Faculty of Electrical Engineering & Computer Science
Master Degree Course Electronics Engineering, MSc EE

Master 2017

Florian Osterloh

Development of a Hydrophone Noise Model.

ABSTRACT - Masterthesis

Noise is a basic limitation for the hydrophone performance and therefore needs to be determined to complete a sonar performance prediction. Each system component in the analogue part of the receiving system of a sonar system adds its noise to the signal path which needs to be analyzed in order to predict and reduce noise.

Hydrophone noise can be described as thermal noise related to the real part of the electrical impedance. The hydrophone is usually a piezoelectric device which provides signals with a low amplitude for an applied pressure. Therefore the signals need to be amplified for further signal processing. The hydrophone impedance is a necessary design parameter for the amplifier. Furthermore the extrinsic noise which occurs in an ocean can be predicted and should be the basic limitation for the receiving system in order to reach the highest possible range for detection of underwater signals.

The main goal of this thesis is to develop a noise model of a piezoelectric hollow spherical hydrophone, which is basically a distributed model based on the exact spherically symmetric, linear, differential equations for exterior fluids and for elastic or piezoelectric materials of a hollow spherical hydrophone. A lumped parameter model is used for a comparison with that model. The thermal noise has been predicted theoretically while the electrical impedance has been compared with measurements.

The model provides a sufficient correspondence to the measurement. A complete model has been developed with a model for a charge amplifier, where the hydrophone noise of a piezoelectric hollow spherical hydrophone was found to be insignificant with 0.74 nV/pHz at 6.3 kHz below the resonance of 62 kHz.