2.1. Номер проекта
05-07-90024

2.2. Руководитель проекта
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2.3. Название проекта
The developing of methods for increasing reliability of data transmission in telecommunication systems

2.4. Год представления отчета
2008

2.5. Вид отчета
итоговый (2005-2007)

2.6. annotation

The project implementation covered the research into the effectiveness of the multi-threshold decoder (MTD) application for channels with an additive white Gaussian noise (AWGN). The research has shown that with the help of the MTD it is possible to get a coding gain of up to $8 \div 10$ dB and more with the implementation complexity tens times lower than in other error correction methods comparable in their efficiency. Also, the error propagation effect in linear codes has been analyzed. It has been shown that to reduce error propagation it is necessary to choose codes having a small number of the same errors included in checks concerning different information symbols. A new technique for the construction of such codes has been suggested and realized in the software form. The results of the analysis allow to further raise the coding efficiency in channels with higher rates of noise.

A technique of MTD application in non-equal energy channels has been developed. It has been shown that with the help of the redistribution of energy between information and check bits it is possible to approach the area of MTD efficiency to the channel capacity by approximately 0,5 dB and more. Research has been conducted into MTD application efficiency in channels with erasures and in channels with errors and erasures. It has been shown that in these conditions MTD demonstrates a high erasure correction performance.

A technique of MTD application together with multi-positional modulation (M-ary PSK and QAM) has been developed. Also a technique of MTD efficiency improvement in such conditions is considered. It has been shown that the application of the given technique allows to approach the area of MTD effective work to the channel capacity by more than 0,7 dB.

The development of the non-binary MTD has been implemented showing that the non-binary MTD can provide a better symbol error rate than the Reed-Solomon code decoder with ~10000 and much less complexity. The non-binary MTD can be used in organizing storages of very large special-, audio- and video data bases.

The technique of using MTD for concatenated codes has been developed. Concatenated codes consisting of MTD and Hamming or Viterbi codec were suggested. It has been shown that these concatenated codes improve the bit error rate performance by hundreds of times.

A new way of self-orthogonal code decoding is suggested. This method is based on the decoding of the block received from the channel with several MTDs. The application of this method has allowed to approach the area of effective work of the MTD for simple codes to the channel capacity by approximately 0,2 dB.

The simulator of digital communication system has been developed that

allows to perform comprehensive investigation of the best error-correction methods. A demo test bench has been developed completed with the digital satellite channel simulator to study the characteristics of the transmission-receiving equipment.

In the Space Research Institute of the Russian Academy of Sciences the MTD for convolutional code is implemented at PLIS Altera. The decoder supports decoding with the rate of up to 1,6 Gbit/s at Eb/N0 near 1,7 dB. This decoder can be used for Earth Remote Observation. Foreign analogues of similar speed and efficiency are not known.

A specialized website of the Space Research Institute of the Russian Academy of Sciences has been developed: www.mtdbest.iki.rssi.ru showing the main results of the research into the MTD development. The website is accessible in 53 countries; up to 4 Gbytes of data is annually downloaded from the website.

2.7. *Полное название организации, где выполняется проект*
Space Research Institute of the RAS