Prediction of robust chaos in nanoelectromechanical resonators induced by two frequency excitation

André Gusso, Wellington Gomes Dantas, Sebastian Ujevic Tonino

Universidade Federal Fluminense

Micro and nanoelectromechanical resonators have been considered as sources of chaotic signals for practical applications in chaos-based communications, data encryption and pseudo-random number generators. However, as for many other physical systems, their application has been prevented because they do not exhibit robust chaos. This kind of chaos is characterized by the persistence of the chaotic dynamics with changes in the system parameters and the existence a single chaotic attractor. Robust chaos is generally required for the practical application of the chaotic dynamics of any physical system. In this work we show that robust chaos can be induced in a nanoresonator through two frequency excitation. We consider a doubly-clamped suspended beam nanoresonator with two lateral electrodes. We demonstrate the robustness of the chaotic dynamics through an extensive numerical analysis. The largest Lyapunov exponent is calculated changing several relevant physical parameters of the external forcing (DC and AC voltages, frequencies and frequency ratios) and damping. Sufficiently large volumes in the relevant parameter space are found where the Lyapunov exponent is positive. Furthermore, the existence of a single chaotic attractor is corroborated by the calculation of double Poincaré sections. With this result, micro and nanoelectromechanical resonators can now be considered as strong candidates as sources of chaotic signals for practical applications.