Designing hyperchaotic systems and complexity optimization

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Abstract

Associated with the development of applications in many fields, there is a growing demand to use complex chaotic systems. Therefore, complexity performance of a physical time series has attracted attention researchers due to its importance to measure the randomness. However, based on Sine map and the principle of anti-control discrete-time systems, a new approach for designing desirable hyperchaotic system with high complexity is implemented. The anti-controlled system is designed with a closed-loop form, where each equation contains only two state variables, for which the proposed system has simple structure with extremely high complexity performance. Two-dimensional (2D) model of this system is investigated as an example, and several properties of the this system are analyzed using phase space, bifurcation diagrams and Lyapunov exponents. The complexity is investigated by means of Permutation and Sample Entropy. Performance evaluations show that the new system has higher complexity, wider chaotic and hyperchaotic region than different chaotic systems. Owing to the simplicity of its structure and its low implementation cost, the proposed system is very suitable in various real applications.