Karlsruhe Institute of Technology

Communications Engineering Lab (CEL)
Prof. Dr.-Ing. Laurent Schmalen
Prof. Dr.-Ing. Peter Rost

Code Design of Non-binary Parity-Check Codes

Master's Thesis

Project

Low-density parity-check (LDPC) codes are a prominent example of parity-check (PC) codes that are used in a large variety of applications. They were first proposed by Gallager together with a low-complexity message-passing decoder often called belief propagation (BP) decoder. LDPC codes with large block lengths can achieve low error rates and close to capacity performance. Yet, many low-latency communication systems, such as the internet of things, autonomous driving, or communicating control commands, require codes of short block lengths. For such codes, there is still a considerable gap between the performance of a BP decoder and the maximum likelihood (ML) decoder.

Recently, there has been active research to improve the decoding performance by using an automorphism ensemble decoder. Yet, the search for suitable automorphisms for decoding existing codes is challenging. Hence, different approaches investigate the design of linear codes with specifically designed automorphisms.

In this thesis, an algorithm to design non-binary as well as binary PC codes with suitable automorphisms should be developed and implemented. In addition, their performance should be evaluated and benchmarked with existing codes. Ideally, adaptions of the generalized AED considering the structure of the constructed codes should be proposed.

Tasks

1. Become acquainted with the automorphism ensemble decoder
2. Development of an algorithm to design non-binary channel codes
3. Implementation and performance evaluation

Requirements

- ✔ Good skills in at least one programming language (e.g. Python, C++)
- ✔ Good knowledge of linear algebra, channel coding

Institute

Communications Engineering Lab

Hertzstr. 16
Gebäude 06.45
76187 Karlsruhe
www.cel.kit.edu

Contact

Dr.-Ing.
Holger Jäkel

Room 102
holger.jaekel@kit.edu

M.Sc.
Jonathan Mandelbaum

Room 204
jonathan.mandelbaum@kit.edu