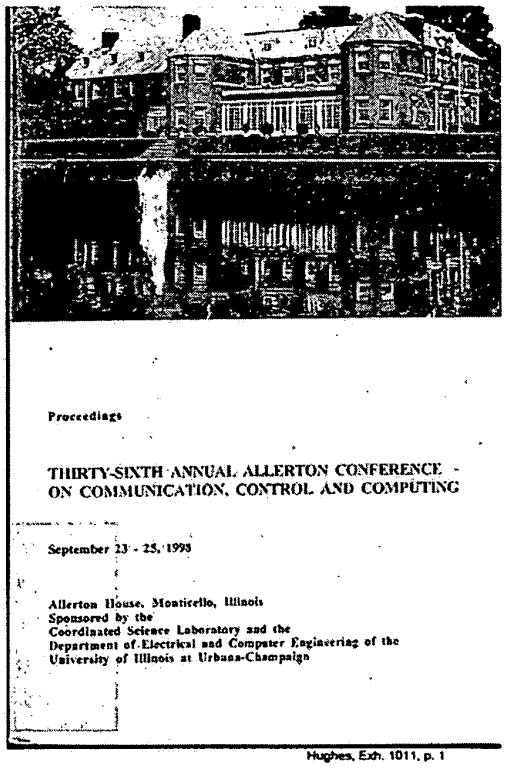
2. additional claim terms

For purposes of this decision, we find it unnecessary to construe additional claim terms.

B. *Divsalar (Ex. 1011)*

1. Divsalar as a Publication

The cover page of the Divsalar document is reproduced below.



Proceedings

THIRTY-SIXTH ANNUAL ALLERTON CONFERENCE ON COMMUNICATION, CONTROL AND COMPUTING

September 23 - 25, 1998

Allerton House, Monticello, Illinois
Sponsored by the
Coordinated Science Laboratory and the
Department of Electrical and Computer Engineering of the
University of Illinois at Urbana-Champaign

Hughes, Exh. 1011, p. 1

The cover page includes a photograph of the "Allerton House" in which the Allerton Conference is held. It also includes the date range of the conference and indicates sponsorship information.

Petitioner states that Divsalar was "published no later than April 30,

1999 at the University of Texas library." In support, Petitioner proffers the declaration testimony of the University of Texas librarian (Ex. 1064), including an acquisition record pasted into an email. According to Dr. Pfister, Petitioner's declarant, the Allerton Conference is generally regarded as one of the main conferences in the field of information theory and communications. Ex. 1010 ¶ 29.

Patent Owner argues that Petitioner has not established that Divsalar is a publication within the meaning of 35 U.S.C. § 311(b). Patent Owner states that Divsalar is "undated" (Prelim. Resp. 19) and that the library acquisition record does not state that the paper was actually shelved or otherwise displayed and accessible to those of "ordinary skill." *Id.* at 22.

According to the Divsalar cover page, it was presented at the Allerton Conference held Sept 23–25, 1998. Ex. 1011, 1. 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. *See* attachment to Declaration of Robin Fradenburgh, Ex. 1064. Given Dr. Pfister's testimony that the Allerton Conference is the premier conference for information theorists, we find sufficient evidence to establish Divsalar as having been presented and published as required by 35 U.S.C. § 311(b).

We note that Divsalar is listed as being of record among the "References Cited" in the '781 patent itself. It was not of record in the prosecution of its grandparent application (issued as the '710 patent).

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 explanation and supporting evidence with evidence that Divsalar was not presented and published as part of the

Allerton Conference.

2. Challenge to Claims 1 and 2 based on Divsalar

Divsalar describes a rate-1 accumulate convolutional encoder known as a "repeat-accumulator" or "RA" code. Ex. 1010 at para. 31–32. Petitioner relies on Divsalar's Figure 3, reproduced below.

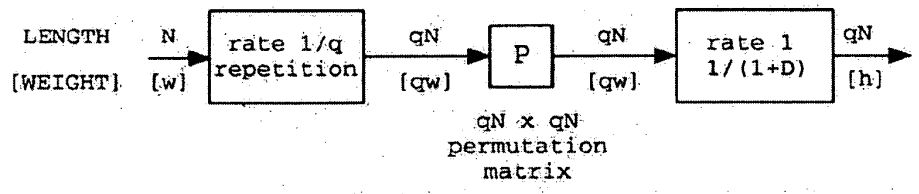


Figure 3 of Divsalar describes an encoder for a ($_qN$, N) repeat and accumulate code. Ex. 1011, 7. The numbers above the input-output lines indicate the length of the corresponding block, and those below the lines indicate the weight of the block. *Id.*

Petitioner argues that Divsalar's "rate 1/q repetition" followed by a permutation constitutes a linear transform operation as required by claim 1. Pet. 14. Patent Owner disagrees, arguing that Petitioner has not demonstrated why this is so. Prelim. Resp. 23–27. Patent owner draws a distinction between the'781 patent being directed to "irregular" repeat codes and Divsalar being directed to "regular" repeat codes. Patent Owner correctly points out that Divsalar does not disclose an encoding operation utilizing irregular repetition. Prelim. Resp. 26. Patent Owner argues that the specification explains how irregular coding can be achieved. Pet. 26. Patent Owner points to a passage of the '781 patent specification including the statement that "'[t]he outer coder may be an (n,k) binary linear block coder,'" and describes the relationship between the input and output data in

mathematical terms. Pet. 24 (citing Ex. 1005, 2:47–53). We agree with Patent Owner that the specification explains how irregular coding is achieved.

However, we do not read claim 1 as being limited to irregular repeat coding. Claim 1 requires "performing a first encoding operation on at least some of the information bits, the first encoding operation being a linear transform operation that generates L transformed bits." The first encoding can be on "at least some" of the information bits. Thus, it could also be on all of the information bits. Also, according to the claim, the first encoding operation must produce "L" transformed bits. There is no explanation in the claim as to the relationship of "L" to the incoming block of bits being transformed. All the reader of claim 1 is told, at the end of the claim, is that L is 2 or more. Thus, claim 1 could produce a regular repeat code by repeating all of the information bits to generate L (more than 2) transformed bits. If claim 1 is limited to producing irregular codes, it has not yet been made clear to us what language so limits the claim.

If claim 1 were limited to "irregular" codes, Patent Owner's position would have more merit. However, claim 1 embraces more than just "irregular" repeat codes. It includes first and second encoding operations that may produce "regular" and "irregular" repeat codes. Thus, on this record, Patent Owner's argument does not appear to be commensurate in scope with the actual language of claim 1.

Claim 2 depends from claim 1 and further requires that a codeword resulting from the claim 1 encoding process includes parity bits. Divsalar adds parity bits by outputting more bits than are input. *See* Divsalar's Figure 3 showing a first encoding having a rate less than 1. Nothing in claim 2 limits it to producing irregular repeat codewords.

For the above-stated reasons we conclude that on this record Petitioner has demonstrated it is reasonably likely to prevail in challenging claims 1 and 2 as anticipated by Divsalar.

C. *Challenges based on Ping (Ex. 1014)*

1. What Ping describes

Ping generally relates to low density parity check (LDPC) codes that have been known since 1962. *See* Ex. 1014, 7 n.1. It was known to randomly generate matrix elements using a process referred to as "Gaussian elimination." Ex. 1014, 6.[12] Ping describes generating LDPC using a semi-random parity check matrix. Ex. 1014, Title. Some of the matrix elements are determined randomly and some of the matrix elements are deterministic. *Id.* at 6. Ping states that a fully random matrix is best, but leads to codes that are not practical to decode. *Id.* Ping's theorizes that by only semi-randomizing the parity check matrix, one can achieve a code scheme that is almost as good as that which can be obtained by a fully randomized matrix and at considerable less encoding complexity. *Id.* Ping randomly selects a portion of the coding matrix and determines the rest of the matrix by formula, thus deterministically rather than randomly. *Id.*

2. Anticipation Challenges based on Ping

Claim 1 does not require an irregular repeat (the only independent claim requiring irregular repeat is claim 13). Petitioner reads the challenged claims on Ping at Pet. 16–31. This portion of the Petition is supported by the Pfister Report (Ex. 1010¶¶ 49–60.

[12] We refer to exhibit page numbers rather than pages number of the cumulative publication in which the article is positioned.

According to Petitioner, Ping discloses a low-density generator matrix with an accumulate encoder. Pet. 17 (citing Ex. 1010 ¶ 51).

With regard to the claim 1 "first encoding," Petitioner provides a lengthy quote from Ping at page 6 of Exhibit 1014. Pet. 18–19. Petitioner then asserts that Ping's encoding procedure, reproduced above, is a low-density generator matrix (LDGM) encoding combined with an accumulate encoder. Pet. 19 (citing Ex. 1010 ¶ 55). Petitioner states that equation (4) of Ping (Ex. 1010, 56) performs an accumulation to determine parity bits. Petitioner further states that the summation term used to calculate each parity bit is a linear transform operation. *Id.* Petitioner relies on the assertion that one of ordinary skill would recognize that the (n-k) term (allegedly corresponding to the claimed "L" bits) would be two or more. Pet. 21 (citing Ex. 1010 ¶ 59). Petitioner's argued mathematical equivalence further relies upon a person of ordinary sill recognizing that "any reasonable configuration of the encoder of Ping would use (n-k) much greater than two. Pet. 21 (citing Ex. 1010 ¶ 59).

Patent Owner argues that Petitioner has not carried its burden. First, according to Patent Owner, Ping improperly equates Ping's LDPC codes with the '781 use (Fig. 4) of a low density generator matrix (LDGM) in order to imply that Ping meets limitations [b] and [c] of claim 1. Prelim. Resp. 28. Patent Owner argues that Petitioner and Dr. Pfister jump to the unexplained conclusory statement that the LDGM code definition is given by "basic coding theory" without any explanation as to why this is so. *Id.* at 29.

Although Patent Owner does not offer an alternative analysis. We nonetheless do not find helpful Petitioner's unexplained conclusory remarks regarding Ping's equivalency to claim 1. Absent sufficient explanation and

evidence, we are not persuaded by Petitioner that Ping's LDPC codes meets limitation [b] and [c] of claim 1. Accordingly, we are not persuaded that there is a reasonable likelihood that Petitioner will prevail with respect to claim 1.

3. Obviousness Challenges based on Ping, Patterson , and Luby

The additional references (Patterson and Luby) do not overcome the flaws identified above with respect to Ping. Luby is relied upon for its description of irregularizing known codes. Pet. 9–10. Patterson is relied upon for its description of codewords comprising information bits followed by parity bits. Pet. 10–11.

Petitioner does not explain why one of ordinary skill would have made the assumptions referred to above with respect to the anticipation challenges based on Ping. Luby and Patterson do not overcome this. We therefore conclude that Petitioner is not reasonably likely to succeed in its obviousness challenges based upon Ping and additional references.

SUMMARY

For the foregoing reasons, we determine that the information presented in the Petition establishes a reasonable likelihood that Petitioner would prevail on at least one alleged ground of unpatentability with respect to claims 1 and 2 of the '781 patent. The Board has not made a final determination on the patentability of any challenged claims.

ORDER

For the reasons given, it is

ORDERED that *inter partes* review of the '781 patent is hereby instituted as to all the challenged claims as follows: claims 1 and 2 as anticipated by Divsalar;

FURTHER ORDERED that no ground other than those specifically granted above is authorized for the *inter partes* review; and

FURTHER ORDERED that 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 on the grounds of unpatentability authorized above; the trial commences on the entry date of this Decision.

PETITIONER:

Eliot D. Williams
G. Hopkins Guy
Baker Botts, LLP
eliot.williams@bakerbotts.com
hop.guy@bakerbotts.com

PATENT OWNER:

Michael T. Rosato
Matthew A. Argenti
Wilson Sonsini Goodrich & Rosati
mrosato@wsgr.com
margenti@wsgr.com

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

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

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.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/165,606	03/29/2011	7916781	09081-8025.US00	2149

97075 7590 03/09/2011

Perkins Coie LLP
PO Box 1247
Seattle, WA 98111-1247

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 424 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

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 Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Hui Jin, Glen Gardner, NJ;
Aamod Khandekar, Pasadena, CA;
Robert J. McEliece, Pasadena, CA;

IR103 (Rev. 10/09)

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
12/165,606	06/30/2008	Hui Jin	06618-0637003/3220-C-C

CONFIRMATION NO. 2149

97075
Perkins Coie LLP
PO Box 1247
Seattle, WA 98111-1247

POA ACCEPTANCE LETTER

OC000000046214035

Date Mailed: 02/28/2011

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 11/05/2010.

