Faculty of Electrical Engineering & Computer Science
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City University of Applied Sciences

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Rishabh Chikker

Design of a Verification Tool Prototype for the Parameters of Underwater Electro-Acoustic Tonpilz Transducer.

ABSTRACT - Masterthesis

The underwater electro-acoustic Tonpilz transducer is one of the most popular types of SONAR transducers because of its low cost, simplicity and good performance in generating high acoustic power. Tonpilz transducers are typically grouped into arrays for SONAR applications to increase power radiation and for beam steering, the foundation of sonar design begins with the design of elements of a single transducer. It is typically composed of three main parts: a head mass, piezoelectric ceramic stack and a tail mass. Additionally, a stress bolt is used to hold the transducer together and fine adjust the properties of the transducer by applying pre-stress to the bolt. Furthermore, the Tonpilz is protected by a casing material. Irrespective of its success in the industry, up to now a complete understanding of the component based effect on the electrical parameters of the transducer is missing in literature. The present study aims to fill this gap for the existing transducer modelling techniques and creating a prototype of a verification tool to check the impact of individual components on the various transducer parameters. Since the level of accuracy and modelling time of each literature presented model differs, the present work explains which model is preferred and to be used for an accurate and fast calculation. The dependence of resonance frequency and admittance values on effective mass, stiffness and ceramic dimensions is shown. Furthermore, models are developed to model the Tonpilz with stress bolt, its surrounding material (silicone and polyurethane casing) and water medium effects. Finally, the prototype of verification tool software is developed which would aid the user to quickly verify the effect of individual transducer components on the resonance frequency and admittance curves. With proven credibility for other transducer setups, the tool could also be employed to yield an optimized design of the transducer prior to FEM simulation thus reducing the design time and providing greater flexibility.