PhD position in digital communications

Analysis and design of Polar Codes constructions

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Description: Polar Codes is a new family of codes recently introduced in the seminal paper by Erikan [1]. They are the first provably capacity-achieving family of codes for binary-input symmetric channels. Moreover, they can be decoded using a low-complexity belief propagation or successive cancellation algorithm.

The principle of polar codes is the following: let \( G_2 = \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix} \) be a 2×2 matrix and consider the \( n \times n \) matrix \( G \) being the \( n^{th} \) Kronecker product of \( G_2 \). Matrix \( G \) is applied to a block of \( N=2^n \) bits and the output is transmitted over independent copies of a binary-input symmetric channel. In [1] it was shown that the channels seen by individual bits polarize, in the sense that they approach either a noiseless channel or a pure-noise channel, where the fraction of noiseless channels approaches the symmetric mutual information as \( n \) gets large. Therefore, this scheme achieves the capacity of the channel.

More recently, these codes have also been used in the context of source coding. In particular, in [2] it is shown that polar codes achieve the Shannon bound for lossless compression of a binary memoryless source, and the optimal rate for zero distortion in lossy source coding.

This Ph.D. Thesis is devoted to the analysis and design of new “Polar Code” coding structures for both channel and source coding. We are particularly interested in their extension to concatenated structures, e.g. turbo product or turbo polar code structures.


Requirements: Applicants must hold a Master of Science degree (or equivalent diploma) in telecommunications, electrical engineering, or computer science. A strong background in communications, information theory and coding theory is required.

Location: Electronics department of Telecom Bretagne, Brest, France.

Motivated candidates, please contact:

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