Energy Efficiency Comparison between ZXM and CPM

Master/Diploma Thesis
Diplomarbeit

Problem Statement

Utilizing the vast, unused frequency bands in the sub-THz and THz range offers a promising solution to meet the ever-growing data rate demands of future applications. However, energy efficiency in these frequency ranges is a major challenge. For one, the power amplifier (PA) efficiency is reduced for high carrier frequencies, leading to high power consumption. Additionally, components, whose power consumption is uncritical at low frequencies, become problematic at these high frequency ranges. One of these components is the analog-to-digital converter (ADC), whose power consumption scales quadratically with the sampling rate for bandwidths beyond 300 MHz.

As such, modulation schemes have been developed, that partly mitigate this increase in ADC power consumption by reducing the amplitude resolution down to the minimum of 1-bit. Two such schemes are Zero-Crossing Modulation (ZXM) and Continuous-Phase-Modulation (CPM). While ZXM offers higher spectral efficiency, CPM—being a constant modulus modulation scheme—enables more efficient amplification and is highly robust against PA distortions.

As such, the aim of this work is to analyze both ZXM and CPM in terms of energy per bit using models of hardware power consumption.

Tasks

- Conduct literature review on ZXM and CPM
- Analyze the power consumption of each scheme
- Evaluate energy per bit using the provided optimization framework

Expected Skills

- Basic knowledge of communications
- Experience with MATLAB

Contact Person

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

Recommended References

- Gerhard Fettweis, et al. "Zero crossing modulation for communication with temporally oversampled 1-bit quantization", *Asilomar* 2019 **Link**
- Florian Gast, et al., "Energy Optimization using Joint Modulation Scheme and Front End Adaptation - the Gearbox-PHY", ISWCS 2024, Rio de Janeiro, Brazil, Jul 2024. **Link**

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