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.

/snguyen/

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
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
12/165,606	06/30/2008	Hui Jin	06618-0637003/3220-C-C

CONFIRMATION NO. 2149

97075
Perkins Coie LLP
PO Box 1247
Seattle, WA 98111-1247

POWER OF ATTORNEY NOTICE

OC000000046214020

Date Mailed: 02/28/2011

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 11/05/2010.

- 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).

/snguyen/

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

Bib Data Sheet

CONFIRMATION NO. 2149

SERIAL NUMBER	FILING OR 371(c) DATE / RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/165,606	06/30/2008	375	2611	06618-0637003/3220-C-C

APPLICANTS

Hui Jin, Glen Gardner, NJ;
Aamod Khandekar, Pasadena, CA;
Robert J. McEliece, Pasadena, CA;

**** CONTINUING DATA ***************************

This application is a CON of 11/542,950 10/03/2006 PAT 7,421,032
which is a CON of 09/861,102 05/18/2001 PAT 7,116,710
which claims benefit of 60/205,095 05/18/2000
and is a CIP of 09/922,852 08/18/2000 PAT 7,089,477

**** FOREIGN APPLICATIONS *********************

IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** SMALL ENTITY **
** 08/13/2008

		STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
Foreign Priority claimed ☐ yes ☐ no 35 USC 119 (a-d) conditions met ☐ yes ☐ no ☐ Met after Allowance Verified and Acknowledged _____ Examiner's Signature Initials		NJ	5	23	3

ADDRESS
97075

TITLE

SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

FILING FEE RECEIVED		
1030	FEES: Authority has been given in Paper 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 _____ ☐ Credit

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 02/22/2011
FISH & RICHARDSON P.C. (SD)
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

EXAMINER
HA, DAC V

ART UNIT	PAPER NUMBER
2611	

DATE MAILED: 02/22/2011

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/165,606	06/30/2008	Hui Jin	06618-0637003/3220-C-C	2149

TITLE OF INVENTION: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$755	$300	$0	$1055	05/23/2011

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 DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

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, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). 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. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

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 02/22/2011
FISH & RICHARDSON P.C. (SD)
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.
12/165,606	06/30/2008	Hui Jin	06618-0637003/3220-C-C	2149

TITLE OF INVENTION: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$755	$300	$0	$1055	05/23/2011

EXAMINER	ART UNIT	CLASS-SUBCLASS
HA, DAC V	2611	375-262000

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 submitted:

❑ Issue Fee
❑ Publication Fee (No small entity discount permitted)
❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**

❑ A check is enclosed.
❑ Payment by credit card. Form PTO-2038 is attached.
❑ The Director is hereby authorized to charge the required fee(s), any deficiency, 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).

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.

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.
12/165,606	06/30/2008	Hui Jin	06618-0637003/3220-C-C	2149

20985 7590 02/22/2011
FISH & RICHARDSON P.C. (SD)
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

EXAMINER	
HA, DAC V	

ART UNIT	PAPER NUMBER
2611	

DATE MAILED: 02/22/2011

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 424 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 424 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.

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.

Notice of Allowability	Application No.	Applicant(s)	
	12/165,606	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 *amendment filed 01/27/11*.

2. ☒ The allowed claim(s) is/are *1-17, 20, 18, 19, 22, 23, renumbered as 1-22, 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/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☐ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

Allowable Subject Matter

1. Claims 1-20, 22, 23 are allowed.

2. The following is a statement of reasons for the indication of allowable subject matter:

Applicant has cancelled claim 21 and amended the remaining claims in compliance with the office action dated 10/28/10. Upon further consideration, applicant's REMARKS filed 01/27/11 is agreed to. Thus, amended claims 1-20, 22, 23 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 4/4.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Payne can be reached on 571-272-3024. 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). If you would like assistance from a

USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Dac V. Ha/
Primary Examiner, Art Unit 2611

***

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12165606	JIN ET AL.
	Examiner	**Art Unit**
	Dac V Ha	2611

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	10/18/2010	02/11/2011							
1	1	=	=							
2	2	=	=							
3	3	=	=							
4	4	=	=							
5	5	=	=							
6	6	=	=							
7	7	=	=							
8	8	=	=							
9	9	O	=							
10	10	=	=							
11	11	=	=							
12	12	=	=							
13	13	✓	=							
14	14	✓	=							
15	15	✓	=							
16	16	✓	=							
17	17	✓	=							
19	18	O	=							
20	19	O	=							
18	20	✓	=							
	21	O	-							
21	22	=	=							
22	23	O	=							

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12165606	JIN ET AL.
	Examiner	**Art Unit**
	Dac V Ha	2611

ORIGINAL		INTERNATIONAL CLASSIFICATION														
CLASS	SUBCLASS	CLAIMED					NON-CLAIMED									
375	240	H	0	4	B	1 / 66 (2006.01.01)										

CROSS REFERENCE(S)					
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
375	285	296			
714	801	804			

☐ 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	Final	Original
1	1	17	17												
2	2	16	18												
3	3	20	19												
4	4	18	20												
5	5	21	22												
6	6	22	23												
7	7														
8	8														
9	9														
10	10														
11	11														
12	12														
13	13														
14	14														
15	15														
16	16														

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	22	
/Dac V Ha/ Primary Examiner.Art Unit 2611	02/11/11	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12165606	JIN ET AL.
	Examiner	Art Unit
	Dac V Ha	2611

SEARCHED			
Class	Subclass	Date	Examiner
375	240, 240.24, 254, 285, 295, 296, 260	10/18/2010	DH
714	755, 758, 800, 801, 804, 805	10/18/2010	DH
	Update	2/11/2011	DH

SEARCH NOTES		
Search Notes	Date	Examiner
BRS and Inventor's search	10/18/2010	DH
Update	2/11/2011	DH

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner
	PGPUB text search	10/18/2010	DH
	Update	2/11/2011	DH

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Hui Jin

Application No.: 12/165,606 | Confirmation No.: 2149

Filed: June 30, 2008 | Art Unit: 2611

For: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES | Examiner: Dac V. Ha

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

RESPONSE TO NOTICE OF ALLOWANCE

In response to the Notice of Allowance mailed February 22, 2011, enclosed is a completed Issue Fee Transmittal Form PTOL-85b.

COMMENTS ON EXAMINER'S REASONS FOR ALLOWANCE

It is recognized that in accordance with M.P.E.P. § 1302.14, the Examiner's reasons for allowance need not set forth all of the details as to why the claims are allowed. In the above-referenced application, it is not conceded that the Examiner's stated reasons for allowance are the only reasons for which the claims are allowable. The Examiner's reasons for allowance indicate that particular claim elements are not disclosed or suggested by the prior art of record, yet the claims may be patentable for other reasons as well, including the inventive combination of all of the recited claim elements. It is not conceded that the specific limitations identified by the Examiner are necessary to distinguish the art of record or to satisfy the requirements of 35 U.S.C. § 112. Moreover, the Examiner does not assert, and it would not be conceded, that the Examiner's reasons have any bearing on the patentability of claims in any other applications directed to the disclosed subject matter.

In addition, each dependent claim stands on its own and may be allowable on its own merits. In particular, each dependent claim may be allowable on the basis of a combination of some of the features recited in the dependent claim and its base claim(s), which combination of features may not include all of the limitations identified in the Examiner's reasons for allowance.

Please apply the required fees in the amount of $1,055.00, and any charges or credits, to deposit account 50-5252.

Respectfully submitted,

Date: February 22, 2011

/Bing Ai/
Bing Ai
Reg. No. 43,312

Perkins Coie LLP
P.O. Box 1247
Seattle, Washington 98111-1247
Telephone: (858) 720-5700
Facsimile: (206) 359-7198

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)

97075 7590 02/22/2011

Perkins Coie LLP
P.O. Box 1247
Seattle, Washington 98111-1247

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.
12/165,606	06/30/2008	Hui Jin	09081-8025.US00	2149

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	$755.00	$300.00	$1,055.00	05/23/2011

EXAMINER	ART UNIT	CLASS-SUBCLASS
HA, DAC V.	2611	375-262000

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 Perkins Coie LLP
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: California Institute of Technology

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Pasadena, California

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 50-5252 .

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 /Bing Ai/ Date February 22, 2011

Typed or printed name Bing Ai Registration No. 43,312

Electronic Patent Application Fee Transmittal

Application Number:	12165606
Filing Date:	30-Jun-2008
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Filer:	Bing Ai/Jennifer Canarelli
Attorney Docket Number:	06618-0637003/3220-C-C

Filed as Small Entity

Utility under 35 USC 111(a) 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:				
Utility Appl issue fee	2501	1	755	755
Publ. Fee- early, voluntary, or normal	1504	1	300	300

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1055**

Electronic Acknowledgement Receipt	
EFS ID:	9495219
Application Number:	12165606
International Application Number:	
Confirmation Number:	2149
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Customer Number:	20985
Filer:	Bing Ai/Jennifer Canarelli
Filer Authorized By:	Bing Ai
Attorney Docket Number:	06618-0637003/3220-C-C
Receipt Date:	22-FEB-2011
Filing Date:	30-JUN-2008
Time Stamp:	16:51:41
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$1055
RAM confirmation Number	3915
Deposit Account	505252
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1	Issue Fee Payment (PTO-85B)	2011-02-22_IssueFee.pdf	60080 dad99e89d7a64674bb3421f605e365c8aba52d77	no	3
Warnings:					
Information:					
2	Fee Worksheet (PTO-875)	fee-info.pdf	31819 ae7a3d32ad1bed49082c074a873d5e9d47e9f2ef	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	91899		

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 Patent Application of:
Hui Jin

Application No.: 12/165,606 Confirmation No.: 2149

Filed: June 30, 2008 Art Unit: 2611

For: SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES Examiner: Dac V. Ha

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

AMENDMENT IN RESPONSE TO NON-FINAL OFFICE ACTION

In response to the Office Action dated October 28, 2010, please amend the above-identified U.S. patent application as follows:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 7 of this paper.

AMENDMENT TO CLAIMS

This listing of claims replaces all prior versions and listings of claims in the application:

Listing of Claims:

1. (Original) A method of encoding a signal, comprising:

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

performing a first encoding operation on at least some of the information bits, the first encoding operation being a linear transform operation that generates L transformed bits; and

performing a second encoding operation using the L transformed bits as an input, the second encoding operation including an accumulation operation in which the L transformed bits generated by the first encoding operation are accumulated, said second encoding operation producing at least a portion of a codeword, wherein L is two or more.

2. (Original) The method of claim 1, further comprising:

outputting the codeword, wherein the codeword comprises parity bits.

3. (Original) The method of claim 2, wherein outputting the codeword comprises:

outputting the parity bits; and

outputting at least some of the information bits.

4. (Original) The method of claim 3, wherein outputting the codeword comprises:

outputting the parity bits following the information bits.

5. (Original) The method of claim 2, wherein performing the first encoding operation comprises transforming the at least some of the information bits via a low density generator matrix transformation.

6. (Original) The method of claim 5, wherein generating each of the L transformed bits comprises mod-2 or exclusive-OR summing of bits in a subset of the information bits.

7. (Original) The method of claim 6, wherein each of the subsets of the information bits includes a same number of the information bits.

8. (Original) The method of claim 6, wherein at least two of the information bits appear in three subsets of the information bits.

9. (Currently Amended) The method of claim 6, wherein ~~a number of subsets in which~~ the information bits appear in a variable number of subsets ~~is irregular~~.

10. (Original) The method of claim 2, wherein performing the second encoding operation comprises using a first of the parity bits in the accumulation operation to produce a second of the parity bits.

11. (Original) The method of claim 10, wherein outputting the codeword comprises outputting the second of the parity bits immediately following the first of the parity bits.

12. (Original) The method of claim 2, wherein performing the second encoding operation comprises performing one of a mod-2 addition and an exclusive-OR operation.

