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Nonlinear dynamic response of beam and its application in nanomechanical resonator

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Abstract Nonlinear dynamic response of nanomechanical resonator is of very important characteristics in its application. Two categories of the tension-dominant and curvature-dominant nonlinearities are analyzed. The dynamic nonlinearity of four beam structures of nanomechanical resonator is quantitatively studied via a dimensional analysis approach. The dimensional analysis shows that for the nanomechanical resonator of tension-dominant nonlinearity, its dynamic nonlinearity decreases monotonically with increasing axial loading and increases monotonically with the increasing aspect ratio of length to thickness; the dynamic nonlinearity can only result in the hardening effects. However, for the nanomechanical resonator of the curvature-dominant nonlinearity, its dynamic nonlinearity is only dependent on axial loading. Compared with the tension-dominant nonlinearity, the curvature-dominant nonlinearity increases monotonically with increasing axial loading; its dynamic nonlinearity can result in both hardening and softening effects. The analysis on the dynamic nonlinearity can be very helpful to the tuning application of the nanomechanical resonator.

Keywords: Resonator Dynamic response Dynamic nonlinearity Dimensional analysis

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