

## Modelling of Micro Size Ultrasonic Generator and Receiver Characteristics of Lead Zirconate Titanate and Polyvinylidene Fluoride using Finite Element Analysis

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Ultrasonic devices (sensors, generators and transducers) using piezoelectric materials are more prominent due to its accuracy, efficiency and ease handling. In this research, modelling and simulation of ultrasonic generator and receiver characteristics were performed using finite element analysis (FEA). PZT is the most popular piezoelectric ceramic in ultrasonic applications due to its higher coupling factors, which is the main reason why PZT-5H was chosen for FEA analysis over other piezoceramic materials. PVDF was chosen for FEA analysis over other piezopolymer materials, due to its high piezoelectric voltage coefficient. Then piezoelectric constitutive equations for direct effect and indirect were used for mathematical calculation in thickness mode to determine the generated voltage and displacement along the z direction. The dimensions of the design were selected in micro scale. Using the FEA simulation, disc shape ultrasonic generator and receiver were designed. To identify the resonant frequency of the model wizard, 3D model was created using COMSOL Multiphysics software. The FEA simulation was implemented via 4 different cases, for instance using PZT-5H as generator material with PVDF and PZT-5H as two separate ultrasonic receiver materials and PVDF as generator material with PVDF and PZT-5H as two separate ultrasonic receiver materials. Initially the resonant frequency of the piezoelectric disc was determined as 13 MHz from the simulation and electric potential of 10V with 13MHz was used to generate the ultrasound wave. This ultrasonic wave was then directed to hit the ultrasonic receiver to generate electric potential. When PVDF worked as receiver it generated higher electric potential than PZT. On the other hand, when PZT worked as an ultrasonic generator the high amount of ultrasonic pressure was generated.

**Keywords:** ultrasonic waves, ultrasonic sensor, lead zirconate titanate, polyvinylidene fluoride.