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Inducing or suppressing chaos in a double-well Duffing oscillator by time delay feedback. (English) Zbl 1091.93008

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Summary: The chaotic behavior of a double-well Duffing oscillator with both delayed displacement and velocity feedbacks under a harmonic excitation is investigated. By means of the Melnikov technique, necessary condition for onset of chaos resulting from homoclinic bifurcation is derived analytically. The analytical results reveal that for negative feedback the presence of time delay lowers the threshold and enlarges the possible chaotic domain in parameter space; while for positive feedback the presence of time delay enhances the threshold and reduces the possible chaotic domain in parameter space, which are further verified numerically through Poincaré maps of the original system. Furthermore, the effect of the control gain parameters on the chaotic motion of the original system is studied in detail.

MSC:

93B52 Feedback control
37D45 Strange attractors, chaotic dynamics of systems with hyperbolic behavior
37N35 Dynamical systems in control

Keywords:

delayed displacement; velocity feedbacks; harmonic excitation; Melnikov technique; control gain parameters

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