13. (Currently Amended) A method of encoding a signal, comprising:

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

performing an encoding operation using the information bits as an input, the encoding operation including an accumulation of mod-2 or exclusive-OR sums of bits in subsets of the information bits, the encoding operation generating at least a portion of a codeword,

wherein the information bits appear in a variable number of subsets.

14. (Original) The method of claim 13, further comprising:

outputting the codeword, wherein the codeword comprises parity bits.

15. (Original) The method of claim 14, wherein outputting the codeword comprises:

outputting the parity bits; and

outputting at least some of the information bits.

16. (Original) The method of claim 15, wherein the parity bits follow the information bits in the codeword.

17. (Original) The method of claim 13, wherein each of the subsets of the information bits includes a constant number of the information bits.

18. (Currently Amended) A method of encoding a signal, comprising:

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

performing an encoding operation using the information bits as an input, the encoding operation including an accumulation of mod-2 or exclusive-OR sums of bits in subsets of the information bits, the encoding operation generating at least a portion of a codeword ~~The method of claim 13~~, wherein at least two of the information bits appear in three subsets of the information bits.

19. (Currently Amended) A method of encoding a signal, comprising:

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

information bits; and

performing an encoding operation using the information bits as an input, the encoding operation including an accumulation of mod-2 or exclusive-OR sums of bits in subsets of the information bits, the encoding operation generating at least a portion of a codeword ~~The method of claim 13~~, wherein performing the encoding operation comprises:

mod-2 or exclusive-OR adding a first subset of information bits in the collection to yield a first sum;

mod-2 or exclusive-OR adding a second subset of information bits in the collection and the first sum to yield a second sum.

20. (Original) The method of claim 13, wherein performing the encoding operation further comprises:

performing one of the mod-2 addition and the exclusive-OR summing of the bits in the subsets.

21. (Canceled).

22. (Original) A method comprising:

receiving a collection of information bits;

mod-2 or exclusive-OR adding a first subset of information bits in the collection to yield a first parity bit;

mod-2 or exclusive-OR adding a second subset of information bits in the collection and the first parity bit to yield a second parity bit; and

outputting a codeword that includes the first parity bit and the second parity bit.

23. (Currently Amended) The method of claim 22, wherein:

the method further comprises mod-2 or exclusive-OR adding additional subsets of information bits in the collection and parity bits to yield additional parity bits; and

~~a number of subsets in which~~ the information bits in the collection appear in a variable number of subsets ~~is irregular~~.

REMARKS

Claims 1-20 and 22-23 are pending, with claims 1, 13, 18-19 and 22 being independent. Claims 9, 13, 18-19 and 23 have been amended based on the original disclosure. Allowable subject matter of claim 21 has been incorporated into claim 13 and canceled.

In light of the foregoing amendment and following remarks, reconsideration and allowance of all pending claims are respectfully requested.

Allowable Subject Matter

The Examiner is thanked for indicating claims 1-12 and 22-23 as being allowed and indicating 18-19 and 21 as being allowable. The allowable subject matter of claim 21 has been incorporated into claim 13. Claims 18-19 have been written into independent form. All claims are in condition for allowance.

Claim Objections

Claims 9, 21 and 23 are objected to for minor informalities. In particular, claims 9, 21 and 23 are objected for the use of the term "irregular." It is believed that the meaning of the term "irregular" in the claims is clear and is well known in the art of computer coding technology. However, claims have been amended to recite "...wherein the information bits appear in a variable number of subsets" to obviate the objections.

Claim Rejections – 35 U.S.C. § 102

Claims 13-17 and 20 stand rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by U.S. 5,181,207 to Chapman ("Chapman"). While not agreeing with the rejections, claim 13 has been amended to incorporate the allowable subject matter of claim 21. For at least this reason, claim 13 is patentable over Chapman. Claims 14-17 and 20 depend from claim 13 and are patentable over Chapman for at least the same reason.

Conclusion

The foregoing comments made with respect to the positions taken by the Examiner are not to be construed as acquiescence with other positions of the Examiner that have not been explicitly contested. Accordingly, the above arguments for patentability of a claim should not be construed as implying that there are not other valid reasons for patentability of that claim or other claims.

No fees are believed due. Please apply any other fees or credits to our Deposit Account No. 50-5252.

Respectfully submitted,

Date: January 27, 2011

/Hwa C. Lee 59747/
Hwa C. Lee
Reg. No. 59,747

Perkins Coie LLP
P.O. Box 1247
Seattle, Washington 98111-1247
Telephone: (858) 720-5700
Facsimile: (206) 359-7198

Electronic Acknowledgement Receipt	
EFS ID:	9324977
Application Number:	12165606
International Application Number:	
Confirmation Number:	2149
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Customer Number:	20985
Filer:	Hwa C. Lee/Jennifer Canarelli
Filer Authorized By:	Hwa C. Lee
Attorney Docket Number:	06618-0637003/3220-C-C
Receipt Date:	27-JAN-2011
Filing Date:	30-JUN-2008
Time Stamp:	21:55:11
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		2011-01-27_ReplyOA.pdf	41544 cc40e55b4d94acd77728ae5a5787ff5d8ace e93a	yes	8

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	6
	Applicant Arguments/Remarks Made in an Amendment	7	8
Warnings:			
Information:			
	Total Files Size (in bytes):	41544	

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.

Document code: WFEE

United States Patent and Trademark Office
Sales Receipt for Accounting Date: 02/04/2011

ACOWAN SALE #00000002 Mailroom Dt: 01/27/2011 505252 12165606
01 FC : 2201 220.00 DA

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. 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	Filing Date	☐ To be Mailed
12/165,606	06/30/2008	

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☒		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT 01/27/2011	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 22	Minus	** 23	= 0	X $26 =	0	OR	X $ =	
Independent (37 CFR 1.16(h))	* 5	Minus	***3	= 2	X $110 =	220	OR	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE	220	OR	TOTAL ADD'L FEE	

AMENDMENT	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							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.

Legal Instrument Examiner:
/ANNETTE COWAN/

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.

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: Hui Jin et al.

Application No./Patent No.: 12/165,606 Filed/Issue Date: June 30, 2008

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

California Institute of Technology (Name of Assignee) , a University (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that it is:

1. [X] 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. [ ] an 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. [X] 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 021710 , Frame 0863 , or for which a copy thereof 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).

[X] 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.

/Bing Ai/	November 5, 2010
Signature	Date
Bing Ai, Reg. No. 43,312	Attorney for Assignee
Printed or Typed Name	Title

PTO/SB/80 (11-08)
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 TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(b).

I hereby appoint:

[X] Practitioners associated with the Customer Number: 97075

OR

[ ] Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

as attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(b).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(b) to:

[X] The address associated with Customer Number: 97075

OR

[ ] Firm or Individual Name

Address					
City		State		Zip	
Country		Telephone		Email	

Assignee Name and Address:

California Institute of Technology
1200 E. California Boulevard, M/C 210-85
Pasadena, California 91125
UNITED STATES OF AMERICA

A copy of this form, together with a statement under 37 CFR 3.73(b) (Form PTO/SB/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(b) may be completed by one of the practitioners appointed in this form if the appointed practitioner is authorized to act on behalf of the assignee, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature	Fred Bertin	Date	7/14/2010
Name	Asst. Vice President	Telephone	
Title	Office of Technology Transfer California Institute of Technology		

09081-8000/LEGAL18713099.1

Electronic Acknowledgement Receipt	
EFS ID:	8778494
Application Number:	12165606
International Application Number:	
Confirmation Number:	2149
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Customer Number:	20985
Filer:	Bing Ai/Dana Spear
Filer Authorized By:	Bing Ai
Attorney Docket Number:	06618-0637003/3220-C-C
Receipt Date:	05-NOV-2010
Filing Date:	30-JUN-2008
Time Stamp:	13:35:30
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	Assignee showing of ownership per 37 CFR 3.73(b).	2010-11-05_POA.PDF	216154 af279032e3e6d1cf16fb107e1dc474f9e08acfdc	no	2
Warnings:					
Information:					

Total Files Size (in bytes):	216154

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

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.
12/165,606	06/30/2008	Hui Jin	06618-0637003/3220-C-C	2149

20985 7590 10/28/2010
FISH & RICHARDSON P.C. (SD)
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

EXAMINER	
HA, DAC V	
ART UNIT	PAPER NUMBER
2611	

NOTIFICATION DATE	DELIVERY MODE
10/28/2010	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):

PATDOCTC@fr.com

Office Action Summary	Application No.	Applicant(s)	
	12/165,606	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 --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, 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 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 *30 June 2008*.

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) *1-23* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *1-8,10-12 and 22* is/are allowed.

6)☒ Claim(s) *13-17 and 20* is/are rejected.

7)☒ Claim(s) *9,18,19,21 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 *30 June 2008* 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/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1. **Claim 21** is objected to because of the following informalities:

Claim 21, line 2, the recitation "irregular" should be clarified to avoid potential 112 problem. That is, it is not clear what constitutes the irregularity.

Similar issue exist in claims 9, 23.

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 –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. **Claims 13-17, 20** are rejected under 35 U.S.C. 102(b) as being anticipated by Chapman (US 5,181,207).

Re claim 13, Chapman discloses:

"receiving a block of data in the signal to be encoded, the block of data including information bits" (Fig. 1, element 11; Fig. 2);

"performing an encoding operation using the information bits as an input, the encoding operation including an accumulation of mod-2 or exclusive-0R sums of bits in subsets of the information bits, the encoding operation generating at least a portion of a

codeword" (Fig. 2; col. 3, line 40 to col. 4, line 1), wherein the N data bits and M parity bits teaches the claimed "codeword".

Re claim 14, Chapman further discloses "wherein the codeword comprises parity bits" in Fig. 2.

Re claim 15, Chapman further discloses "outputting the parity bits; and output at least some of the information bits" in Fig. 2 (wherein the N data bits teaches the claimed "at least some of the information bits")

Re claim 16, Chapman further discloses "the parity bits follow the information bits" in Fig. 2.

Re claim 17, Chapman further discloses "wherein each of the subsets of the information bits includes a constant number of the information bits" in Fig. 2; col. 3, lines 57-63 (wherein N/M teaches the "constant number of information bits").

Re claim 20, Chapman further discloses "performing one of the mod-2 addition and the exclusive-OR summing of the bits in the subsets" in Fig. 2; col. 3, lines 48-63.

Allowable Subject Matter

4. Claims 18-19, 21 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.

5. Claims 1-12, 22-23 allowed.

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

McEwen et al. (US 6,732,328)

Fang et al. (US 6,195,396)

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 4/4.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Payne can be reached on 571-272-3024. 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). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Dac V. Ha/
Primary Examiner, Art Unit 2611

Notice of References Cited	Application/Control No. 12/165,606	Applicant(s)/Patent Under Reexamination JIN ET AL.	
	Examiner Dac V. Ha	Art Unit 2611	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,195,396	02-2001	Fang et al.	375/261
*	B	US-5,181,207	01-1993	Chapman, Daniel H.	714/755
*	C	US-6,732,328	05-2004	McEwen et al.	714/795
	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	
	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.

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

BIB DATA SHEET

CONFIRMATION NO. 2149

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/165,606	06/30/2008 RULE	704	2611	06618-0637003/3220-C-C

APPLICANTS

Hui Jin, Glen Gardner, NJ;
Aamod Khandekar, Pasadena, CA;
Robert J. McEliece, Pasadena, CA;

**** CONTINUING DATA ***************************

This application is a CON of 11/542,950 10/03/2006 PAT 7,421,032
which is a CON of 09/861,102 05/18/2001 PAT 7,116,710
which claims benefit of 60/205,095 05/18/2000
and is a CIP of 09/922,852 08/18/2000 PAT 7,089,477

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED **** ** SMALL ENTITY **
08/13/2008

Foreign Priority claimed	35 USC 119(a-d) conditions met	Verified and Acknowledged	Met after Allowance	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
❑ Yes ☑ No	❑ Yes ☑ No	/DAC V HA/ Examiner's Signature	❑ Initials	NJ	5	23	3

ADDRESS

FISH & RICHARDSON P.C. (SD)
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022
UNITED STATES

TITLE

SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

FILING FEE RECEIVED		
510	FEES: Authority has been given in Paper 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 _____ ❑ Credit

BIB (Rev. 05/07).

