Chaotic dynamics of the fractionally damped Duffing equation

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Abstract

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Vibration phenomena of the fractionally damped systems have attracted increasing attentions in recent years. In this paper, dynamics of the fractionally damped Duffing equation is examined. The fractionally damped Duffing equation is transformed into a set of fractional integral equations solved by a predictor－corrector method. The effect of fractional order of damping on the dynamic behaviors of the motion is the main subject of the study. In this work, bifurcation of the parameter-dependent system is drawn numerically. The time evolutions of the nonlinear dynamical system responses are also described in phase portraits and the Poincare´ map technique. In addition, the occurrence and the nature of chaotic attractors are verified by evaluating the largest Lyapunov exponents. Results obtained from this study illustrates that the fractional order of damping has a significant effect on the dynamic behaviors of the motion. The size of the attractor trends to enlarge when fractional order a increases. Regular motions (including period-3 motion) and chaotic motions are examined. Moreover, a period doubling route to chaos is also found. Many period-3 windows are also observed in bifurcation diagram.

Keyword：Chaotic dynamics
The Duffing-like oscillator