Simulation of Acoustic Wave-Structure Interaction in a Quarter Wavelength Tube Energy Harvester

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Abstract

An acoustic energy harvesting system at low frequency (~200 Hz) using lead zirconate titanate (PZT) piezoelectric cantilever plates placed inside of a quarter-wavelength straight-tube resonator has previously been studied using COMSOL and verified experimentally. When an incident pressure wave at the resonator's eigenfrequency is introduced, an amplified acoustic resonant wave is developed that drives the vibration of the piezoelectric plates, which induces an AC power output. The interaction between air particles and the piezoelectric plates was found to play an important role. To improve air flow, a PZT plate was split into several wires, which collectively make up the same volume as the PZT plate. Using the acoustic and structural modules in COMSOL, the displacement of PZT wires was compared with the displacement of the PZT plate using the same initial conditions. The variables were the number of plates, the distance between the plates, and the location of plates within the resonator.

Figures used in the abstract

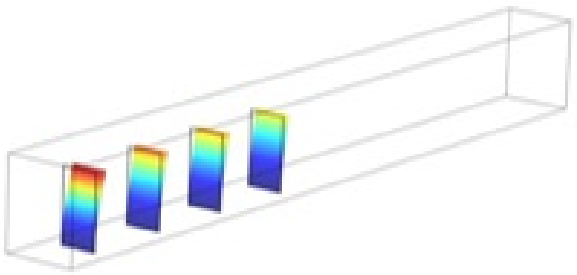

Figure 1: Displacement of Piezoelectric Plates inside of a Quarter-Wavelength Straight Tube Resonator