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12165606	JIN ET AL.
	Examiner	Art Unit
	Dac V Ha	2611

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	10/18/2010								
	1	=								
	2	=								
	3	=								
	4	=								
	5	=								
	6	=								
	7	=								
	8	=								
	9	O								
	10	=								
	11	=								
	12	=								
	13	✓								
	14	✓								
	15	✓								
	16	✓								
	17	✓								
	18	O								
	19	O								
	20	✓								
	21	O								
	22	=								
	23	O								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12165606	JIN ET AL.
	Examiner	Art Unit
	Dac V Ha	2611

SEARCHED			
Class	Subclass	Date	Examiner
375	240, 240.24, 254, 285, 295, 296, 260		
714	755, 758, 800, 801, 804, 805		

SEARCH NOTES		
Search Notes	Date	Examiner
BRS and Inventor's search	10/18/2010	DH

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner
	PGPUB text search	10/18/2010	DH

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S57	1	"6014411".pn.	USPAT	OR	OFF	2005/02/10 16:13
S60	2017	((cod$3 decod$3 encod$3) with rate) with (repeat$4 repetition)	USPAT	OR	ON	2005/02/10 16:18
S61	173	S60 same interleav$3	USPAT	OR	ON	2005/02/10 16:17
S62	113	S61 and ("375"/$.ccls. "714"/$.ccls. "341"/$.ccls.)	USPAT	OR	ON	2005/02/10 16:17
S63	95	S62 and (turbo convolution$4)	USPAT	OR	ON	2005/02/10 16:18
S64	1	S57 and S60	USPAT	OR	OFF	2005/02/10 16:21
S65	11	S63 and ((partition$4 divi$5) with block)	USPAT	OR	OFF	2005/02/10 16:21
S66	17	S63 and ((partition$4 divi$5) with block)	USPAT	OR	ON	2005/02/10 16:22
S83	56760	(decod$4 with (node state stage))	US-PGPUB; USPAT	OR	ON	2007/08/25 16:50
S84	2064	S83 with parallel$4	US-PGPUB; USPAT	OR	ON	2007/08/25 16:50
S85	154	S84 with (viterbi trellis turbo)	US-PGPUB; USPAT	OR	ON	2007/08/25 16:51
S86	13	S84 with (adjacent neighbour $3 neighbor$3)	US-PGPUB; USPAT	OR	ON	2007/08/25 17:02
S90	27	S84 same (adjacent neighbour $3 neighbor$3)	US-PGPUB; USPAT	OR	ON	2007/08/25 17:02
S91	14	S90 not S86	US-PGPUB; USPAT	OR	ON	2007/08/25 17:02
S98	10381	(parity adj bit)	USPAT	OR	ON	2007/08/28 13:26
S99	869	S98 with decod$4	USPAT	OR	ON	2007/08/28 13:26
S100	138	S99 same (viterbi turbo trellis)	USPAT	OR	ON	2007/08/28 13:33
S101	7	S100 same parallel	USPAT	OR	ON	2007/08/28 13:27
S102	7	S101 and parity	USPAT	OR	OFF	2007/08/28 13:28
S103	25817	"5530707".pn. (viterbi turbo trellis)	USPAT	OR	ON	2007/08/28 13:33

S104	1	"5530707".pn. and (viterbi turbo trellis)	USPAT	OR	ON	2007/08/28 13:46
S105	0	"5530707".pn. and (messag $3)	USPAT	OR	ON	2007/08/28 13:46
S106	332	((hui near1 jin) (aamod near1 khandekar) (robert near1 mceliece)).in.	US-PGPUB; USPAT	OR	ON	2010/10/05 14:50
S107	186	S106 and (parity cod$3 encod $3).clm.	US-PGPUB; USPAT	OR	ON	2010/10/05 14:58
S108	34	S107 and (mod$2 accummulat $5 sum$4 exclusi$3).clm.	US-PGPUB; USPAT	OR	ON	2010/10/05 14:59
S109	15	("20010025358" | "5392299" | "5530707" | "5751739" | "5802115" | "5881093" | "6014411" | "6023783" | "6031874" | "6032284" | "6044116" | "6094739" | "6396423" | "6437714" | "6859906").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2010/10/05 15:09
S110	0	("7421032").URPN.	USPAT	OR	OFF	2010/10/05 15:09
S111	13	("5537420" | "5574735" | "5600664" | "5721745" | "5734962" | "5737345" | "5949796" | "5970098" | "5983384" | "5996104" | "5999570" | "6005894" | "6023783").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2010/10/05 15:10
S112	13	("6233711").URPN.	USPAT	OR	OFF	2010/10/05 15:10
S113	187131	(mod$2 accummulat$5 sum$4 exclusi$3) with (encod$3 cod $3)	US-PGPUB; USPAT	OR	ON	2010/10/05 15:11
S114	2296	S113 with parity	US-PGPUB; USPAT	OR	ON	2010/10/05 15:11
S115	792	S114 and ("375"/$.ccls. "714"/$.ccls. "341"/$.ccls.)	USPAT	OR	ON	2010/10/05 15:12
S116	648	S115 and (parity cod$3 encod $3).ab.	US-PGPUB; USPAT	OR	ON	2010/10/05 15:12
S117	0	11@ad>"20000818"	US-PGPUB; USPAT	OR	ON	2010/10/05 15:13
S118	356	S116 not @ad>="20000818"	US-PGPUB; USPAT	OR	ON	2010/10/05 15:14
S119	348	S118 and (parity cod$3 encod $3).clm.	US-PGPUB; USPAT	OR	ON	2010/10/05 15:14
S120	209	(mod$2 accummulat$5 sum$4 exclusi$3).clm. and S119	US-PGPUB; USPAT	OR	ON	2010/10/05 15:15
S121	102	S120 and (codeword or (code adj word))	US-PGPUB; USPAT	OR	ON	2010/10/05 15:16

S122	332	((hui near1 jin) (aamod near1 khandekar) (robert near1 mceliece)).in.	US-PGPUB; USPAT	OR	ON	2010/10/07 15:18
S123	57	S122 and block.clm.	US-PGPUB; USPAT	OR	ON	2010/10/07 15:18
S124	38	S123 and (cod$3 encod$3).clm.	US-PGPUB; USPAT	OR	ON	2010/10/07 15:18
S125	12	S124 and (codeword parity).clm.	US-PGPUB; USPAT	OR	ON	2010/10/07 15:19
S126	187311	(mod$2 accummulat$5 sum$4 exclusi$3) with (encod$3 cod $3)	US-PGPUB; USPAT	OR	ON	2010/10/07 15:25
S127	2300	S126 with parity	US-PGPUB; USPAT	OR	ON	2010/10/07 15:25
S128	792	S127 and ("375"/$.ccls. "714"/$.ccls. "341"/$.ccls.)	USPAT	OR	ON	2010/10/07 15:25
S129	648	S128 and (parity cod$3 encod $3).ab.	US-PGPUB; USPAT	OR	ON	2010/10/07 15:25
S130	356	S129 not @ad>="20000818"	US-PGPUB; USPAT	OR	ON	2010/10/07 15:25
S131	348	S130 and (parity cod$3 encod $3).clm.	US-PGPUB; USPAT	OR	ON	2010/10/07 15:25
S132	209	(mod$2 accummulat$5 sum$4 exclusi$3).clm. and S131	US-PGPUB; USPAT	OR	ON	2010/10/07 15:25
S133	102	S132 and (codeword or (code adj word))	US-PGPUB; USPAT	OR	ON	2010/10/07 15:25
S134	75	S133 and ((mod$2 accummulat$5 sum$4 exclusi $3) with (encod$3 cod$3) with bit)	US-PGPUB; USPAT	OR	ON	2010/10/07 16:27
S135	0	(((mod$6 exclusi$3) with sum $4) with accummulat$5) with ((encod$3 cod$3) with bit)	US-PGPUB; USPAT	OR	ON	2010/10/07 16:35
S136	41524	(mod$6 exclusi$3) with ((encod$3 cod$3) with bit)	US-PGPUB; USPAT	OR	ON	2010/10/07 16:36
S137	1883	S136 with (sum$4 accummulat $5 integra$5)	US-PGPUB; USPAT	OR	ON	2010/10/07 16:36
S138	168	S137 with (codeword (code adj word))	US-PGPUB; USPAT	OR	ON	2010/10/07 16:37
S139	46	S138 not @ad>="20000818"	US-PGPUB; USPAT	OR	ON	2010/10/07 16:37
S140	40	S139 and ("375"/$.ccls. "714"/$.ccls. "341"/$.ccls.)	USPAT	OR	ON	2010/10/07 16:37
S141	196	S137 same (codeword (code adj word))	US-PGPUB; USPAT	OR	ON	2010/10/07 16:45
S142	39	S141 same parity	US-PGPUB; USPAT	OR	ON	2010/10/07 16:45

S143	18	S142 and ("375"/$.ccls. "714"/$.ccls. "341"/$.ccls.)	USPAT	OR	ON	2010/10/07 16:45
S144	37	S142 and ("375"/$.ccls. "714"/$.ccls. "341"/$.ccls.)	US-PGPUB; USPAT	OR	ON	2010/10/07 16:45
S145	11	S144 not @ad>="20000818"	US-PGPUB; USPAT	OR	ON	2010/10/07 16:46
S146	187090	((mod$6 exclusi$3) with bit)	US-PGPUB; USPAT	OR	ON	2010/10/07 16:59
S147	465	S146 same ((codeword (code adj word)) with parity)	US-PGPUB; USPAT	OR	ON	2010/10/07 17:00
S148	12	S123 and parity.clm.	US-PGPUB; USPAT	OR	ON	2010/10/07 17:00
S149	0	S148 not @ad>="20000818"	US-PGPUB; USPAT	OR	ON	2010/10/07 17:01
S150	122	S147 not @ad>="20000818"	US-PGPUB; USPAT	OR	ON	2010/10/07 17:02
S151	41550	(mod$6 exclusi$3) with ((encod$3 cod$3) with bit)	US-PGPUB; USPAT	OR	ON	2010/10/13 16:55
S152	2344	S151 with (codeword (code adj word))	US-PGPUB; USPAT	OR	ON	2010/10/13 16:55
S153	1884	S151 with (sum$4 accummulat $5 integra$5)	US-PGPUB; USPAT	OR	ON	2010/10/13 16:56
S154	313	S153 same (codeword (code adj word) parity)	US-PGPUB; USPAT	OR	ON	2010/10/13 16:56
S155	313	S154 same (accummulat$5 sum$4 integra$5 averag$3)	US-PGPUB; USPAT	OR	ON	2010/10/13 16:58
S156	147	S155 and parity.clm.	US-PGPUB; USPAT	OR	ON	2010/10/13 16:58
S157	52	S156 not @ad>="20000818"	US-PGPUB; USPAT	OR	ON	2010/10/13 16:58
S158	45	S157 and ("375"/$.ccls. "714"/$.ccls. "341"/$.ccls.)	US-PGPUB; USPAT	OR	ON	2010/10/13 16:58
S159	2018	(xor$2) with ((encod$3 cod $3) with bit)	US-PGPUB; USPAT	OR	ON	2010/10/13 17:24
S160	132	S159 with (codeword (code adj word))	US-PGPUB; USPAT	OR	ON	2010/10/13 17:24
S161	9	S160 with (sum$4 accummulat $5 integra$5)	US-PGPUB; USPAT	OR	ON	2010/10/13 17:25
S162	9	S161 same (codeword (code adj word) parity)	US-PGPUB; USPAT	OR	ON	2010/10/13 17:25
S163	158	S153 same (parity)	US-PGPUB; USPAT	OR	ON	2010/10/13 17:26
S164	158	S163 same (accummulat$5 sum$4 integra$5 averag$3)	US-PGPUB; USPAT	OR	ON	2010/10/13 17:26
S165	63	S164 not @ad>="20000818"	US-PGPUB; USPAT	OR	ON	2010/10/13 17:27
S166	48	S165 and ("375"/$.ccls. "714"/$.ccls. "341"/$.ccls.)	US-PGPUB; USPAT	OR	ON	2010/10/13 17:27

