KYBERNETIKA — VOLUME 44 (2008), NUMBER 1, PAGES 35-42

Hopf Bifurcation Analysis of Some Hyperchaotic Systems with Time-Delay Controllers

Lan Zhang; Chengjian Zhang

Abstract: A four-dimensional hyperchaotic Lü system with multiple time-delay controllers is considered in this paper. Based on the theory of Hopf bifurcation in delay system, we obtain a simple relationship between the parameters when the system has a periodic solution. Numerical simulations show that the assumption is a rational condition, choosing parameter in the determined region can control hyperchaotic Lü system well, the chaotic state is transformed to the periodic orbit. Finally, we consider the differences between the analysis of the hyperchaotic Lorenz system, hyperchaotic Chen system and hyperchaotic Lü system.

Keywords: Hopf bifurcation; periodic solution; multiple delays and parameters; hyperchaotic Lü system; hyperchaotic Chen system; hyperchaotic Lorenz system;

AMS Subject Classification: O415;

References

[1] A. M. Chen, J. A. Lu, J. H. Lü, and S. M. Yu: Generating hyperchaotic Lü attractor via state feedback control. Physica A 364 (2006), 103–110.

[2] A. Wolf, J. B. Swift, H. L. Swinney, and J. A. Vastano: Determining Lyapunov exponents from a time series. Physica D 16 (1985), 285–317.

[3] J. J. Wei and S. G. Ruan: Stability and bifurcation in a neural network model with two delays. Physica D 130 (1999), 255–272.

[4] K. Briggs: An improved method for estimating Liapunov exponents of chaotic time series. Phys. Lett. A 151 (1990), 27–32.

[5] K. L. Cooke and Z. Grossman: Discrete delay, distribute delay and stability switches. J. Math. Anal. Appl. 86 (1982), 592–627.

[6] L. Olien and J. Belair: Bifurcation, stability and monotonicity properities of a delayed neural network model. Physica D 102 (1997), 349–363.

[7] N. D. Heyes: Linear autonomous neutral functional differential equations. J. Differential Equations 15 (1974), 106–128.

[8] Q. Jia: Hyperchaos generated from the Lorenz chaotic system and its control. Phys. Lett. A 366 (2007), 217–222.

[9] R. Datko: A procedure for determination of the exponential stability of certain differential difference equations. Quart. Appl. Math. 36 (1978), 279–292.

[10] X. J. Wu: Chaos synchronization of the new hyperchaotic Chen system via nonlinear control. Acta Phys. Sinica 22 (2006), 12, 6261–6266.