MASTER'S THESIS

Topic:

Implementation of a Testbed for Future AI-based Wireless Communications

Motivation:

Generally, communication systems are designed in a component-wise approach, by dividing transmitter and receiver into individual blocks, each of which performing specific tasks, such as source coding, channel coding, modulation and waveform generation. However, this disjoint approach cannot guarantee to obtain the best possible performance. During the past years, Deep Learning (DL) based methods showed impressive capabilties in joinlty optimizing the communication systems for end-to-end performance.

The main purpose of this master's thesis is to build a testbed for end-to-end wireless communication systems, using off-the-shelf Software Defined Radios[1] (SDR[2]s). To this aim, the first step would be to model an end-to-end wireless communication mathematically, using the concept of autoencoder and removing block structure. The key idea of autoencoder-based communication systems is to represent the transmitter, channel, and receiver as a single Neural Network (NN), which is called autoencoder and aims to reproduce its input at its output. As the second step, the designed NN should be trained and then be evaluated by some synthetic data and assuming a stochastic channel model in Python. The model is then implemented on two available SDRs, one of which would be the transmitter side and the other would be the receiver side. Further fine tuning and retraining of the implemented model might need at this stage, since the real channel might have different behaviour compare to which the model has been trained for. Finally, the setup needs to be complemented with a graphical user interface by which one can evaluate the performance of the designed model for different transmit/receive parameters or retrain the model by new measurements in different environments. Figure 1 shows a schematic of this testbed setup.
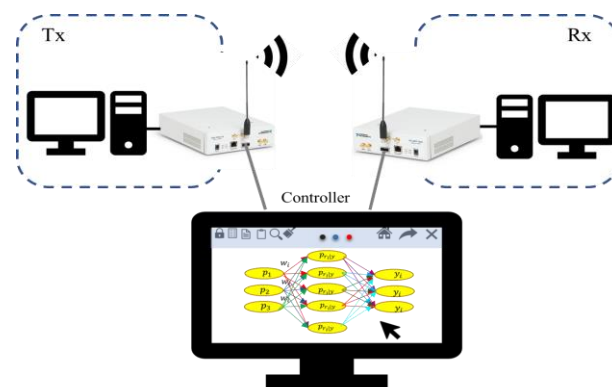

Figure 1 *Schematic of the Testbed setup for End-to-End Wireless Communication Systems*

Tasks:

- Mathematical modelling of an end-to-end communication system based on autoencoders
- Simulation and performance evaluation in Python
- Implementation of the model on SDRs
- Building a trainable testbed setup supported by a user interface with tuneable parameters

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[1] https://ieeexplore.ieee.org/document/8214233
[2] A software-defined radio system is a radio communication system which uses software for the modulation and demodulation of radio signals.