World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:12, No:08, 2018

# Longitudinal Vibration of a Micro-Beam in a Micro-Scale Fluid Media

**Authors :** M. Ghanbari, S. Hossainpour, G. Rezazadeh

**Abstract :** In this paper, longitudinal vibration of a micro-beam in micro-scale fluid media has been investigated. The proposed mathematical model for this study is made up of a micro-beam and a micro-plate at its free end. An AC voltage is applied to the pair of piezoelectric layers on the upper and lower surfaces of the micro-beam in order to actuate it longitudinally. The whole structure is bounded between two fixed plates on its upper and lower surfaces. The micro-gap between the structure and the fixed plates is filled with fluid. Fluids behave differently in micro-scale than macro, so the fluid field in the gap has been modeled based on micro-polar theory. The coupled governing equations of motion of the micro-beam and the micro-scale fluid field have been derived. Due to having non-homogenous boundary conditions, derived equations have been transformed to an enhanced form with homogenous boundary conditions. Using Galerkin-based reduced order model, the enhanced equations have been discretized over the beam and fluid domains and solve simultaneously in order to obtain force response of the micro-beam. Effects of micro-polar parameters of the fluid as characteristic length scale, coupling parameter and surface parameter on the response of the micro-beam have been studied.

**Keywords :** micro-polar theory, Galerkin method, MEMS, micro-fluid
**Conference Title :** ICMEM 2018 : International Conference on Mechanical Engineering and Manufacturing
**Conference Location :** Dublin, Ireland
**Conference Dates :** August 16-17, 2018