S167	44	S166 and parity.clm.	US-PGPUB; USPAT	OR	ON	2010/10/13 17:27
S168	0	S167 not S158	US-PGPUB; USPAT	OR	ON	2010/10/13 17:29
S169	9248	parity same (mod$3 xor$2) same bit	US-PGPUB; USPAT	OR	ON	2010/10/14 15:09
S170	3098	S169 same (codeword word (code adj word))	US-PGPUB; USPAT	OR	ON	2010/10/14 15:10
S171	1092	S170 and parity.clm.	US-PGPUB; USPAT	OR	ON	2010/10/14 15:10
S172	623	S171 and parity.ab.	US-PGPUB; USPAT	OR	ON	2010/10/14 15:10
S173	349	S172 and ("375"/$.ccls. "714"/$.ccls. "341"/$.ccls.)	USPAT	OR	ON	2010/10/14 15:10
S174	428	S170 same (subset (sub adj set) portion segment$5 section)	USPAT	OR	ON	2010/10/14 15:11
S175	153	S174 and parity.clm.	US-PGPUB; USPAT	OR	ON	2010/10/14 15:11
S176	4959	"4" and parity.ab.	US-PGPUB; USPAT	OR	ON	2010/10/14 15:12
S177	87	S175 and parity.ab.	US-PGPUB; USPAT	OR	ON	2010/10/14 15:12
S178	2300	S176 and ("375"/$.ccls. "714"/$.ccls. "341"/$.ccls.)	USPAT	OR	ON	2010/10/14 15:12
S179	82	S177 and ("375"/$.ccls. "714"/$.ccls. "341"/$.ccls.)	USPAT	OR	ON	2010/10/14 15:12
S180	42	S179 not @ad>="20000818"	US-PGPUB; USPAT	OR	ON	2010/10/14 15:12
S181	41	S180 and (parity with (first second))	US-PGPUB; USPAT	OR	ON	2010/10/14 15:27
S182	32	S180 and ((parity with first) same (parity with second))	US-PGPUB; USPAT	OR	ON	2010/10/14 15:31
S183	14	("4429391").URPN.	USPAT	OR	OFF	2010/10/14 16:26
S184	11	("4586183").URPN.	USPAT	OR	OFF	2010/10/14 16:26
S185	35	("4710934").URPN.	USPAT	OR	OFF	2010/10/14 16:26
S186	11	("5151902").URPN.	USPAT	OR	OFF	2010/10/14 16:26
S187	4	("5581567").URPN.	USPAT	OR	OFF	2010/10/14 16:27

10/ 18/ 2010 4:26:14 PM
C:\ Documents and Settings\ dha\ My Documents\ EAST\ Workspace2\ 12165606.wsp

Substitute Form PTO-1449 (Modified) U.S. Department of Commerce Patent and Trademark Office	Attorney's Docket No. 06618-637003	Application No. Not yet assigned
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))	Applicant Hui Jin et al.	
	Filing Date June 30, 2008	Group Art Unit

U.S. Patent Documents

Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
/D.H./	AA	2001/0025358	09/2001	Eidson et al.			
	AB	5,392,299	02/1995	Rhines et al.			
	AC	5,530,707	06/1996	Lin			
	AD	5,751,739	05/1998	Seshadri et al.			
	AE	5,802,115	09/1998	Meyer			
	AF	5,881,093	03/1999	Wang et al.			
	AG	6,014,411	01/2000	Wang			
	AH	6,023,783	02/2000	Divsalar et al.			
	AI	6,031,874	02/2000	Chennakeshu et al.			
	AJ	6,032,284	02/2000	Bliss			
	AK	6,044,116	03/2000	Wang			
	AL	6,094,739	07/2000	Miller et al.			
	AM	6,396,423	05/2002	Laumen et al.			
	AN	6,437,714	08/2002	Kim et al.			
/D.H./	AO	6,859,906	02/2005	Hammons et al.			

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
	AP							
	AQ							
	AR							

Other Documents (include Author, Title, Date, and Place of Publication)

Examiner Initial	Desig. ID	Document
/D.H./	AS	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.
/D.H./	AT	Benedetto, S., et al., "A Soft-Input Soft-Output Maximum A Posteriori (MAP) Module to Decode Parallel and Serial Concatenated Codes," *The Telecommunications and Data Acquisition Progress Report (TDA PR 42-127)*, pp. 1-20, November 1996.

Examiner Signature	Date Considered
/Dac Ha/	10/05/2010

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. 06618-637003	Application No. Not yet assigned
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))	Applicant Hui Jin et al.	
	Filing Date June 30, 2008	Group Art Unit

Other Documents (include Author, Title, Date, and Place of Publication)

Examiner Initial	Desig. ID	Document
/D.H./	AU	Benedetto, S., et al., "Bandwidth efficient parallel concatenated coding schemes," *Electronics Letters*, 31(24):2067-2069, November 1995.
/D.H./	AV	Benedetto, S., et al., "Design of Serially Concatenated Interleaved Codes," *ICC 97*, vol. 2, pp. 710-714, June 1997.
/D.H./	AW	Benedetto, S., et al., "Parallel Concatenated Trellis Coded Modulation," *ICC 96*, vol. 2, pp. 974-978, June 1996.
/D.H./	AX	Benedetto, S., et al., "Serial Concatenated Trellis Coded Modulation with Iterative Decoding," *Proceedings 1997 IEEE International Symposium on Information Theory (ISIT)*, Ulm, Germany, p. 8, June 29-July 4, 1997.
/D.H./	AY	Benedetto, S., et al., "Serial Concatenation of Interleaved Codes: Performace Analysis, Design, and Iterative Decoding," *The Telecommunications and Data Acquisition Progress Report (TDA PR 42-126)*, pp. 1-26, August 1996.
/D.H./	AZ	Benedetto, S., et al., "Serial concatenation of interleaved codes: performance analysis, design, and iterative decoding," *Proceedings 1997 IEEE International Symposium on Information Theory (ISIT)*, Ulm, Germany, p. 106, June 29-July 4, 1997.
/D.H./	BA	Benedetto, S., et al., "Soft-Output Decoding Algorithms in Iterative Decoding of Turbo Codes," *The Telecommunications and Data Acquisition Progress Report (TDA PR 42-124)*, pp. 63-87, February 1996.
/D.H./	BB	Berrou, C., et al., "Near Shannon Limit Error - Correcting Coding and Decoding: Turbo Codes," *ICC 93*, vol. 2, pp. 1064-1070, May 1993.
/D.H./	BC	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 Technical Report, pp. 1-104 (pg. 64), February 2005.
/D.H./	BD	Divsalar, D., et al., "Coding Theorems for 'Turbo-Like' Codes," *Proceedings of the 36th Annual Allerton Conference on Communication, Control, and Computing*, Monticello, Illinois, pp. 201-210, September 1998.
/D.H./	BE	Divsalar, D., et al., "Effective free distance of turbo codes," *Electronics Letters*, 32(5):445-446, February 1996.
/D.H./	BF	Divsalar, D., et al., "Hybrid Concatenated Codes and Iterative Decoding," *Proceedings 1997 IEEE International Symposium on Information Theory (ISIT)*, Ulm, Germany, p. 10, June 29-July 4, 1997.
/D.H./	BG	Divsalar, D., et al., "Low-Rate Turbo Codes for Deep-Space Communications," *Proceedings 1995 IEEE International Symposium on Information Theory (ISIT)*, Whistler, BC, Canada, p. 35, September 1995.
/D.H./	BH	Divsalar, D., et al., "Multiple Turbo Codes for Deep-Space Communications," *The Telecommunications and Data Acquisition Progress Report (TDA PR 42-121)*, pp. 66-77, May 1995.
/D.H./	BI	Divsalar, D., et al., "Multiple Turbo Codes," *MILCOM '95*, vol. 1, pp. 279-285, November 1995.
/D.H./	BJ	Divsalar, D., et al., "On the Design of Turbo Codes," *The Telecommunications and Data Acquisition Progress Report (TDA PR 42-123)*, pp. 99-121, November 1995.
/D.H./	BK	Divsalar, D., et al., "Serial Turbo Trellis Coded Modulation with Rate-1 Inner Code," *Proceedings 2000 IEEE International Symposium on Information Theory (ISIT)*, Sorrento, Italy, pp. 194, June 2000.
/D.H./	BL	Divsalar, D., et al., "Turbo Codes for PCS Applications," *IEEE ICC '95*, Seattle, WA, USA, vol. 1, pp. 54-59, June 1995.

Examiner Signature /Dac Ha/	Date Considered 10/05/2010

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. 06618-637003	Application No. Not yet assigned
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))	Applicant Hui Jin et al.	
	Filing Date June 30, 2008	Group Art Unit

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
/D.H./	BM	Jin, H., et al., "Irregular Repeat - Accumulate Codes," *2nd International Symposium on Turbo Codes*, Brest, France, 25 pages, September 2000.
/D.H./	BN	Jin, H., et al., "Irregular Repeat – Accumulate Codes," *2nd International Symposium on Turbo Codes & Related Topics*, Brest, France, pg. 1-8, September 2000.
/D.H./	BO	Richardson, T.J., et al., "Design of Capacity-Approaching Irregular Low-Density Parity-Check Codes," *IEEE Transactions on Information Theory*, 47(2):619-637, February 2001.
/D.H./	BP	Richardson, T.J., et al., "Efficient Encoding of Low-Density Parity-Check Codes," *IEEE Transactions on Information Theory*, 47(2):638-656, February 2001.
/D.H./	BQ	Wiberg, N., et al., "Codes and Iterative Decoding on General Graphs," *Proceedings 1995 IEEE International Symposium on Information Theory (ISIT)*, Whistler, BC, Canada, p. 468, September 1995.

Examiner Signature /Dac Ha/	Date Considered 10/05/2010
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. 06618-0637003	Application No. 12/165,606
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))	Applicant Hui Jin et al.	
	Filing Date June 30, 2008	Group Art Unit 2626

U.S. Patent Documents

Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
/D.H./	1	7,089,477	08/2006	Divsalar et al.			
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						

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
	12							
	13							
	14							
	15							
	16							

Other Documents (include Author, Title, Date, and Place of Publication)

Examiner Initial	Desig. ID	Document
/D.H./	17	Aji, S.M., et al., "The Generalized Distributive Law," *IEEE Transactions on Information Theory*, 46(2):325-343, March 2000.
/D.H./	18	Tanner, R.M., "A Recursive Approach to Low Complexity Codes," *IEEE Transactions on Information Theory*, 27(5):533-547, September 1981.
	19	
	20	

Examiner Signature /Dac Ha/	Date Considered 10/05/2010

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

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/165,606	06/30/2008	Hui Jin	06618-637003/3220-C-C

CONFIRMATION NO. 2149

20985
FISH & RICHARDSON, PC
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

POA ACCEPTANCE LETTER

OC000000033857747

Date Mailed: 01/05/2009

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 12/23/2008.

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.

/hgray/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Hui Jin et al.
Serial No. : 12/165,606
Filed : June 30, 2008
Title : SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

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

POWER OF ATTORNEY BY ASSIGNEE; ELECTION OF ASSIGNEE TO CONDUCT PROSECUTION TO EXCLUSION OF INVENTORS; CERTIFICATE UNDER 37 CFR §3.73(B)

The undersigned, as authorized representative of the assignee of the entire right, title and interest in the above-identified application, hereby appoints

Bing Ai, Reg. No. 43,312
David L. Feigenbaum, Reg. No. 30,378
John C. Phillips, Reg. No. 35,322
Hwa Lee, Reg. No. 59,747
John F. Conroy, Reg. No. 45,485
William E. Hunter, Reg. No. 47,671
Terry J. Stalford, Reg. No. 39,522
John Hayden, Reg. No. 37,640
Tina Williams McKeon, Reg. No. 43,791
Sushil Shrinivasan, Reg. No. L0368

as its attorney to prosecute the application and to transact all business in the Patent and Trademark Office connected therewith with full powers of substitution and revocation, said appointment to be to the exclusion of the inventors and their attorney(s) in accordance with the provisions of 37 CFR §3.71 *et seq.* of the Patent Office Rules of Practice.

Ownership is in the assignee by virtue of the assignment documents filed on October 20, 2008, Reel/Frame 021710/0863. The documents evidencing ownership have been reviewed and to the best of the assignee's knowledge and belief, title is in the assignee.

The undersigned has reviewed all the documents in the chain of title of the patent application identified above and, to the best of undersigned's knowledge and belief, title is in the assignee identified above.

The undersigned, whose title is supplied below, is empowered to act on behalf of the assignee.

