Finite element analysis using a hierarchal decomposition for the interaction of structure, fluid and electrostatic field in MEMS

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ABSTRACT

MEMS (micro-electro-mechanical system) are driven typically by the electrostatic force, and their vibration under atmospheric condition is strongly damped by the fluid viscous force from the surrounding air. Moreover, both of these forces are sensitive to its dynamic behavior. Therefore, the interaction of the structure, fluid and electrostatic field or the structure-fluid-electrostatic interaction has to be carefully taken into account during the design process in order to predict the vibration characteristics such as the resonance frequency and the damping ratio, which are the key design parameters.

In this study, a hierarchal decomposition for the structure-fluid-electrostatic interaction is proposed in order to solve it efficiently. The proposed decomposition partitions it into the fluid-structure interaction (FSI) and the electrostatic field, and moreover splits the FSI into the fluid pressure and the fluid-structure velocities using a projection method [1] [2].

The proposed decomposition is implemented using a finite element method and is applied for a micro cantilever beam actuated by the electrostatic force in air. It follows from the comparison between the computational and experimental results that the proposed method predicts the vibration characteristics of the micro cantilever beam with the strong interaction accurately.

REFERENCES

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