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Nonlinear free vibration of a cantilever nanobeam with surface effects: Semi-analytical solutions

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Abstract

Nanobeams and nanowires are widely used as building blocks in the rapid development of Nano/Micro-electro-mechanical system (N/MEMS), micro-sensors, energy harvesting and storage devices, etc., and their vibration behaviors have aroused great concerns in both pure science and engineering applications. In this study, we investigate the nonlinear free vibration of a nanobeam considering its surface effects, including the surface elasticity and residual surface stress. Firstly, a mechanics model on the transverse vibration of a cantilever nanobeam is developed according to the Hamilton's principle. In use of the Galerkin and complex normal form methods, the approximate analytical solution of the nonlinear equation is obtained, which has

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