“A Finite Volume Method for Stress Analysis with Application to MEMS”

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Abstract:
Radio-frequency microelectromechanical systems (RF MEMS) are widely used for contact actuators and capacitative switches, and involve metal-dielectric contact. Proper understanding of structure-electrostatics interaction is necessary to prevent failure of these systems. In these devices, the structure is activated by an electrostatic force, whose magnitude changes as the gap closes. Accurate modeling of fluid-structure-electrostatics interaction is important to determine device dynamical behavior, and ultimately, device lifetime. It is advantageous to model fluid and structural mechanics and electrostatics within a single comprehensive numerical framework to facilitate coupling between them. In our work, we extend a cell-based finite volume approach popularly used to simulate fluid flow to characterize structure-electrostatics interactions. The method employs fully-implicit second order finite volume discretization of the integral conservation equations governing elastic solid mechanics and electrostatics, and uses arbitrary convex polyhedral meshes. The electrostatic actuation is treated as a surface force, and is directly added to the force balance for the control volume. The resulting set of algebraic equations is solved using a biconjugate gradient stabilized (BCGSTAB) solver. Results are presented for a fixed-fixed beam under electrostatic actuation.

Bio: Shankhadeep Das is a PhD student in the Mechanical Engineering Department at Purdue University. He works with Professor Jayathi Murthy and Professor Sanjay Mathur in the areas of fluid-structure-electrostatics interactions in MEMS. He has previously done his M.S. in Mechanical Engineering from the University of Minnesota - Twin Cities, and his B. Tech in Mechanical Engineering from the Indian Institute of Technology, Kharagpur in India.