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Abstract

AN INVESTIGATION OF THE DYNAMIC BEHAVIORS OF THE CHAOTIC CHEN–LEE SYSTEM

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The dynamics of fractional-order systems have attracted a great deal of attention in recent years. In this paper, the effects of parameter on the dynamics of the recently presented fractional-order Chen–Lee system were studied numerically. The ranges of parameters which studied in this thesis were relatively broad. The order used for the system was fixed at 2.7 ($q_1 = q_2 = q_3 = 0.9$). The system displays rich dynamic behaviors, such as a fixed point, periodic motion, chaotic motion, and transient chaos. The chaotic motion was validated by the confirmation of a positive Lyapunov exponent. Period-doubling routes to chaos in the fractional-order Chen–Lee system were also found. In addition, the hyperchaotic dynamical behavior of the system was examined by introducing a perturbation. A system with more than one positive Lyapunov exponent can be classified as a hyperchaotic system. In this study, a sinusoidal perturbation was designed for generating hyperchaos from the Chen–Lee chaotic system. The hyperchaos was identified by the existence of two positive Lyapunov exponents. The system is hyperchaotic in several different regions of the parameters c, ε and ω. It was found that this method not only enhances or suppresses chaotic behavior, but also induces chaos in non-chaotic parameter ranges. In addition, some interesting dynamical behaviors, such as Hopf bifurcation and intermittency, were also found in this study.