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.

Please direct all communications regarding the application to **Customer Number 20985**.

Signature: _____ Date: DEC 17 2008

Typed name: ADAM COCHRAN, ESQ.

Title: Intellectual Property Counsel

Assignee: California Institute of Technology

Fish & Richardson P.C.
USPTO Customer No. **20985**
12390 El Camino Real
San Diego, CA 92130
Telephone: (858) 678-5070
Facsimile: (858) 678-5099

Electronic Acknowledgement Receipt	
EFS ID:	4517742
Application Number:	12165606
International Application Number:	
Confirmation Number:	2149
Title of Invention:	SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES
First Named Inventor/Applicant Name:	Hui Jin
Customer Number:	20985
Filer:	Bing Ai/Jennifer Payne
Filer Authorized By:	Bing Ai
Attorney Docket Number:	06618-637003/3220-C-C
Receipt Date:	23-DEC-2008
Filing Date:	30-JUN-2008
Time Stamp:	20:26:31
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	06618-00637003_POA.pdf	73603 112f20730f0436694b942d75371f2bdbe47b03a9	no	2

Warnings:

The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing	
Information:	
Total Files Size (in bytes):	73603

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

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
12/165,606	06/30/2008	Hui Jin	06618-637003/3220-C-C

CONFIRMATION NO. 2149

20985
FISH & RICHARDSON, PC
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

PUBLICATION NOTICE

OC000000033363430

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

Publication No.US-2008-0294964-A1
Publication Date:11/27/2008

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently http://pair.uspto.gov/. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Hui Jin et al.
Serial No. : 12/165,606
Filed : June 30, 2008
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

INFORMATION DISCLOSURE STATEMENT

Applicants call attention to the attached Information Disclosure Statement and documents listed on form PTO-1449.

The documents are in the English language; hence no concise explanation is necessary per Rule 98(a)(3).

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.

This filing is being made before the receipt of a first Office action on the merits. No fee is required. Please apply any credits or additional charges to deposit account 06-1050.

Respectfully submitted,

Date: November 12, 2008

/John F. Conroy, Reg. #45,485/
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
Facsimile: (858) 678-5099

Substitute Form PTO-1449 (Modified)	U.S. Department of Commerce Patent and Trademark Office	Attorney's Docket No. 06618-0637003	Application No. 12/165,606
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant Hui Jin et al.	
		Filing Date June 30, 2008	Group Art Unit 2626

U.S. Patent Documents

Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
	1	7,089,477	08/2006	Divsalar et al.			
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						

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
	12							
	13							
	14							
	15							
	16							

Other Documents (include Author, Title, Date, and Place of Publication)

Examiner Initial	Desig. ID	Document
	17	Aji, S.M., et al., "The Generalized Distributive Law," *IEEE Transactions on Information Theory*, 46(2):325-343, March 2000.
	18	Tanner, R.M., "A Recursive Approach to Low Complexity Codes," *IEEE Transactions on Information Theory*, 27(5):533-547, September 1981.
	19	
	20	

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)

Electronic Acknowledgement Receipt	
EFS ID:	4275679
Application Number:	12165606
International Application Number:	
Confirmation Number:	2149
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:	06618-637003/3220-C-C
Receipt Date:	12-NOV-2008
Filing Date:	30-JUN-2008
Time Stamp:	14:51:25
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	Information Disclosure Statement (IDS) Filed (SB/08)	06618-0637003_IDS.pdf	67976 9c0ecd0e42073aa0fc821211ac8eade9ee6a6257	no	2
Warnings:					
Information:					

This is not an USPTO supplied IDS fillable form					
2	NPL Documents	Aji-GeneralizedDistributive.pdf	407592 e1df272da14727aa05a5e264a7c8eae537a8a3d8	no	19
Warnings:					
Information:					
3	NPL Documents	Tanner-RecursiveApproach.pdf	1660282 67668832914b1380c0897326fc2e01964bcad7df	no	15
Warnings:					
Information:					
			Total Files Size (in bytes):	2135850	

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.

<u>New Applications Under 35 U.S.C. 111</u>
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.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
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.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
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

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	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
12/165,606	06/30/2008	2626	510	06618-637003/3220-C-C	23	3

CONFIRMATION NO. 2149

20985
FISH & RICHARDSON, PC
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

FILING RECEIPT

OC000000031558149

Date Mailed: 08/15/2008

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Hui Jin, Glen Gardner, NJ;
Aamod Khandekar, Pasadena, CA;
Robert J. McEliece, Pasadena, CA;

Assignment For Published Patent Application

California Institute of Technology

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 11/542,950 10/03/2006 PAT 7,421,032
which is a CON of 09/861,102 05/18/2001 PAT 7,116,710
which claims benefit of 60/205,095 05/18/2000
and is a CIP of 09/922,852 08/18/2000 PAT 7,089,477

Foreign Applications

If Required, Foreign Filing License Granted: 08/13/2008

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 12/165,606**

Projected Publication Date: 11/27/2008

Non-Publication Request: No

Early Publication Request: No
** **SMALL ENTITY** **

Title

SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

Preliminary Class

704

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where

the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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
12/165,606	06/30/2008	Hui Jin	06618-637003/3220-C-C

CONFIRMATION NO. 2149

20985
FISH & RICHARDSON, PC
P.O. BOX 1022
MINNEAPOLIS, MN 55440-1022

IMPROPER CPOA LETTER

OC000000031558197

Date Mailed: 08/15/2008

NOTICE REGARDING POWER OF ATTORNEY

This is in response to the Power of Attorney filed 06/30/2008. The Power of Attorney in this application is not accepted for the reason(s) listed 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.

/rerry/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

FISH & RICHARDSON P.C.

Frederick P. Fish
1855-1930

W.K. Richardson
1859-1951

Street Address
12390 El Camino Real
San Diego, California
92130

Mail Address
P.O. Box 1022
Minneapolis, Minnesota
55440-1022

Telephone
858 678-5070

Facsimile
877 769-7945

Web Site
www.fr.com

ATLANTA
AUSTIN
BOSTON
DALLAS
DELAWARE
MUNICH
NEW YORK
SAN DIEGO
SILICON VALLEY
TWIN CITIES
WASHINGTON, DC

June 30, 2008

Attorney Docket No.: 06618-637003/3220-C-C

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

Presented for filing is a new continuation patent application of:

Applicant: HUI JIN, AAMOD KHANDEKAR AND ROBERT J. MCELIECE

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

Assignee: California Institute of Technology

Enclosed are the following papers, including those required to receive a filing date under 37 C.F.R. § 1.53(b):

	Pages
Specification	17
Claims	5
Abstract	1
Declaration	4
Drawings	5

Enclosures:

- Form PTO-1449, listing documents cited in the parent applications (3 pages). Please confirm that these have been considered in this application by returning a copy of the Form PTO-1449 with the examiner's initials.
- Rule 63 declaration, copy from a previous application under rule 63(d) for continuation or divisional only.
- Small entity statement. See 37 CFR 1.27.

This application is entitled to small entity status.

This application is a continuation (and claims the benefit of priority under 35 U.S.C. § 120) of U.S. Application Serial No. 11/542,950, filed October 3, 2006, which is a continuation of U.S. Application Serial No. 09/861,102, filed May 18, 2001, now U.S. Patent No. 7,116,710, which claims the priority of U.S. Provisional Application Serial No. 60/205,095, filed May 18, 2000, and is a continuation-in-part of U.S. Application Serial No. 09/922,852, filed August 18, 2000, now U.S. Patent No.

7,089,477. The disclosure of the prior applications are considered part of (and are incorporated by reference in) the disclosure of this application.

			Small Entity	Large Entity	
Basic Filing Fee			75	310	$75
Search Fee			255	510	$255
Examination fee			105	210	$105
Total Claims 23	over 20	**3 x $25**	25	50	$75
Independent Claims 3	over 3	**0 x $105**	105	210	$0
Fee for Multiple Dependent claims			185	370	$0
Fee for each additional 50 pages of Specification and Drawings over 100			130	260	$0
Total Filing fee					$510

The filing fee in the amount of $510 is being paid concurrently herewith on the Electronic Filing System (EFS) by way of Deposit Account authorization. Please apply all charges or credits to Deposit Account No. 06-1050, referencing Attorney Docket No. 06618-637003.

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.

Please direct all correspondence to the following:

20985
PTO Customer Number

Respectfully submitted,

/John F. Conroy, Reg. # 45,485/

John F. Conroy
Reg. No. 45,485
Enclosures
JFC/jhp

Substitute Form PTO-1449 (Modified)	U.S. Department of Commerce Patent and Trademark Office	Attorney's Docket No. 06618-637003	Application No. Not yet assigned
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant Hui Jin et al.	
		Filing Date June 30, 2008	Group Art Unit

U.S. Patent Documents

Examiner Initial	Desig. ID	Document Number	Publication Date	Patentee	Class	Subclass	Filing Date If Appropriate
	AA	2001/0025358	09/2001	Eidson et al.			
	AB	5,392,299	02/1995	Rhines et al.			
	AC	5,530,707	06/1996	Lin			
	AD	5,751,739	05/1998	Seshadri et al.			
	AE	5,802,115	09/1998	Meyer			
	AF	5,881,093	03/1999	Wang et al.			
	AG	6,014,411	01/2000	Wang			
	AH	6,023,783	02/2000	Divsalar et al.			
	AI	6,031,874	02/2000	Chennakeshu et al.			
	AJ	6,032,284	02/2000	Bliss			
	AK	6,044,116	03/2000	Wang			
	AL	6,094,739	07/2000	Miller et al.			
	AM	6,396,423	05/2002	Laumen et al.			
	AN	6,437,714	08/2002	Kim et al.			
	AO	6,859,906	02/2005	Hammons et al.			

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
	AP							
	AQ							
	AR							

Other Documents (include Author, Title, Date, and Place of Publication)

Examiner Initial	Desig. ID	Document
	AS	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.
	AT	Benedetto, S., et al., "A Soft-Input Soft-Output Maximum A Posteriori (MAP) Module to Decode Parallel and Serial Concatenated Codes," *The Telecommunications and Data Acquisition Progress Report (TDA PR 42-127)*, pp. 1-20, November 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. 06618-637003	Application No. Not yet assigned
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))		Applicant Hui Jin et al.	
		Filing Date June 30, 2008	Group Art Unit

Other Documents (include Author, Title, Date, and Place of Publication)

Examiner Initial	Desig. ID	Document
	AU	Benedetto, S., et al., "Bandwidth efficient parallel concatenated coding schemes," *Electronics Letters*, 31(24):2067-2069, November 1995.
	AV	Benedetto, S., et al., "Design of Serially Concatenated Interleaved Codes," *ICC 97*, vol. 2, pp. 710-714, June 1997.
	AW	Benedetto, S., et al., "Parallel Concatenated Trellis Coded Modulation," *ICC 96*, vol. 2, pp. 974-978, June 1996.
	AX	Benedetto, S., et al., "Serial Concatenated Trellis Coded Modulation with Iterative Decoding," *Proceedings 1997 IEEE International Symposium on Information Theory (ISIT)*, Ulm, Germany, p. 8, June 29-July 4, 1997.
	AY	Benedetto, S., et al., "Serial Concatenation of Interleaved Codes: Performace Analysis, Design, and Iterative Decoding," *The Telecommunications and Data Acquisition Progress Report (TDA PR 42-126)*, pp. 1-26, August 1996.
	AZ	Benedetto, S., et al., "Serial concatenation of interleaved codes: performance analysis, design, and iterative decoding," *Proceedings 1997 IEEE International Symposium on Information Theory (ISIT)*, Ulm, Germany, p. 106, June 29-July 4, 1997.
	BA	Benedetto, S., et al., "Soft-Output Decoding Algorithms in Iterative Decoding of Turbo Codes," *The Telecommunications and Data Acquisition Progress Report (TDA PR 42-124)*, pp. 63-87, February 1996.
	BB	Berrou, C., et al., "Near Shannon Limit Error - Correcting Coding and Decoding: Turbo Codes," *ICC 93*, vol. 2, pp. 1064-1070, May 1993.
	BC	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 Technical Report, pp. 1-104 (pg. 64), February 2005.
	BD	Divsalar, D., et al., "Coding Theorems for 'Turbo-Like' Codes," *Proceedings of the 36th Annual Allerton Conference on Communication, Control, and Computing*, Monticello, Illinois, pp. 201-210, September 1998.
	BE	Divsalar, D., et al., "Effective free distance of turbo codes," *Electronics Letters*, 32(5):445-446, February 1996.
	BF	Divsalar, D., et al., "Hybrid Concatenated Codes and Iterative Decoding," *Proceedings 1997 IEEE International Symposium on Information Theory (ISIT)*, Ulm, Germany, p. 10, June 29-July 4, 1997.
	BG	Divsalar, D., et al., "Low-Rate Turbo Codes for Deep-Space Communications," *Proceedings 1995 IEEE International Symposium on Information Theory (ISIT)*, Whistler, BC, Canada, p. 35, September 1995.
	BH	Divsalar, D., et al., "Multiple Turbo Codes for Deep-Space Communications," *The Telecommunications and Data Acquisition Progress Report (TDA PR 42-121)*, pp. 66-77, May 1995.
	BI	Divsalar, D., et al., "Multiple Turbo Codes," *MILCOM '95*, vol. 1, pp. 279-285, November 1995.
	BJ	Divsalar, D., et al., "On the Design of Turbo Codes," *The Telecommunications and Data Acquisition Progress Report (TDA PR 42-123)*, pp. 99-121, November 1995.
	BK	Divsalar, D., et al., "Serial Turbo Trellis Coded Modulation with Rate-1 Inner Code," *Proceedings 2000 IEEE International Symposium on Information Theory (ISIT)*, Sorrento, Italy, pp. 194, June 2000.
	BL	Divsalar, D., et al., "Turbo Codes for PCS Applications," *IEEE ICC '95*, Seattle, WA, USA, vol. 1, pp. 54-59, June 1995.

