



## **Joint Parameter Estimation and Synchronization with 1-bit Quantization at the Receiver**

Studienarbeit, Diplomarbeit or SHK

### **Problem Statement**

Future communications systems with data rates of 100 Gb/s and above are facing a major challenge in terms of energy-efficiency. A promising solution is to employ 1-bit quantization at the receiver to reduce power consumption. However, with this novel approach it is necessary to redesign the complete receiver chain. This includes algorithms for synchronizing the transmitter and receiver in phase, time and frequency. The estimation of those parameters is challenging, as only 1-bit quantized samples are available at the receiver. First work has established parameter estimators and their synchronization working with one parameter at a time. It is an open question how to perform joint estimation and how it impacts communication performance. Moreover, it is of great interest how to perform joint synchronization of phase, timing and frequency.

### **Tasks**

- Literature research on existing phase, timing and frequency estimation algorithms with 1-bit quantization at the receiver
- Implementation of estimation algorithms in python or MATLAB
- Analysis of communications systems performance

### **Expected Skills**

- Basic knowledge of communication systems
- Experience with python or MATLAB

### **Contact Person**

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Please include a recent transcript of your grades when getting in contact

### **Recommended References**

- G. Fettweis, M. Dörpinghaus, S. Bender, L. Landau, P. Neuhaus, and M. Schlüter, "Zero crossing modulation for communication with temporally oversampled 1-bit quantization," in Proc. Asilomar Conf. Signals, Syst., Comput., Pacific Grove, CA, USA, Nov. 2019, pp. 207–214.
- M. Schlüter, M. Dörpinghaus, and G. Fettweis, "Joint phase and timing estimation with 1-bit quantization and oversampling," IEEE Trans. Commun., vol. 70, no. 1, pp. 71–86, Jan. 2022.
- H. Meyr, M. Moeneclaey, and S. A. Fechtel, Digital Communication Receivers: Synchronization, Channel Estimation, and Signal Processing. New York, NY, USA: Wiley, 1998.