

## Specialization Module

### Calibration and Test of mm-Wave Sensing System

#### Task Description

Future mobile radio systems tend to use high frequency bands to face the demand for larger data rates. The 6G standardization discusses carrier frequencies up to 30 GHz offering significantly larger bandwidths compared to the sub 6 GHz band. Large bandwidths up to multiple 100 MHz allow very fine time resolution making the communication systems attractive for sensing applications. However, the parameterizations of communication and radar systems are quite different requiring a careful fusion.

This project considers a communication system with an OFDM air interface operating at a carrier frequency of 28 GHz. The system consists of a conventional host PC equipped with an Ethernet connection supporting data rate of 100 Gbit/s. The analog to digital (AD) and digital to analog (DA) conversions are performed on a Universal Software Radio Peripheral (USRP) board X410 from Ettus providing output frequencies up to 8 GHz. The frequency shift to 28 GHz is done with a TYMTEK UD Box equipped with appropriate antenna arrays (TYMTEK BBox). Since transmitter and receiver run on the same USRP board, a mono-static radar system can be built. The transmitted signal is a typical OFDM communication signal.

Measuring the distance between transmit and receive antennas or between an object and transmitter/receiver shall be performed in two steps. First, the time delay between transmission and reception is measured as an integer multiple of the sampling interval. Second, the phase shift from subcarrier to subcarrier can be used to determine a fractional delay within a sampling interval. Thereby, delays originating from the USRP and the lengths of cables and conductor tracks on a circuit board have to be considered.

The following tasks shall be performed.

- a) Familiarization with sensing algorithms (measuring distances with electromagnetic waves) and the existing hardware and Python software
- b) Development of system calibration for unbiased distance, angle, and SNR estimation
- c) Software implementation for sensing distances, angles, and signal-to-noise ratio (SNR)
- d) Testing robustness of algorithms for different SNRs and propagation conditions

**Chair:** Prof. Dr.-Ing. Volker Kühn



**Supervisor:** Dr.-Ing. Henryk Richter

**Email:** [henryk.richter@uni-rostock.de](mailto:henryk.richter@uni-rostock.de)