Design and Analysis of Communication Schemes via Polar Coding

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A fundamental problem in communication theory is \textit{channel coding problem} [Shannon ’48].

The question of how to construct practical coding schemes with low complexity decoders is not answered in Shannon’s work.

The invention of polar codes [Arıkan ’08] made it possible to

1. achieve the \textit{symmetric capacity} of all binary-input memoryless channels. They achieve the capacity of several channel classes of practical importance such as the \textit{binary-input additive white Gaussian noise channel}, the \textit{binary symmetric channel}, and the \textit{binary erasure channel}.

2. have low complexity. It is shown in [Arıkan ’08] the complexity of both the encoder and decoder is $O(N \log N)$.

3. have a block error probability of roughly $O(2^{-\sqrt{N}})$. 
Interactive Function Computation

- We show that the rate region of the function computation problem for two-terminal network and multiterminal collocated network can be achieved using polar codes.

Two-terminal network

Multiterminal collocated network
We prove that the capacity of wiretap channel is achievable via polar coding.

We also show that the rate region of broadcast channel with confidential messages is achievable using polar codes.