Designing an M-dimensional nonlinear model for producing hyperchaos

ABSTRACT

This paper proposes an M-dimensional nonlinear hyperchaotic model (M-NHM) for producing new discrete-time systems with complex hyperchaotic behaviors. The M-NHM is constructed by designing an M-dimensional nonlinear system ($M \geq 2$) to generate a chaotic behavior. To enhance the nonlinearity of M-NHM, hence changing its behavior to hyperchaotic, an iterative chaotic map with infinite collapse (ICMIC) is composed. Mathematical analysis shows that the M-NHM has either no equilibria, or an arbitrarily large number of equilibria. Moreover, Routh−Hurwitz criterion reveals that all these equilibria are unstable when $M \geq 3$. To investigate the dynamical properties and complexity of the M-NHM, we provide 2-NHM and 3-NHM as typical examples. Simulation results show that the 2-NHM and 3-NHM have good ergodicity, wide hyperchaotic behavior, highly sensitivity dependence, and high complexity. With all these features, the M-NHM would be an ideal model for secure communications and other engineering applications.

Keyword: High-dimensional systems; Hyperchaotic behavior; No equilibria; Stability; Complexity