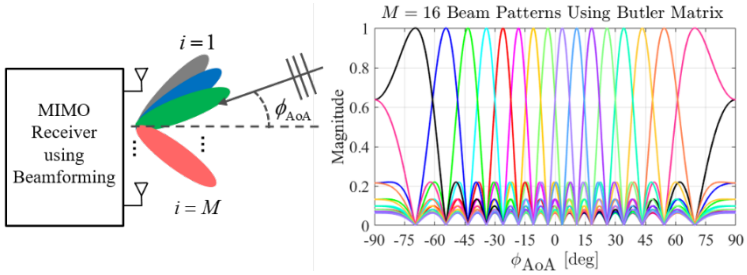
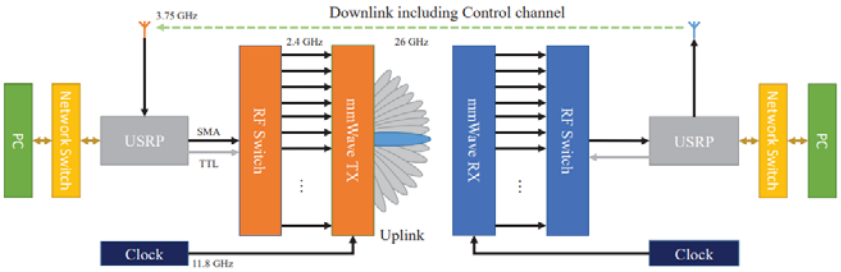
Diploma/Master Thesis:

Experimental Evaluation of Classical and Machine-Learning-Based Beam Alignment Techniques

Due to the large available spectrum, millimeter wave (mmWave) band is at the center of attention for next-generation wireless communication systems. However, highly directional transmission is necessary for cellular communication at these frequencies to compensate for higher isotropic path loss. Directional data transmission in practical multiple antenna systems can be achieved via electronically controllable beamforming networks like Butler Matrix. Such a network provides a set of orthogonal beams (denoted as 'codebook') steered into different mainlobe directions. A crucial question at the receiver side during beam training, is how to select the best beam(s) capturing the highest amount of receive power from a given codebook while minimizing the training overhead. Beam selection techniques based on Energy Detection, Compressed Sensing and Machine Learning are some of top contenders, which approach the problem from different aspects.



A state-of-the-art platform for 26/28GHz mmWave experimentation has been developed at Vodafone chair in TU Dresden, which introduces analog mmWave multi-beam antenna array that can be interfaced with regular software-defined radio (SDR) platforms. This experimental setup can be used to evaluate multiple aspects of end to end communication at mmWave frequencies.



Bomfin et. al., "USRP-based platform for 26/28 GHz mmWave Experimentation," IEEE WCNC, 2020

Your role will involve the following tasks:

- Literature study on mmWave Communication Systems and the beam alignment problem.
- Conducting channel measurements using the available state-of-the-art experimental platform.
- Comparison with respect to the theoretical mmWave channel models.
- Evaluation of different beam selection strategies in MATLAB using the measured data.
- Providing insight to the problem by introducing the trade-off and the best detection strategy.
- Well presentation and documentation of the achieved results in the final thesis.

Requirements:

- Good knowledge in signal processing.
- Good programming skills in MATLAB.

Possible starting date:

- From November 2020 or later

Contact:

- Mostafa Khalili Marandi (mostafa.khalili_marandi@ifn.et.tu-dresden.de)
- Behnam Khodapanah (behnam.khodapanah@ifn.et.tu-dresden.de)