Channel Adapted Decoding Algorithms for Correction Modular Errors and Erasures in Communication System

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In modern communication systems widely used wireless channels, including satellite. The quality of these channels, and accordingly the type and errors frequency, greatly depends on the transmission conditions. All this eventually leads to a need for using adaptive encoding/decoding alghoritms that can adjust to changes in real time.

It is offer a modification of belief propagation (sum-product) decoding algorithm for parallel-concatenated low-density parity-check (LDPC) codes for effective correction of modular errors and erasures in the transferring binary messages. The main advantages of the proposed technical solution are increasing a decoding speed, reducing the number of decoding iterations and reducing decoding process errors [1]. The result is achieved by parallelization of the decoding process and nonlinear mutual correction a posteriori log-likelihood ratio of the codeword bits in LDPC decoders. Simulation modelling was performed with codes having code rate of 1/2 and minimum distance of the code equal 10. The results confirmed that using developed parallel-concatenated belief propagation decoding algorithm leads to increasing system performance and reduce the erroneous decoding probability in comparison with known single and parallel-concatenated prior decoding algorithms.

Another area of application of such algorithms are an adaptive noise proof multimode codec. It based on the three-dimensional iterative codes and multithreshold decoding (MTD) algorithm. Adaptive MTD algorithm provides practically optimum decoding time through dynamically modifying iterative code parameters [2]. Code parameters selection and codec restructuring occurs based on the calculated channel quality characteristics. Dynamically switching allow to use «fast» codes and thereby the data transfer rate is increasing. It is possible to use several different codes (codeword size, code rate, parity check matrix density and etc.) for one transmitted sequence. Algorithm includes automatically determination the number of error bits, which in turn allows to determine the quality of the channel by the bit error ratio in the mode without channel disconnection.

Software tools for generation and research low-density parity-check and iterative codes were created [3]. It allows to generate random, quasi-cyclic with random arrangement and quasi-cyclic codes with a structured arrangement of submatrices, parallel-concatenated LDPC codes and fountain code series: LT, LTM and P-codes. It helps to investigation decoding performance and error-correcting capability of aforementioned codes. Tools performs simulation packet messages with the predetermined number of erasures and modular errors and statistics collection.

References

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