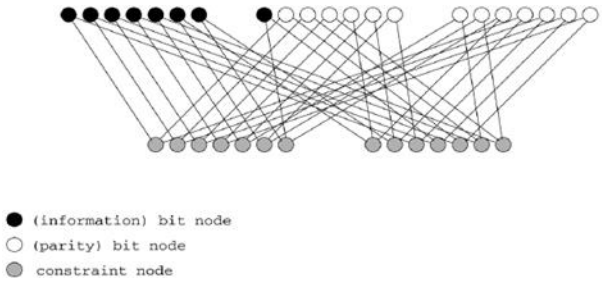
DTU Fotonik
Department of Photonics Engineering

MSc Thesis Project

Rate-adaptive Constellation Shaping for LDPC coded communications



Introduction: Constellation shaping is a well-established method for approaching the channel capacity in various scenarios, particularly in the additive white Gaussian noise (AWGN) channel, but also emerging in other applications, such as optical communications. It is the process of modifying the uniform distribution of user data to one, which is matched to the channel conditions. When these conditions are non-static, the transmission method, including the constellation shaping scheme, must be flexible enough to adapt to the channel. Such methods are referred to as rate adaptive schemes, and include among others the channel code and modulation format. Turbo codes are well known for being flexible in such scenarios, which is what made them so popular with wireless transmission [1]. However, their complexity and high error floor limit their application in other scenarios, such as the ultra-fast optical communications. Low density parity check convolutional codes (LDPC-CC) on the other hand are able to combine near-capacity performance with low-complexity decoding, and in recent years, they have also shown some potential for rate-adaptivity [2].

Contents: In this project the student will investigate the potential of combining low density parity check convolutional codes (LDPC-CC) with the constellation shaping scheme from [1]. In particular, suitable puncturing schemes will be investigated. Throughout the project work the student will be familiarized and obtain a working knowledge of turbo codes, LDPC codes and LDPC-CC, and general modulation methods, suitable for state of the art communication systems.

Prerequisites:

- General error-correcting coding, e.g. 01405, 34251
- Programming experience in Matlab and/or C
- General digital communications, e.g. 34230

Additional information:

- [1] M. Yankov et.al, "Rate-adaptive Constellation Shaping for Turbo-coded BICM", proc. International Conference on Communcations, pp. 2118-2123, 2014.
- [2] H. Zhou et. Al, "Robust Rate-Compatible Punctured LDPC Convolutional Codes", IEEE Transactions on Communications, vol.61, no.11, Nov. 2013.

Practical details: The project is intended for 1 or 2 students with 30 ECTS-points per student.

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