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Complicated behaviors and bifurcation mechanism of the periodic parameter-switching Chen system

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Abstract:

In this paper, a switched system that switches between two Chen systems based on the parameters altered periodically is established. To investigate the mechanism of switching oscillation of the whole system, Poincaré map of the whole system is defined by the switching scheme and the solutions of the subsystems. Different types of periodic switching oscillations revolved around the unstable equilibrium points and their transitions to chaotic oscillations can be observed. We conclude that bifurcation scenarios, such as period-doubling bifurcation, pitchfork bifurcation and saddle-node bifurcation, play an important role in the generation of various (symmetric or asymmetric) periodic oscillations and chaos in the switched system.

Keywords: Switched system; Floquet multiplies; Symmetric switching oscillation; Bifurcation mechanism

1 Introduction

The original Chen system was first found by Chen and Ueta [1], expressed as

$$\dot{x} = \alpha(y - x), \dot{y} = (p - \alpha)x - xz + py, \dot{z} = xy - \beta z, \quad (1.1)$$

where x, y, z are the state variables and α, p, β are positive parameters. This simple nonlinear model has received much interest, and a lot of results have been reported [2-4]. The equations of Chen

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