ABSTRACT

A distinctive faculty with which humans are gifted is ‘communication’ – passing information from a source to a destination over a medium. The medium may technically be called ‘channel’. The long-standing issue is to achieve efficient and reliable communication over an unreliable channel. For efficient communication, we use ‘source codes’ which provide a compressed representation of the information. Reliability is obtained by using ‘channel codes’ which protect information from corruptions by adding structured redundancy into it.

Communication is always over a channel and the channel, as mentioned above is invariably subjected to disturbances or noise. To minimize the effects of noise, coding is essential. Joint source channel coding (JSCC) is considered as the most promising scheme for communication over wireless channels, in view of its ability to cope with varying channel quantities. The direct source-channel mapping scheme is a good candidate for joint source channel coding. This thesis discusses two types of direct source channel mapped JSCC - Variable Length Error-correcting Codes (VLECs) and Reversible Variable Length Codes (RVLCs).

The combinatorial results are important and these provide limitations on search of a code. We have derived an improved combinatorial bound on average codeword length of a subclass of VLECs. Further, we have considered constant length error correcting codes, available in literature, and developed an algorithm to generate VLECs which can be used in real-time applications. Code construction is incomplete without a decoding algorithm. To reduce the complexity of the decoding algorithm, we have developed a modified method of “Maximum Likelihood VLEC Decoding” which converts exponential search into a tabular search, and thereby reduces the computation time.
Further in practice, due to the variable length, a source code may face synchronization loss in a noisy environment. To overcome this problem, error resilient codes- RVLCs, which can be decoded in both forward and backward directions, are studied. RVLCs have been receiving extensive attention fairly recently, especially in H.263++ and MPEG-4 video coding standards. These video coding standards are equipped with excellent error resilient capabilities as they use RVLC in place of a source code (Huffman code). This thesis also examines a scope of improvement in H.263++ video coding standard. The improved results obtained through MATLAB simulation and analysis show a reduction in the number of total encoding bits; maximum codeword length and average codeword length for a multimedia file encoded using Yan RVLCs instead of Golomb and Rice RVLCs, while maintaining the same perceptual quality.

In this thesis, the performance of image compression is also evaluated for three different entropy encoders: Huffman, RVLCs and VLECs. For communication over noisy channels, although the performance of RVLCs is better than Huffman codes, still some information is lost during the decoding process. We demonstrate the use of VLECs which provide a complete decoding of received messages. We show that better performance of image compression is obtained with the use of VLECs as compared to RVLCs or Huffman codes. Further research may be undertaken by replacing Huffman codes with VLECs in multimedia applications, such as video coding, speech coding and audio coding in order to achieve improved performance.