

Master thesis project:

Efficient source polar coding design

Arikan introduced polar coding in 2008 for binary input channels [1]. It has been shown that they can achieve the capacity of binary channels with complexity $\mathcal{O}(n \log n)$ and vanishing error probability with block length n . Since then the polar coding theory has been extended in many directions, including lossless and lossy source coding [2,3] as well as taking security into account [4,5]. However, only recently very efficient algorithmic implementations of polar codes have been studied [6]. Therefore, the main objective of this project is to investigate practical implementation of secure polar codes which are complexity efficient and perform well. The project is more of research nature and therefore requires a good analytic capability to be able to read and identify interesting algorithmic approaches from the literature. Although the performance guarantees of polar codes are built on information theoretic arguments, the concepts can be easily understood with limited information theoretic background which can be easily obtained. Simulative experiments should be performed to test, compare, and assess various algorithmic solutions with respect to their performance and complexity. Therefore, sufficient programming skills (e.g. using Matlab) are necessary. If you are interested, please do not hesitate to contact me.

Requirements: The project requires strong analytical skills and a sufficiently good programming competence (e.g. in Matlab).

REFERENCES:

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- [2] E. Arikan, "Source polarization," in *Proc. of the IEEE International Symposium on Information Theory*, Austin, Texas, June 2010, pp. 899–903.
- [3] S. B. Korada and R. Urbanke, "Polar codes are optimal for lossy source coding," *IEEE Trans. on Information Theory*, vol. 56, no. 4, pp. 1751–1768, April 2010.
- [4] M. Andersson, V. Rathi, R. Thobaben, J. Kliewer and M. Skoglund, "Nested polar codes for wiretap and relay channels", *IEEE Commun. Lett.*, 2010
- [5] M. Andersson, R. F. Schaefer, T. J. Oechtering, and M. Skoglund, "Polar Coding for Bidirectional Broadcast Channels with Common and Confidential Messages," *IEEE Journal on Selected Areas in Communications*, September 2013.
- [6] I. Tal and A. Vardy, "How to Construct Polar Codes," talk given in *Information Theory Workshop*, Dublin, Aug. 2010. (also available on arxiv)

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