Initially curved microbeam as sensitive element of resonant accelerometer

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Abstract. In this work the initially curved clamped-clamped microbeam is considered as sensitive element of resonant accelerometer. «Veering» phenomenon between two first symmetric eigenforms allows detect external acceleration.

Introduction

A huge part of industrial instrumentation today is micro-electromechanical systems (MEMS). All around the world scientists are researching and designing more and more advanced sensors, filters, switches, micromirrors, actuators and so on [1-3]. New modes of operation, schemes of signal detection and control systems are arising. Such rapid development is due to wide spectrum of applications of these devices: consumer and industrial electronics, civil aviation, medicine, etc. [4]

Results and discussion

In this work we study an initially curved clamped-clamped microbeam used as a sensitive element of resonant accelerometer (Fig. 1).
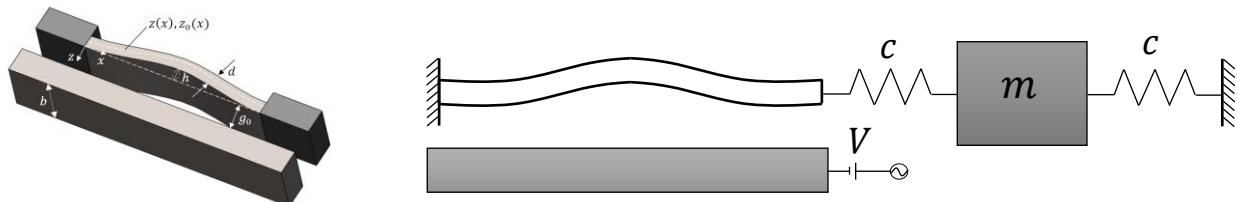

Figure 1: Sensitive element (left) and scheme of accelerometer (right)

Mode of operation of this device is based on «veering phenomenon», that is proximity between weakly coupled eigenforms. It can become a low-cost analog of existing high precision devices.

Equilibria forms branching for various geometric parameters was investigated utilizing model order reduction technique (MOR) and numerical continuation methods. In system of finite-element analysis ANSYS a couple-field analysis was conducted and conclusions on the degree of applicability of FEM and ROM-FEM methods were drawn. Also, spectrum of the eigenfrequencies of the microbeam was studied taking into consideration the external force, caused by acceleration of proof mass. It was shown that careful selection of the geometric and electric parameters of system allows using veering phenomenon between first and third eigenforms, so clamped-clamped microbeam in field of one electrode can be used as sensitive element of resonant accelerometer.

References

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