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Effect of Box Microspring Sizes on Nonlinear Deformation

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Microsprings are often used in micro-electro-mechanical system (MEMS) actuators to transmit force and to restore its original position by its spring force after a movement. Owing to its high stiffness and good capability of resisting lateral forces, the box microspring has the advantages of resisting induced transverse forces and preventing lateral deformation over other microsprings. For better operation, the nonlinear behavior of the microspring should be avoided when the spring is used in MEMS devices. Microspring size can significantly affect microspring performance. In this paper, we report on the effect of box microspring size on the nonlinear deformation of the microspring. The width (W) of the vertical beam of rectangular frames, microspring thickness (T), the width (B) of the horizontal beam of rectangular frames, and the spring number (N) of the box microspring are used as parameters to investigate the effect of box microspring size on nonlinear force. The finite element software COMSOL Multiphysics is used as the simulation tool. From the simulation results, the linear spring constant k and cubic spring constant k_3 are determined and expressed in terms of T, B, W, and N by the regression analytical method. The simulation results of this work can be used to design a microspring in an actuator such that nonlinear deformation is avoided.

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