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. 06618-637003	Application No. Not yet assigned
Information Disclosure Statement by Applicant (Use several sheets if necessary) (37 CFR §1.98(b))	Applicant Hui Jin et al.	
	Filing Date June 30, 2008	Group Art Unit

Other Documents (include Author, Title, Date, and Place of Publication)		
Examiner Initial	Desig. ID	Document
	BM	Jin, H., et al., "Irregular Repeat - Accumulate Codes," *2nd International Symposium on Turbo Codes*, Brest, France, 25 pages, September 2000.
	BN	Jin, H., et al., "Irregular Repeat – Accumulate Codes," *2nd International Symposium on Turbo Codes & Related Topics*, Brest, France, pg. 1-8, September 2000.
	BO	Richardson, T.J., et al., "Design of Capacity-Approaching Irregular Low-Density Parity-Check Codes," *IEEE Transactions on Information Theory*, 47(2):619-637, February 2001.
	BP	Richardson, T.J., et al., "Efficient Encoding of Low-Density Parity-Check Codes," *IEEE Transactions on Information Theory*, 47(2):638-656, February 2001.
	BQ	Wiberg, N., et al., "Codes and Iterative Decoding on General Graphs," *Proceedings 1995 IEEE International Symposium on Information Theory (ISIT)*, Whistler, BC, Canada, p. 468, September 1995.

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)

SERIAL CONCATENATION OF INTERLEAVED CONVOLUTIONAL CODES FORMING TURBO-LIKE CODES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. Application Serial No. 11/542,950, filed October 3, 2006, which is a continuation of U.S. Application Serial No. 09/861,102, filed May 18, 2001, now U.S. Patent No. 7,116,710, which claims the priority of U.S. Provisional Application Serial No. 60/205,095, filed May 18, 2000, and is a continuation-in-part of U.S. Application Serial No. 09/922,852, filed August 18, 2000, now U.S. Patent No. 7,089,477. The disclosure of the prior applications are considered part of (and are incorporated by reference in) the disclosure of this application.

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 $[x_1,...,x_n]$ and output block $[y_1,...,y_n]$ 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 $r = (k\Sigma_i i f_i)/a$ 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

$$x_j = x_{j-1} + \sum_{i=1}^{a} v_{(j-1)a+i}$$

($v_1, \ldots, v_{ra}$), then we have the recursive formula

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 $(u_1,...,u_k)$ is $(x_1,..., x_r)$. The systematic version is a (k+r, k) code, in which the codeword is $(u_1,..., u_k; x_1,..., x_r)$.

[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

$$f_i = \frac{\lambda_i / i}{\sum_j \lambda_j / j}$$

the generating functions of these sequences. The pair (λ, ρ) is called a degree distribution. For $L(x) = \Sigma_i f_i x_i$,

[0033] The rate of the systematic IRA code given by the

$$L(x) = \int_0^x \lambda(t)\,dt \Big/ \int_0^1 \lambda(t)\,dt$$

$$\text{Rate} = \left(1 + \frac{\sum_j \rho_j / j}{\sum_j \lambda_j / j}\right)^{-1}$$

degree distribution is given by

[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 → u) and m(u → 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 ∈ {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.

TABLE 1

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

[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.

WHAT IS CLAIMED IS:

1. A method of encoding a signal, comprising:

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

performing a first encoding operation on at least some of the information bits, the first encoding operation being a linear transform operation that generates L transformed bits; and

performing a second encoding operation using the L transformed bits as an input, the second encoding operation including an accumulation operation in which the L transformed bits generated by the first encoding operation are accumulated, said second encoding operation producing at least a portion of a codeword,

wherein L is two or more.

2. The method of claim 1, further comprising:

outputting the codeword, wherein the codeword comprises parity bits.

3. The method of claim 2, wherein outputting the codeword comprises:

outputting the parity bits; and

outputting at least some of the information bits.

4. The method of claim 3, wherein outputting the codeword comprises:

outputting the parity bits following the information bits.

5. The method of claim 2, wherein performing the first encoding operation comprises transforming the at least some of the information bits via a low density generator matrix transformation.

6. The method of claim 5, wherein generating each of the L transformed bits comprises mod-2 or exclusive-OR summing of bits in a subset of the information bits.

7. The method of claim 6, wherein each of the subsets of the information bits includes a same number of the information bits.

8. The method of claim 6, wherein at least two of the information bits appear in three subsets of the information bits.

9. The method of claim 6, wherein a number of subsets in which the information bits appear is irregular.

10. The method of claim 2, wherein performing the second encoding operation comprises using a first of the parity

bits in the accumulation operation to produce a second of the parity bits.

11. The method of claim 10, wherein outputting the codeword comprises outputting the second of the parity bits immediately following the first of the parity bits.

12. The method of claim 2, wherein performing the second encoding operation comprises performing one of a mod-2 addition and an exclusive-OR operation.

13. A method of encoding a signal, comprising:

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

performing an encoding operation using the information bits as an input, the encoding operation including an accumulation of mod-2 or exclusive-OR sums of bits in subsets of the information bits, the encoding operation generating at least a portion of a codeword.

14. The method of claim 13, further comprising:

outputting the codeword, wherein the codeword comprises parity bits.

15. The method of claim 14, wherein outputting the codeword comprises:

outputting the parity bits; and

outputting at least some of the information bits.

16. The method of claim 15, wherein the parity bits follow the information bits in the codeword.

17. The method of claim 13, wherein each of the subsets of the information bits includes a constant number of the information bits.

18. The method of claim 13, wherein at least two of the information bits appear in three subsets of the information bits.

19. The method of claim 13, wherein performing the encoding operation comprises:

mod-2 or exclusive-OR adding a first subset of information bits in the collection to yield a first sum;

mod-2 or exclusive-OR adding a second subset of information bits in the collection and the first sum to yield a second sum.

20. The method of claim 13, wherein performing the encoding operation further comprises:

performing one of the mod-2 addition and the exclusive-OR summing of the bits in the subsets.

21. The method of claim 13, wherein a number of subsets in which the information bits appear is irregular.

22. A method comprising:

receiving a collection of information bits;

mod-2 or exclusive-OR adding a first subset of information bits in the collection to yield a first parity bit;

mod-2 or exclusive-OR adding a second subset of information bits in the collection and the first parity bit to yield a second parity bit; and

outputting a codeword that includes the first parity bit and the second parity bit.

23. The method of claim 22, wherein:

the method further comprises mod-2 or exclusive-OR adding additional subsets of information bits in the collection and parity bits to yield additional parity bits; and

a number of subsets in which the information bits in the collection appear is irregular.

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.

1/5

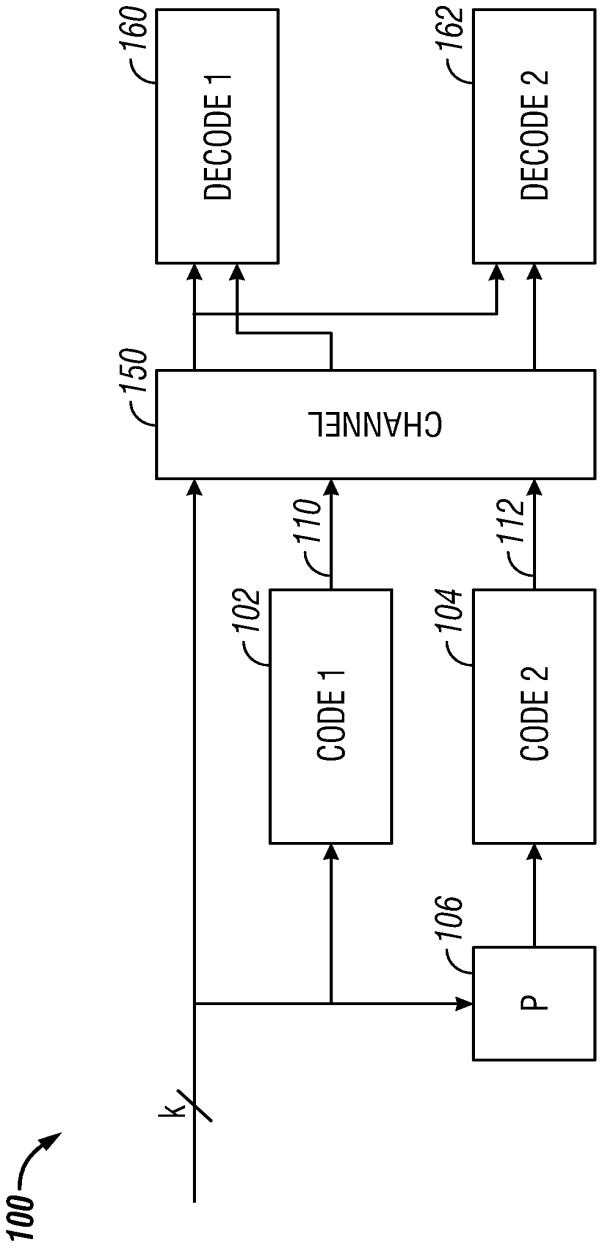


FIG. 1
(Prior Art)

