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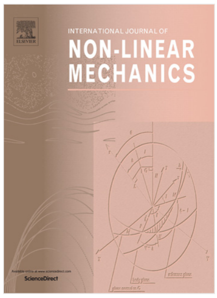

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The Static and Dynamic Behavior of MEMS Arch Resonators near Veering and the Impact of Initial Shapes

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ABSTRACT

We investigate experimentally and analytically the effect of initial shapes, arc and cosine wave, on the static and dynamic behavior of microelectromechanical systems (MEMS) arch resonators. We show that by carefully choosing the geometrical parameters and the initial shape of the arch, the veering phenomenon (avoided-crossing) among the first two symmetric modes can be strongly activated. To demonstrate this, we study electrothermally tuned and electrostatically driven initially curved MEMS resonators. Upon changing the electrothermal voltage, we demonstrate high frequency tunability of arc resonators compared to the cosine-configuration resonators for the first and third resonance frequencies. For arc beams, we show that the first resonance frequency increases up to twice its fundamental value and the third resonance frequency decreases until getting very close to the first resonance frequency triggering the veering phenomenon. Around the veering regime, we study experimentally and analytically the dynamic behavior of the arc beam for different electrostatic loads. The analytical study is based on a reduced order model of a nonlinear Euler-Bernoulli shallow arch beam model. The veering phenomenon is also confirmed through a finite-element multi-physics and nonlinear model.

Keywords: Arch, nonlinearity, vibrations, micro and nano systems, veering, near-crossing, electrothermal and electrostatic actuation

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