Master Thesis

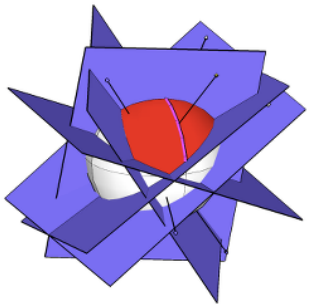
Chair for Theoretical Information Technology | RWTH AACHEN UNIVERSITY

1-Bit Quantized Compressed Spectrum Sensing

Research Area
Compressed Spectrum Sensing

Keywords
Spectrum Sensing, Quantization, Compressed Sensing, Statistical Signal Processing

Description
In the past decades, most parts of the radio spectrum have been licensed off to companies and public institutions by governments worldwide, leaving little to no space for new and upcoming wireless services. In stark contrast to this spectral scarcity, measurement campaigns have shown that license holders (primary users, PUs) are drastically underutilizing their share of the spectrum as spectral bands are only used at certain times and/or locations.



Feasible region of 1-bit CS recovery problem

To tackle this problem, opportunistic spectrum access (OSA) has been proposed. Therein, secondary users (SUs) are allowed to access unused spectral bands as long as they do not interfere with the PU. One of the main enablers of OSA is fast and reliable spectrum sensing. Testing the occupancy status of a spectral band can be accomplished in different ways based on cyclostationarity, the amount of energy in a band or the eigenvalues of the sample covariance matrix.

For some of these properties, the signal statistics required for PU detection are sparse, allowing them to be estimated from far fewer measurements than traditionally deemed necessary via methods from the field of compressed sensing (CS).

Goal
Based on the concept of energy detection, this thesis aims at the design and implementation of new algorithms for compressed spectrum sensing using quantized measurements. Specifically, the applicability of both adaptive and non-adaptive 1-bit CS with random quantization thresholds is to be evaluated. Using extensive simulations, the developed algorithms are to be compared to other known algorithms in terms of the achieved detection performance given a common bit budget constraint.

Requirements
- Good understanding of statistical signal processing
- Solid experience in Python programming

Contact

- Niklas Koep ✉ niklas.koep@ti.rwth-aachen.de ☎ +49 241 80 27740