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//*****//
//
//      IRA.h
//      Head file for IRA
//*****//
//
//  Author:   Hui Jin
//  Modification:   Mar 10, 2000 First version
//  This file defines the class of Irregular Repeat Accumulate code.
//  the code essentially is a concatenate of LDGM code and Accumulate
code.

#ifndef _IRA_H
#define _IRA_H

#include <iostream.h>
#include <stdlib.h>

#include "ldpc.h"
#include "node.h"
#include "random.hh"

class IRAcode
{
private:
    RandomGenerator *Rand;    //random generator, used to simulate
noise.

    int    infobits_len;      //length of information
bits
    int    codebits_len;     //length of code bits
    int    checkbits_len;    //length of check bits
    double rate;             //related by rate of this
code.

    int    LEdge_num;        //edges number on the left. LDGM
part.
    int    REdge_num;        //edges number on the right, Acc.
part.

    int    *Interleaver;     // the permutation of LDGM code. Length
is
                                // LEdge_num.
    double *y_r;             //received codebits. Length codebits_len.
    double sigma;           //sigma, noise standard deviation, channel.

    degree_sequence *pLV;    //LDGM variable degree profile.
    degree_sequence *pLC;    //LDGM check degree profile.

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// passed by calling function.

double * LMessage; // the message updated between left
// variable and check nodes.
// Length should be LEdge_num.
double * RMessage; // The message update between check
nodes and // variable nodes on right.

int * Lbelief; //the belief from left variables, through
edges.
int * Rbelief; //the belief from right variables, through
edges.

var_node *RVarNode; //for LDPC codes, only L exists.
var_node *LVarNode;
check_node * CheckNode; //check nodes.

void getYrAWGN();

//initialize Left variable nodes.
void initLVNode(int nv[]);
//initialize right variable nodes.
void initRVNode();

//initialize check nodes.
void initCNode();
void initMessage();
void initM0();

//debug function.

public:
IRAcoder() { }
IRAcoder(int info_len, int check_len, int _LEdgenum, int nv[],
degree_sequence * _pLV, degree_sequence * _pLC, \
double _sigma, RandomGenerator *_Rand, int *_Interleaver);

~IRAcoder() {
delete [] LMessage;
delete [] RMessage;
delete [] Lbelief;
delete [] Rbelief;
delete [] RVarNode;
delete [] LVarNode;
}

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        delete [] CheckNode;
        delete [] Interleaver;
        delete [] y_r;
    }

    void update_message();//update message by message passing.

    int  wrong_bits();    // total wrong bits after belief
propagation is stoped.
    bool state_check(); //1 if every parity check is satisfied.
                        //0 otherwise
    void iteration(int num);    // do message passing in num
iterations.
    int  smartIteration();    // do iterations in a smart way.

//debug function.
    void displayConnection();
    void displayMessage();
};

/*
this function gets the received sequence after AWGN channel. Given
sigma, and
assuming all zero is transmitted.
*/

inline void IRAcode::getYrAWGN() {
    int codeseq[codebits_len];
    for(int i=0; i<codebits_len; i++)
        codeseq[i]=0;

    Rand->binAWGNchannel(codeseq, codebits_len, sigma, y_r);
}

/*
This function initializes all the message to zero.
*/

inline void IRAcode::initMessage()
{
    int i;
    for(i=0; i<LEdge_num; i++)
    {
        LMessage[i]=0;
        Lbelief[i]=1;
    }
    for(i=0; i<REdge_num; i++)
    {

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        RMessage[i]=0;
        Rbelief[i]=1;
    }
}

/*
this function displays the connection between nodes.
*/

inline void IRAcode::displayConnection()
{
    int i;
    for(i=0; i<infobits_len; i++)
        LVarNode[i].display_edgeid();
    for(i=0; i<checkbits_len; i++)
    {
        RVarNode[i].display_edgeid();
        CheckNode[i].display_edgeid();
    }
}

/*
this function displays the message on all edges.
*/
inline void IRAcode::displayMessage()
{
    int i;
    for(i=0; i<LEdge_num; i++)
        cout << i << " " << LMessage[i] << " " << endl;
    for(i=0; i<REdge_num; i++)
        cout << i << " " << RMessage[i] << " " << endl;
}

#endif _IRA_H

```

