INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

The binary low-density parity-check (LDPC) codes of short-to-medium lengths usually suffer from the error floor problem while decoded by an iterative algorithm. This problem is largely due to certain kinds of subgraphs known as the trapping sets present in the Tanner graph of the code. In addition to the good error floor behavior, the codes should preferablyexhibit rate-compatibility. Puncturing is a popular technique to realize rate-compatible codes. The non-binary LDPC codes are more flexible and robust in the context of puncturing than their binary equivalents. The thesis primarily deals with two broad problems related to the LDPC codes: (1) to study the various aspects of trapping sets in the case of binary LDPC codes and identify them, (2) to designan optimum puncturing pattern to achieve rate-compatibility in the case of non-binary LDPC codes.

The identification of the dominant trapping sets of a binary LDPC code is an important task. The knowledge of these dominant trapping sets helps to design a robust coding system. A technique is proposed to find the dominant trapping sets in irregular LDPCcodes. The proposed technique is based on the hierarchical approach where a smaller trapping set known as the predecessor is progressively expanded to obtain larger successor trapping sets. The technique considers six types of predecessors to find the trapping sets of a particular class.

The dominant trapping sets generally contain one or more short cycles. The extrinsic message degree (EMD) of a cycle in the Tanner graph measures the connectivity of the cycle. As it is difficult to calculate the EMD, the approximate cycle EMD (ACE) is generally used as a simpler alternative. The ACE of a cycle, however, is not equal to its EMD when the cycle contains sub-cycles. We investigate the possibility of the formation of any sub-cycle within a cycle for the ACE spectrum constrained LDPC codes. This investigation leads to the derivation of three sufficient conditions for the equality of the ACE and the EMD of a cycle.

The non-binary LDPC codes are suitable for rate-compatible puncturing. They provide one extra degree of freedom: a codeword symbol may be punctured bitwise or symbolwise. An extrinsic information transfer (EXIT) chart tool for the puncturing of the non-binary LDPC codes is formulated. With the help of this tool, the thresholds for various bitwise and symbolwise puncturing patterns can be found out. The grouping algorithm is a useful technique tofind the recoverable variable nodes in the Tanner graph of the short-length codes. A method is devised to find the optimum recoverable puncturing pattern by the joint use of the EXIT chart model and the grouping algorithm.