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Analysis of non-linear dynamics and bifurcations of a double pendulum. (English)

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Summary: The dynamic behaviour of a double pendulum system in the vicinity of several compound critical points is explored through both analytical and numerical approaches. Four types of critical points are considered, which are characterized by a double zero eigenvalue, a simple zero and a pair of pure imaginary eigenvalues, and two pairs of pure imaginary eigenvalues including resonant and non-resonant cases. With the aid of normal form theory, the explicit expressions for the critical bifurcation lines leading to incipient and secondary bifurcations are obtained. Possible bifurcations leading to 2-D and 3-D tori are also investigated. Closed form stability conditions of the bifurcation solutions are presented. A time integration scheme is used to find the numerical solutions for these bifurcation cases, which agree with the analytical results. Finally, numerical simulation is also applied to obtain double-period cascading bifurcations leading to chaos.

MSC:

70K50 Bifurcations and instability for nonlinear problems in mechanics

34C15 Nonlinear oscillations and coupled oscillators for ordinary differential equations

34C23 Bifurcation theory for ordinary differential equations

Cited in **16** Documents

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