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Achievable Error Exponents for Channel with Side Information – Erasure and List Decoding

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Abstract

We consider a decoder with an erasure option and a variable size list decoder for channels with non-casual side information at the transmitter. First, universally achievable error exponents are offered for decoding with an erasure option using a parameterized decoder in the spirit of Csiszár and Körner's decoder. Then, the proposed decoding rule is generalized by extending the range of its parameters to allow variable size list decoding. This extension gives a unified treatment for erasure/list decoding. Exponential bounds on the probability of list error and the average number of incorrect messages on the list are given. Relations to Forney's and Csiszár and Körner's decoders for discrete memoryless channel are discussed. These results are obtained by exploring a random binning code with conditionally constant composition codewords proposed by Moulin and Wang, but with a different decoding rule.

1 Introduction

A decoder with an erasure option is a decoder which has the option of not deciding, i.e., to declare an "erasure". On the other hand, a variable size list decoder is a decoder which produces a list of estimates for the correct message rather than a single estimate, where a list error occurs when the correct message is not on the list. In [1], Forney explored the random coding error exponents of erasure/list decoding for discrete memoryless channels (DMC's). These bounds were obtained by analyzing the optimal decoding rule [1, eq. (11)]

$$\boldsymbol{y} \in \mathcal{R}_m \text{ iff } \Pr(\boldsymbol{y}, \boldsymbol{x}_m) \geq e^{NT} \sum_{m' \neq m} \Pr(\boldsymbol{y}, \boldsymbol{x}_{m'}) \tag{1}$$