

Design and Analysis of Novel Equalisation Concepts Based on Neural Networks

Master's Thesis

Project

After having revolutionised many fields in science and engineering, Machine Learning (ML) techniques have recently found their way into the physical layer of communication systems. "Classical" model-based algorithms had set the bar very high regarding performance and complexity, but new algorithms are necessary to meet the increasing bandwidth demands of future communication systems. One example is neural network (NN) based equalisation, where classical approaches are optimised with ML techniques or substituted by NNs.

Currently, we are working on an unsupervised, model-agnostic equaliser concept based on a generative adversarial network (GAN). Precisely, a generator network tries to equalise the received signal and a discriminator network compares the estimated sequence against a reference sequence which may not contain the same information. By optimising both networks in an adversarial manner, an equaliser can be learned without actual knowledge of the channel properties. In fact, this concept gives a lot of freedom and, hence, a lot of space for optimisation.

This thesis involves the design of appropriate generator and discriminator networks, the analysis of different GAN-"dialects" (Wasserstein-GAN, NS-GAN, etc.) as well as a thorough evaluation for different communication scenarios. Therefore, a communication system has to be modelled and implemented along with a flexible simulation environment.

Tasks

1. Designing and evaluating new architectures
2. Implementing a simulation platform
3. Optimising and analysing the concept in different scenarios

Requirements

- ✓ Experienced in programming (preferably Python, PyTorch)
- ✓ Good knowledge of machine learning and optimisation (MLOC)
- ✓ Knowledge of communication basics and equalisation (CE2/NT2, SigNT)

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