

# Satellite Communication Laboratory

*Possible project for winter term 2018/2019*

## 1. Development of a digital signal to noise ratio (SNR) estimator for PSK modulation

### Problem description:

Many signal processing elements in a digital receiver work best if the statistics of the receiver noise and thus the signal to noise ratio is known. Due to the changing distance between a satellite and a ground station as well as environmental effects (interference, temperature) the signal to noise ratio is hard to predict. Instead it is often estimated based on the incoming symbols and the underlying signal structure.

### Your task in the SatComLab:

Within this lab course a symbol based signal to noise ratio estimation block as described above shall be implemented for the BPSK and QPSK modulation alphabets. This implementation will require the development of a complete new GNURadio block. Single instruction multiple data (SIMD) operations from the GNURadio VOLK library shall be used wherever possible to utilize the capabilities of modern processors. The resulting new block shall be thoroughly tested by meaningful tests that have to be developed as well. The estimated SNR values shall be passed along the signal to further processing blocks. Finally all findings shall be documented in a written lab report and presented in a final presentation.

### Expected results:

By the end of the lab a working implementation of the SNR estimation block described above is expected to be integrated into our software receiver. It is capable of forwarding its estimation results to the processing blocks downstream (although the implementation in these blocks is not part of this lab). The source code of the implementation shall be according to the GNURadio programming baselines, well documented and inserted into our software version control system. The correct functionality of your implementation is demonstrated by meaning full tests and their results are documented in the final report.

### Requirements:

- Understanding of signal processing
- Understanding of Maximum likelihood estimation
- Experience in C++ and python programming or comparable languages (The signal processing has to be programmed in C++ and the unit tests have to be programmed in python, however neither tasks requires specific knowledge about these specific two programming languages)

## Topics discussed during this lab:

- Maximum likelihood estimation
- BPSK and QPSK modulation
- European standard for satellite downlink signals: *ECSS-E-ST-50-01C Telemetry synchronization and channel coding*
- Software defined radios, USRP & GNURadio
- Testing of a software receiver with a real satellite