

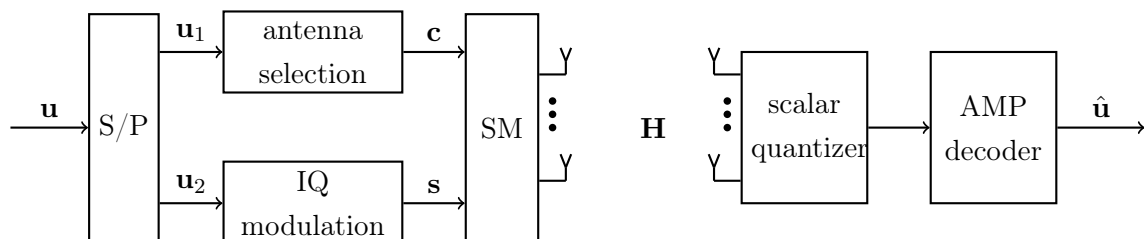
Specialization Module

Investigation of Quantized Spatial Modulation Systems with Channel Estimation

Task Description

Multiple antenna systems have boosted the performance of mobile radio systems significantly. Since their introduction in third generation mobile radio systems they became an integral part of all modern wireless communication systems like 4G, 5G and WIFI. Multiple antennas at transmitter and receiver offer a variety of advantages. They can be used to increase diversity and improve robustness against fading. Beamforming improves the signal to noise ratio and spatial multiplexing multiplies the achievable data rate. Currently, massive MIMO systems with a hundred or more antenna elements are developed. For broadband transmission over frequency-selective channels, MIMO systems are usually combined with the multi-carrier technique OFDM.

A relatively new approach is spatial modulation (SM). SM only uses N_a out of N_t available transmit antennas and conveys information by antenna selection. Additionally, conventional modulation symbols carry information. For large antenna arrays, spatial modulation can achieve very high spectral efficiencies. As the receiving antenna array has less antennas than the transmitter, a compressed sensing problem arises, which can be efficiently solved by [Approximate Message Passing \(AMP\)](#) algorithms. They even allow the detection for frequency-selective transmission channels without using OFDM, thus avoiding the loss in spectral efficiency due to the insertion of the cyclic prefix and PAPR issues. The block diagram of an SM system with quantization at the receiver is illustrated in the figure below.



This thesis shall investigate spatial modulation in massive MIMO systems with coarse quantization at the receiver. Thereby, the quantization of the (estimated) channel coefficients has to be considered as well. At the receiver, the generalized AMP (GAMP) algorithm has to be

employed to exploit the nonlinear quantization appropriately. The influence of quantization shall be analyzed with respect to the achievable throughput and error rate. The following tasks have to be carried out:

- Literature study on massive MIMO and spatial modulation
- Extension of existing simulation environment by implementation of coarse quantization including the channel estimation.
- The influence of the quantization on error rates and throughput has to be analyzed.

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