Karlsruher Institut für Technologie

Communications Engineering Lab (CEL)
Prof. Dr.-Ing. Laurent Schmalen

Waveforms for Future Wireless Communication and Joint Communication and Sensing

Master's Thesis (or partly Bachelor's Thesis)

Project

The currently dominating orthogonal frequency-division multiplexing (OFDM) waveform is suboptimal (unable to reach full channel diversity) in time-varying communication channels as encountered in e.g. vehicle-to-X communication. Especially channels for joint communication and sensing can profit from the increased channel diversity that alternative waveforms can provide.
Orthogonal time frequency space (OTFS) modulation was proposed in 2016 and has since been studied as a candidate waveform for high mobility channels such as for vehicle-to-X communication. Modulation is performed in the delay-doppler domain leading to robustness in high mobility scenarios First improvements of decoding algorithms have recently been proposed. We propose to develop and study new low complexity algorithms for joint communication and sensing applying methods such as factor graphs, machine learning, or other optimization methods.

Tasks

In this project, there are multiple tasks to be solved (not necessarily in a single thesis). An implementation of OTFS for communication currently exists at CEL, so you will be able to work with the existing code and adapt it to your specific task. Implementation of the following functionalities is planned:

- Low-complexity decoding using factor graphs
- Channel models for sensing
- Detection of multiple radar targets
- Low-complexity parameter estimation algorithms

You will investigate the topics of your task(s) and propose algorithms to efficiently solve the respective research problems. We will provide you with literature to demonstrate possible approaches to improve the system. You will have to study scientific literature to familiarize yourself with the topics of the thesis. You will work with existing code and extend it by implementing algorithms and comparison metrics for communication and sensing.

Requirements

- ✓ Programming experience in Python
- ✓ Communications Engineering I & II
- ✓ Motivation to deal with complex problems

Institute

Communications Engineering Lab

Hertzstr. 16
Gebäude 06.45
76187 Karlsruhe
https://cel.kit.edu

Contact

Charlotte Muth, M.Sc.

Room 208
charlotte.muth@kit.edu

Luca Schmid, M.Sc.

Room 116
luca.schmid@kit.edu