Modeling Ferrofluid Sloshing Vibration Energy Harvesting Using Level-Set Method

N. Anand[1], R. Gould[1]

[1]North Carolina State University, Raleigh, NC, USA

Abstract

Ferrofluid sloshing vibration energy harvesters are the recent addition in the domain of vibration energy harvesting systems. These systems are unique in their use of a liquid state transduction mechanism to harvest ambient vibrations/oscillations to generate electric power. In this paper, a 2-D representation of one such system is numerically simulated. The simulation consists of interface tracking between air and ferrofluid via the level-set method, modeling permanent magnets using the AC/DC Module, and the general incompressible Navier-Stokes equations using the CFD Module. To establish the accuracy of the simulation, grid convergence studies are performed. Secondly, additional validation of numerical algorithms in COMSOL® is performed by mimicking a published experimental configuration for Ferrofluid Vibration Energy Harvesting. The extracted RMS voltages from the experimental results and COMSOL® numerical simulation agree within 5% of the variance. Finally, the proposed system with four permanent magnets is analyzed for max power and voltage using impedance matching.

Figures used in the abstract

Figure 1 : Symmetric Ferrofluid Vibration Energy Harvester surface evolution