Public Abstract
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Title:DAMPING AND STIFFENING FORCES OF A SQUEEZE-FILM BETWEEN TWO PLATES

Micro-Electro-Mechanical System (MEMS) power harvesting devices, converting mechanical vibration energy into electrical energy by capacitive principles, often employ a microstructure whose geometry involves a squeeze film. Squeeze film is the small air gap being squeezed between a moving element and a fixed substrate, and could significantly affect the dynamic behavior of a MEMS device. It is necessary to be able to account for and use the added damping and stiffness from squeeze film for a successful design. The effect of the squeeze film has been represented by the damping effect in previous studies. In this research, however, our goal is to quantify the stiffening effect which affects the resonance frequency of the oscillator system. The finite difference method for rectangular geometries is applied to solve the governing equation nonlinear isothermal Reynold’s equation for the squeeze film. To demonstrate the stiffening effect of the squeeze film, the dynamic response of sinusoidally forced oscillator involving one squeeze film is investigated by solving dynamic equation numerically. By conducting simulation and experiments, we obtain the dependence of the resonance frequency on the initial gap and the forcing amplitude, and identify conditions when the stiffening effect must be included in dynamic study of the structures with squeeze films.