SAINT PETERSBURG STATE UNIVERSITY

2014 INTERNATIONAL CONFERENCE ON COMPUTER TECHNOLOGIES IN PHYSICAL AND ENGINEERING APPLICATIONS

ICCTPEA

IVESC-ICEE-ICCTPEA-BDO-2014

RUSSIA, SAINT-PETERSBURG,
JUNE 30 — JULY 4, 2014

Proceedings
Edited by: E. I. Veremey

ISBN 978-1-4799-5316-5
IEEE Catalog number CFP14BDA-USB

Computer Model for Research of Decoders for Error-Correction Codes

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***Abstract*—It's described computer model for research of decoders for error-correction codes (turbo, low-density parity-check, self-orthogonal, short convolutional and others codes). The model allows evaluate bit and block error rate versus signal to noise ratio performance of decoders and estimate decoding rate. Simulation results are presented in convenient to analysis form.**

Researching of data transmission systems is significantly complicated by almost complete absence of available software products allowing to implement comprehensive analysis of such systems. Existing tools (Matlab etc.) are expensive or difficult to master. This forces the developers of data transmission equipment to create their own tools for modeling such systems. Obviously, this approach has a number of significant drawbacks; the main one is significant time for simulation program development. Therefore an extremely urgent task is developing public tools for modeling data transmissions systems.

Experts engaged in the development of digital data networks need software tools under development and they will give an opportunity to implement different decoder for error-correcting codes in the developed systems. This enables a proper design of new communication systems, taking into account the required characteristics.

Basic requirements for the projected software tools:

- Holding simulation data transmission system comprising a data source, an encoder, a modulator, a communication channel, a demodulator, a decoder and a data receiver;
- ability to configure system components;
- ability to connect dynamically the components of a data transmission system;
- obtaining statistics of modeling;
- the simulation results representation in an easy form for further analysis of both texts and graphics.

Let's outline some features of development. A programming language C# was chosen, because it realizes the ideas in their best way of object-oriented programming of all languages supported platform. NET. This language has a number of features and benefits, which considerably simplify the implementation of many decisions that take place in this project compared to other programming languages.

Provided development features the ability to connect dynamically system components data that will eventually increase the number and variety of efficient coding techniques available for study, with no necessity to introduce changes in the developed tools. Therefore in the process under development there was a question selection by which means the components are connected dynamically to be a data transmission system implemented as a class library (*. Dll).

The structure of the developed software tools, based on the analysis of the requirements specified above, is shown in Figure 1.

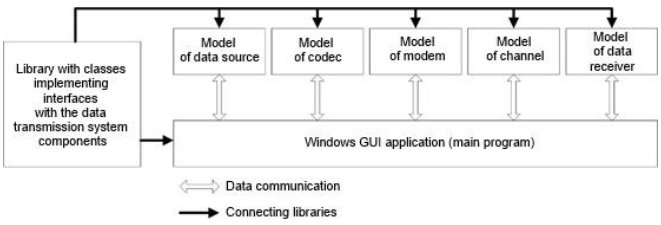

Figure 1. Structure of software tools

Each of these libraries should contain a specific component class, inherited from the corresponding interface. Thus, in each such class there will be implemented a set of a certain characteristic of the component functions which provide chat interaction with the main program.

As a part of the development of software tools for modeling, it was decided to develop the following components of the data:

- The data source generates a random bit block content consisting of zeros and ones and having a given length;
- Codec for extended Hamming code with the ability to select the type of code and use soft decisions when decoding [1];
- Codec for convolutional code with Viterbi decoding with the ability to determine the generator polynomials, the decoding depth and the block length;
- Codec for self-orthogonal codes with threshold decoding;
- Modem with binary phase modulation;
- The channel with additive white Gaussian noise (AWGN);
- Data receiver which allows to set as its parameters:

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- The maximum number of transmitted bits;
- The maximum amount of transmission blocks;
- The maximum number of error bits;
- The maximum number of erroneous blocks;

A set of these components can be easily extended without changing the already developed software.

Simulation data transmission systems with those developed codecs are unlikely to be useful in real practical problems, as implemented codecs have a weak correction capability compared with other methods of encoding / decoding. Nevertheless, these codecs may be useful in training. In nearest future list of codecs will be increased by effective codecs such as codec for low-density parity-check, codec for turbo-codes, multithreshold decoder for self-orthogonal codes etc. A flexible structure configuration and application settings open up interesting prospects for mass use of application.

REFERENCES

[1] *Zolotarev V.V., Ovechkin G.V.* Error-correction coding. Methods and algorithms. directory. – Moscow, Hotline - Telecom, 2004 – 126 page.