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Spread Spectrum Based Detection using a Sound Card

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Introduction

Lock-in amplifiers (LIA) are currently used for signal recovery in the presence of high noise [1]. They are based on low-pass filtering the product of a sinusoidal signal by a reference sinusoid with the same frequency, effectively calculating the zero-time correlation between sinusoid and signal (Figure 1). To ensure that the frequencies of signal and reference are the same, in a LIA signal and reference are phase-locked.

We note that LIAs can be sensitive to narrowband noise with a frequency closer to the reference frequency than the bandwidth of the low-pass filter. In this respect, generating a signal synchronous with a pseudo-random reference, and detecting it by correlation with the sequence itself, offers promise of a better noise immunity [2].

In this work we investigate a computer sound card as an acquisition system for the extraction of signal by correlation with a pseudorandom sequence.

Methods

Maximum-length pseudorandom sequences [3] are generated with open – source electronic platform Arduino. A signal is simulated through sequence attenuation and noise addition using a Bruel & Kjaer noise generator, and detected through a Behringer U-Phoria UMC404HD sound card. A correlation algorithm has been implemented in Python using the Jupyter platform. Simultaneously, a dedicated hardware platform is currently under development, designed using with the EDA platform KiCad.

Results & Discussion

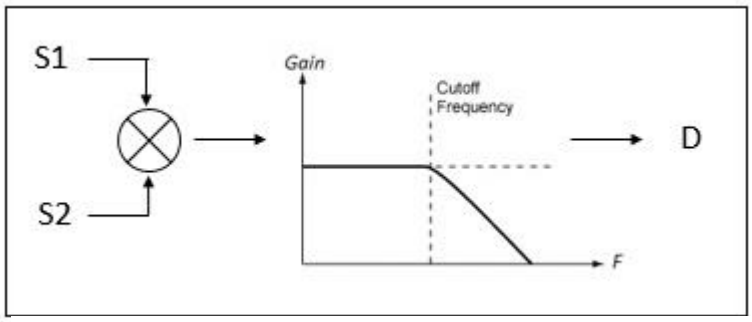

Figure 1 – *Basic principle of a LIA, when S1 is the signal with noise, S2 is the reference signal and D is the detected signal.*

The comparison between the Lock –in amplifier and our spread spectrum based detection system will be presented.

The hardware designed is currently under fabrication by a third – party contractor.

Conclusion

Spread spectrum as alternative to Lock – in technology for signal recovery is under evaluation.

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