Polar Codes for the Binary Coded Side-Information Problem

Objective.

Polar codes, introduced by Arıkan in [1], have been demonstrated to achieve the capacity of any binary-input memoryless output-symmetric channel with encoding and decoding complexity \( \Theta(N \log N) \) and error probability decaying roughly as \( 2^{-\sqrt{N}} \), where \( N \) is the block length of the code. Since then, the original point-to-point communication scheme has been extended to several multi-terminal scenarios (e.g., the Gelfand-Pinsker, Wyner-Ziv, and Slepian-Wolf problems, the multiple-access channel, the interference channel, the relay channel, and the broadcast channel, just to name some), in order to provide low-complexity coding schemes capable of matching the information theoretic bounds.

A practical solution for the problem of binary source coding with coded side-information which employs LDPC codes and a trellis quantizer has been developed in [2]. The aim of this project is to develop a polar coding scheme suited for this problem. First, one would start from the study of the binary case, for which a closed-form expression of the achievable rate region is known. Then, it would be interesting to implement such a polar scheme and see how it compares to the scheme in [2] based on LDPC codes and, in general, to the state of the art. Finally, the description of a general polar scheme for the non-binary case can be considered.

Prerequisites.

The student is required to have a good knowledge of information theory and coding. No prior knowledge of polar codes is required. Programming skills are also appreciated.

Supervisors.

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References.