Karlsruhe Institute of Technology

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Soft-Decision Decoding for Modulation on Conjugate-Reciprocal Zeros (MOCZ)

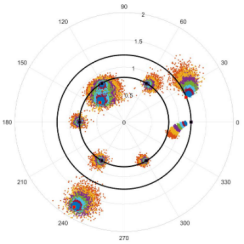
Bachelor's Thesis/Master's Thesis

Project

A relatively unexplored modulation technique called modulation on conjugate-reciprocal zeros (MOCZ) consists in transmitting information using the zeros of the z-transform of the TX signal. Proposed in 2019, this technique allows for non-coherent transmission, where neither the receiver nor the transmitter possess channel state information (CSI), and also no pilot-symbols are used. It was design for spontaneous short-burst transmission.

The mathematical concepts behind this format are easy to understand and already motivates a simple design of the constellations used. However, a complete analysis of this problem under AWGN transmission is still open, as well as the optimization of transmission for this channel.

In this work we propose a data-driven approach to MOCZ using machine learning. Fine-tuning the transmission parameters can be seen as an optimization problem to be solved using gradient descent, and more interestingly, perhaps a neural-network based soft detector could be trained for MOCZ under AWGN and other more complex channels.



Tasks

1. Familiarize themselves with the MOCZ modulation format.
2. Implement and test the already established transmission/detection algorithms in a machine-learning framework (PyTorch, TensorFlow, ...).
3. Make the implemented scheme trainable, replace the receiver by a neural-network.
4. Evaluate the techniques using bit-error-rate Montecarlo simulations.

Requirements

- ✔ Experience with a machine-learning framework.
- ✔ Interest in mathematics.
- ✔ Communications Engineering I/II.

Institute

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