Complex dynamics of a typical electrostatic MEMS resonator and its control by delayed position feedback

Huilin Shang[1]

[1] *School of Mechanical Engineering, Shanghai Institute of Technology, Shanghai 201418, China*
(e-mail: suliner@tongji.edu.cn)

Pull-in instability, jump and chaos of the electrostatic microstructures are common undesirable phenomena which imply the loss of reliability of micro-electromechanical systems. Therefore, it is necessary to understand their mechanisms and then reduce the phenomena. Delayed position feedback is introduced to suppress the phenomena. The thresholds of AC voltage for pull-in instability and chaos in the initial system and the controlled systems are obtained analytically by the Melnikov method. It follows that pull-in instability and chaos of the MEMS resonator can be ascribed to the homoclinic bifurcation inducing by the AC and DC load. Furthermore, it is found that the delayed controller is a good strategy to reduce pull-in instability when the gain is positive.

Keywords: MEMS; pull-in instability; chaos; jump; safe basin; time delay; homoclinic orbit