Universität Rostock Traditio et Innovatio

FAKULTÄT FÜR INFORMATIK UND ELEKTROTECHNIK

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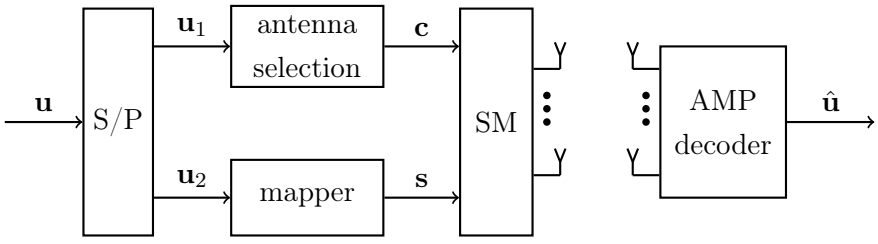
Master Thesis

Comparison of Spatial Modulation and MIMO-OFDM Systems

Task Description

Multiple antennas at transmitter and receiver have boosted the performance of mobile radio communications. Since their introduction in 3G systems, they became a well-established component in many state-of-the-art mobile communication systems like 4G, 5G and WIFI systems. Multiple antennas can be used in different ways. They can improve diversity and robustness against fading, they can increase the SNR by beamforming, and they can enhance data rates by spatial multiplexing. Current research focuses on massive Multiple-Input Multiple-Output (MIMO) systems with hundred or even more antennas at a base station.

A relatively new approach is Spatial Modulation (SM). SM uses only N_a out of N_t transmit antennas and delivers information by the choice of active antennas. Additionally, conventional data symbols can be transmitted over the activated antennas. Particularly in massive MIMO systems, spatial modulation can achieve very large spectral efficiencies. For such large systems, optimal maximum likelihood detection is no longer feasible and Approximate Message Passing (AMP) decoding becomes appropriate. These algorithms can even handle the transmission over frequency-selective channels for which the channel matrix has a block Toeplitz structure. The principal structure of the SM system is illustrated in the figure below.



The master shall study the performance of conventional massive MIMO-OFDM systems with spatial modulation systems for frequency selective channels. The comparison must address the spectral efficiency and the error rate performance. If possible, some conclusions about the decoder complexity can be drawn. The following tasks have to be performed:

- Literature study w.r.t. massive MIMO, MIMO-OFDM and spatial modulation.
- Familiarize with existing simulation environment in Python

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- Extend environment by implementation of MIMO-OFDM transmitter and receiver. Simple linear transmission concepts like maximum ratio transmission, ZF transmission and MMSE transmission shall be considered.
- Performance comparison of MIMO-OFDM and spatial modulation systems

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