2/5

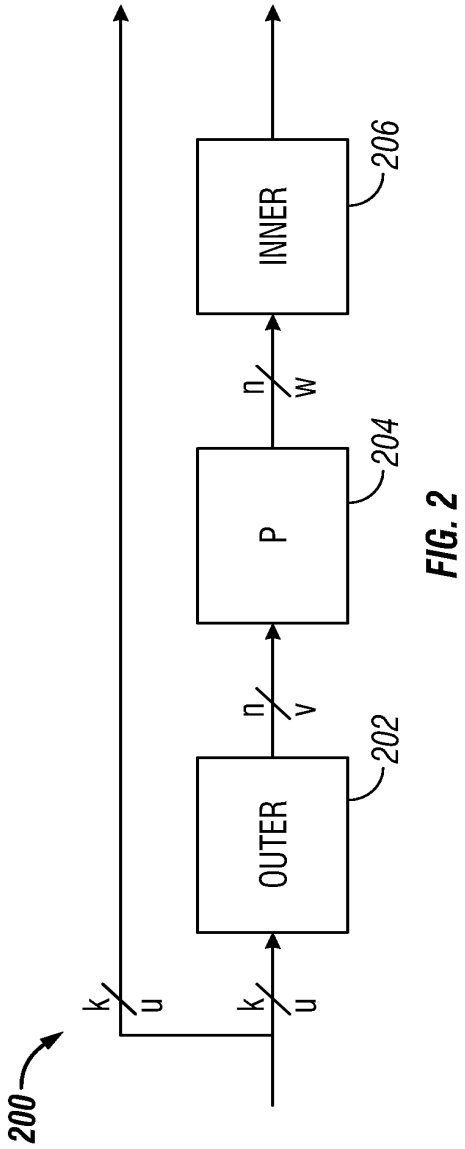


FIG. 2

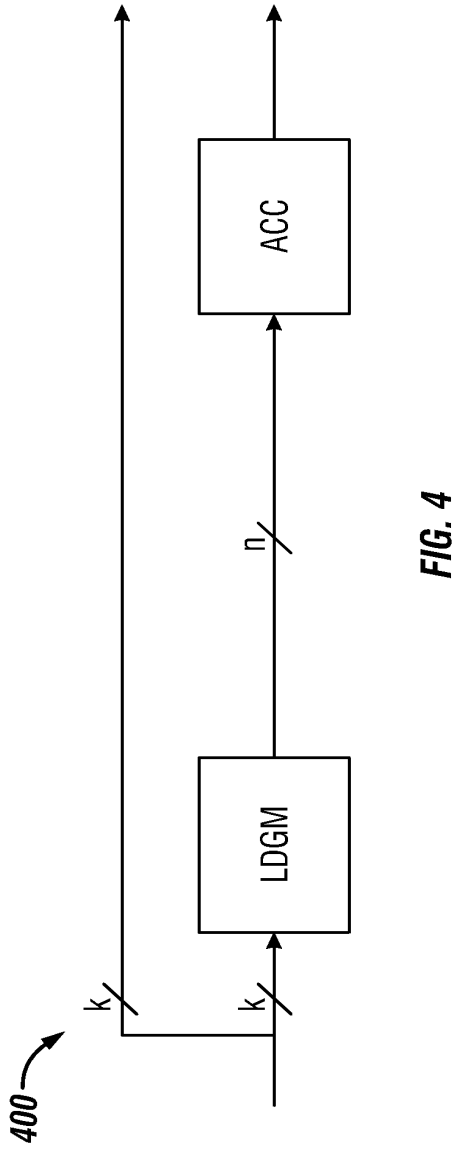


FIG. 4

3/5

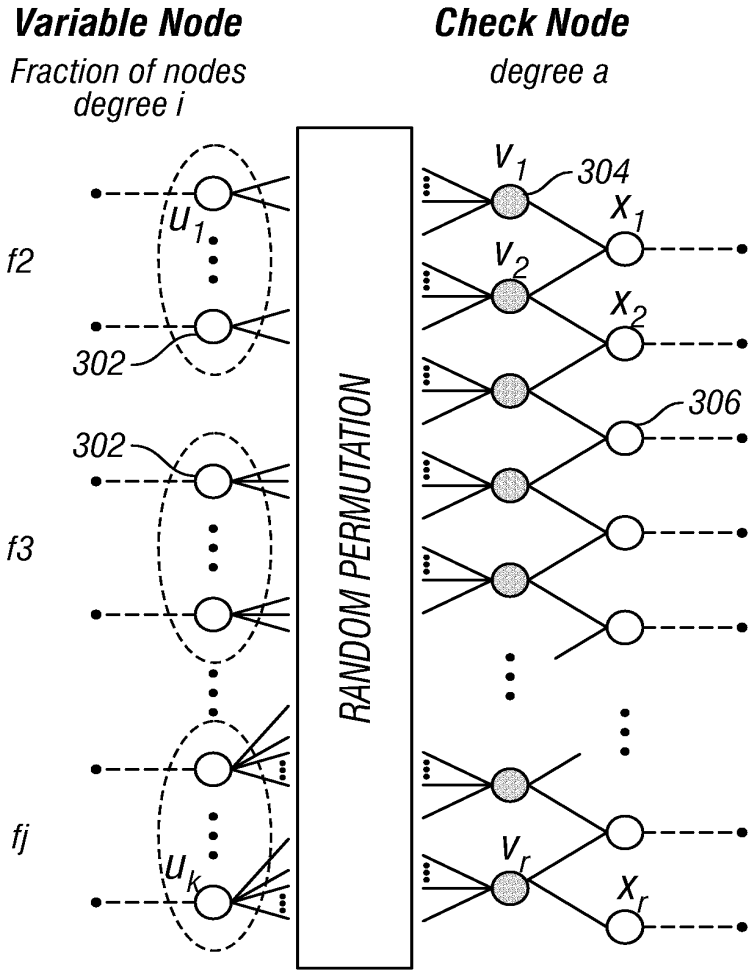

Variable Node
Fraction of nodes
degree i
Check Node
degree a
f2
f3
fj
302
302
304
306
RANDOM PERMUTATION

FIG. 3

4/5

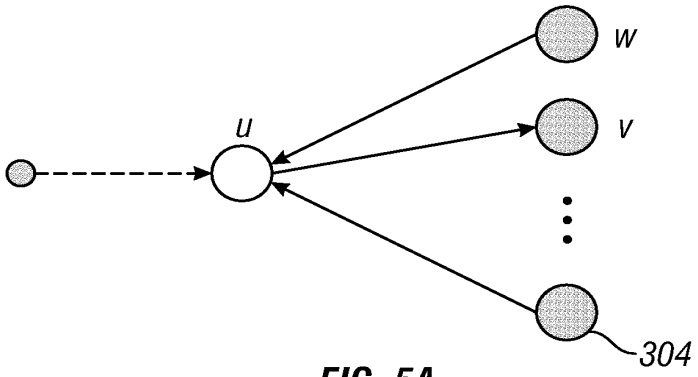


FIG. 5A

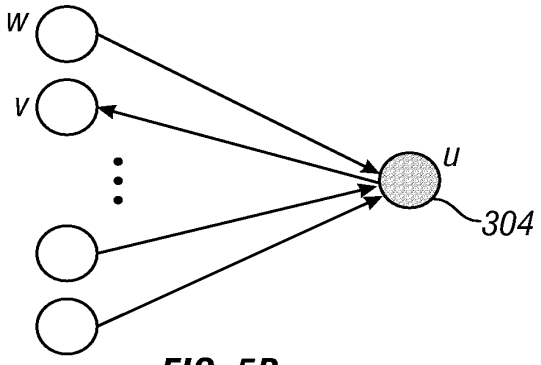


FIG. 5B

5/5

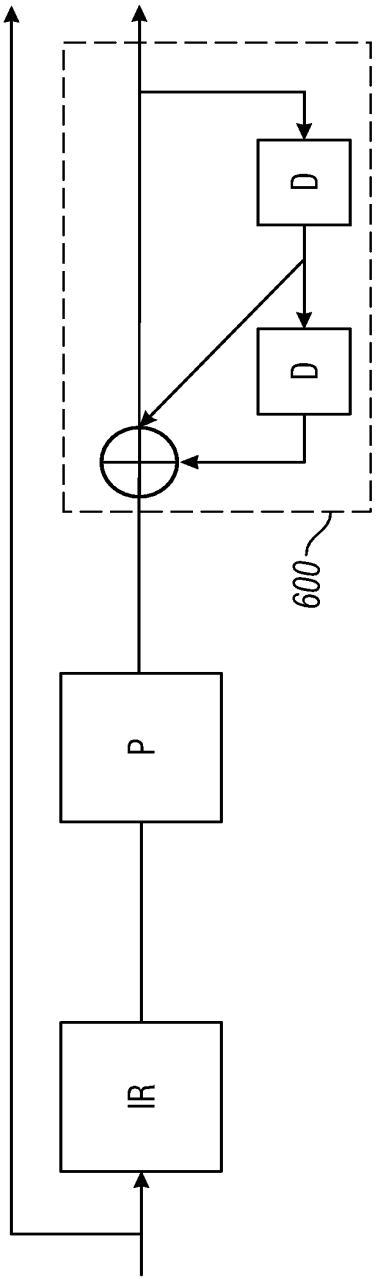


FIG. 6

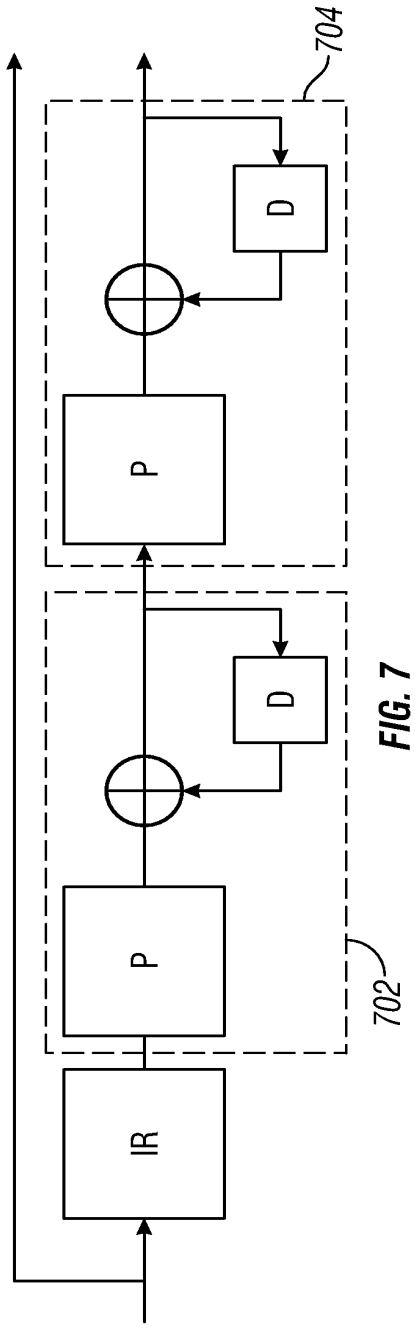


FIG. 7

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

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: 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: _____

10127692.doc

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: 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: _____
_____

10127692.doc

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: _____
_____

10127692.doc

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
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:	06618-637003/3220-C-C
Filed as Small Entity	

Utility Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility filing Fee (Electronic filing)	4011	1	75	75
Utility Search Fee	2111	1	255	255
Utility Examination Fee	2311	1	105	105
Pages:				
Claims:				
Claims in excess of 20	2202	3	25	75
Miscellaneous-Filing:				
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**510**

Electronic Acknowledgement Receipt	
EFS ID:	3546390
Application Number:	12165606
International Application Number:	
Confirmation Number:	2149
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/Kelly Smith
Filer Authorized By:	John F. Conroy
Attorney Docket Number:	06618-637003/3220-C-C
Receipt Date:	30-JUN-2008
Filing Date:	
Time Stamp:	22:35:38
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$510
RAM confirmation Number	6289
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	Transmittal of New Application	06618-637003_Transmittal.pdf	57783 10a1f2225a92a20a598dae22ac834081da05b2ac	no	2
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Filed	06618-637003_IDS.pdf	67807 4de8b34057c7778ddd1d9f91233c919e0d980993	no	3
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
3		06618-637003_Specification.pdf	88985 91b6b1bc16364ce6debc518aa7cd9824a2b3900c	yes	23
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Specification		1	17	
	Claims		18	22	
	Abstract		23	23	
Warnings:					
Information:					
4	Drawings-only black and white line drawings	06618-637003_Drawings.pdf	250345 15bfbc8c4b49e7b22b2008423e261ba7ba492fe1	no	5
Warnings:					
Information:					
5	Oath or Declaration filed	06618-637003_Declaration.pdf	159322 cf876fe9428d4fd8a4e33021d64dd11cf53f8ded	no	4
Warnings:					
Information:					
6	Fee Worksheet (PTO-06)	fee-info.pdf	8529 9327e57c9a77b7eea99b7ce1c99f4fca780d4556	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	632771		

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/06 (12-04)

Filing Date: 06/30/08

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

12/165,606

APPLICATION 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), (b), or (c))	N/A	N/A	N/A	75		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	255		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	105		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	23 minus20 =	* 3	X$ 25	75	OR	X$50	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	* 0	X$105	0		X$210	
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR		130			260	
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))			185			370	
			TOTAL	510		TOTAL	0

* If the difference in column 1 is less than zero, enter "0" in column 2.

APPLICATION AS AMENDED – PART II

AMENDMENT A

	(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(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					N/A		OR	N/A	
					TOTAL ADD'T FEE		OR	TOTAL ADD'T FEE	

AMENDMENT B

	(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(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					N/A		OR	N/A	
					TOTAL ADD'T FEE		OR	TOTAL ADD'T 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.