Karlsruhe Institute of Technology

Communications Engineering Lab (CEL)
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Constellation Shaping for Modulation on Conjugate-Reciprocal Zeros (MOCZ)

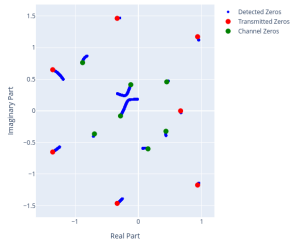
Bachelor's Thesis/Master's Thesis

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.

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.

Fine-tuning the constellation points can be seen as an optimization problem to be solved using gradient descent, where the sub-optimal detector architecture is taken into consideration when the constellation points are being optimized.



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. Familiarize themselves with the concepts of constellation shaping.
4. Finally evaluate the performance of the constellations with state-of-the-art forward error correction codes.

Requirements

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

Institute

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