

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

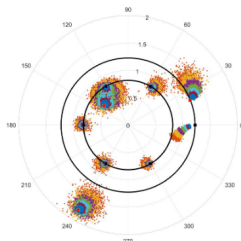
## Bachelor's Thesis/Master's Thesis

### 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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