

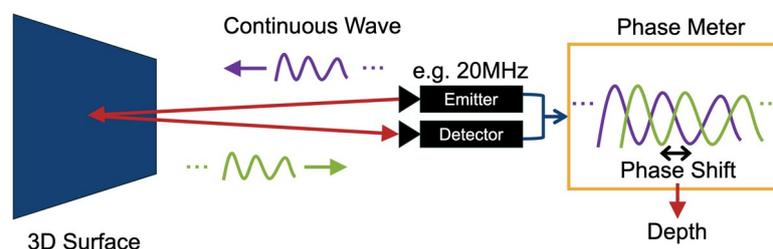
Master-Thesis

One-Bit Continuous-Wave Time-of-Flight Imaging Based on Phase Shift Estimation: A Low-Bit Approach to Depth Reconstruction

Continuous-Wave Time-of-Flight (CW-ToF) imaging estimates scene depth by measuring the phase difference between emitted and received modulated light signals. Conventional CW-ToF systems typically rely on high-resolution ADCs to capture the waveform with sufficient precision. However, high-resolution ADCs are power-hungry and limited in achievable sampling rates, which restricts their use in high-frequency, low-power, or large scale imaging systems.

In this thesis, we focus on one-bit CW-ToF systems using Sigma-Delta ($\Sigma\Delta$) modulation. $\Sigma\Delta$ modulation generates a high-frequency 1-bit bitstream through oversampling and feedback error shaping, which allows reconstruction of the underlying waveform with high precision. This enables accurate phase extraction and depth estimation while maintaining low power consumption and high acquisition speed.

The challenge is to design algorithms that efficiently process the oversampled $\Sigma\Delta$ bitstream to reliably recover phase and depth information for ToF imaging applications.



Requirements:

- Strong understanding of digital signal processing, including filtering, Fourier analysis, sampling theory, and oversampling techniques. Familiarity with phase estimation, modulation schemes, and time-of-flight (ToF) concepts is a plus.
- Knowledge of Python or MATLAB
- Good knowledge of English

After completing the work, there are good career prospects in the following areas:

- 3D Imaging
- Signal Processing
- One-Bit Quantization

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