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Chaotic motions and fractal basin boundaries in spring-pendulum system. (English)

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Summary: This study investigates the chaotic response of the spring-pendulum system. In this system besides of strange attractors, multiple regular attractors may co-exist for some values of system parameters, and it is important to study the global behavior of the system using the basin boundaries of the attractors. Here multiple scales method is used to distinguish the regions of stable and unstable attractors. Early studies show that there are unstable regions for the spring-pendulum system. In this study using bifurcation diagrams and Poincaré maps, it is shown that in some cases the response becomes quasi-periodic or chaotic for some deviations from external and internal resonance frequencies. Also it will be shown that the response is sensitive to the value of damping parameters, which may result in chaotic response. Results show that the jumping phenomena may occur when multiple regular attractors exist. Using basin boundaries of attractors it is also shown that in some regions these boundaries are fractal.

MSC:

70K55 Transition to stochasticity (chaotic behavior) for nonlinear problems in mechanics
37D45 Strange attractors, chaotic dynamics of systems with hyperbolic behavior

Keywords:

Spring-pendulum system; Chaos; Jumping phenomenon; Fractal basin

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