Karlsruher Institut für Technologie

Communications Engineering Lab (CEL)
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Neural Network Based Equalisation in the Presence of Non-ideal Neurons

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.

Commonly, NNs are run on CMOS-based hardware, but, for the specific requirements of real-time implementation in high-speed communication systems, other technologies might be better suited. While having advantages in terms of processing speed and energy efficiency, they differ in their implementation characteristics, which makes it necessary to optimise the algorithms accordingly.

These characteristics can be embedded into the design and learning process of the NNs, which is the goal of this thesis. This involves the modelling of non-ideal neurons and the analysis of their impact. Therefore, a simulation platform should be implemented, where the NN based equalisers can be optimised regarding these imperfections. Additionally, appropriate NN architectures should be designed and evaluated in the context of high-speed communications.

Deliverables

1. Modelling the implementation characteristics (e.g. non-ideal neurons)
2. Building up a simulation platform
3. Designing and evaluating appropriate equaliser structures

Requirements

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

Institute

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