

ALMOST PERIODIC SOLUTIONS TO COHEN-GROSSBERG NEURAL NETWORKS ON TIME SCALES

Chao Wang¹ and Yongkun Li²

Department of Mathematics
Yunnan University, Kunming, Yunnan, P. R. China
Corresponding author email: yklike@ynu.edu.cn

Abstract. In this paper, a class of Cohen-Grossberg neural networks with delays are studied on almost periodic time scales, some new sufficient conditions are established for the existence and global attractivity of the almost periodic solution. Finally, an example and numerical simulations are presented to illustrate the feasibility and effectiveness of the results.

Keywords. Almost periodic solutions; Time scales; Cohen-Grossberg neural networks; Existence; Attractivity.

AMS (MOS) subject classification: 34K14; 34K20; 92B20; 34N05.

References

- [1] M. Bohner, A. Peterson, Dynamic equations on time scales, An Introduction with Applications, Boston: Birkhäuser; 2001.
- [2] M. Bohner, A. Peterson, Advances in Dynamic Equations on Time Scales, Birkhäuser Boston Inc., Boston, Mass, USA, 2003.
- [3] M.A. Cohen, S. Grossberg, Absolute stability and global pattern formation and partial memory storage by competitive neural networks, *IEEE Transactions of Systems, Man and Cybernetics*, **13**, (1983) 815-826.
- [4] T. Chen, L. Rong, Delay-independent stability analysis of Cohen-Grossberg neural networks, *Physics Letters A*, **317**, (2003) 436-449.
- [5] J. Cao, X. Li, Stability in delayed Cohen-Grossberg neural networks: LMI optimization approach, *Physica D*, **212**, (2005) 54-65.
- [6] J. Cao, J. Liang, Boundedness and stability for Cohen-Grossberg neural network with time-varying delays, *J. Math. Anal. Appl.*, **296**, (2004) 665-685.
- [7] Philippe Cieutat, On the structure of the set of bounded solutions on an almost periodic Liénard equation, *Nonlinear Analysis*, **58**, (2004) 885-898.
- [8] J. Cao, A. Chen, X. Huang, Almost periodic attractor of delayed neural networks with variable coefficients, *Physics Letters A*, **340**, (2005) 104-120.
- [9] S. Guo, L. Huang, Periodic oscillatory for a class of neural networks with variable coefficients, *Nonlinear Analysis: Real World Applications*, **6**, (2005) 545-561.
- [10] C.C. Hwang, C.J. Cheng, T.L. Liao, Globally exponential stability of generalized Cohen-Grossberg neural networks with delays, *Physics Letters A*, **319**, (2003) 157-166.
- [11] X. Huang, J. Cao, Daniel W.C. Ho, Existence and attractivity of almost periodic solution for recurrent neural networks with unbounded delays and variable coefficients, *Nonlinear Dynamics*, **45**, (2006) 337-351.
- [12] S. Hilger, Ein Maßkettenkalkül mit Anwendung auf Zentrumsmannigfaltigkeiten, Ph.D. thesis, Universität Würzburg, 1988.
- [13] H. Jiang, J. Cao, Z. Teng, Dynamics of Cohen-Grossberg neural networks with time-varying delays, *Physics Letters A*, **354**, (2006) 414-422.
- [14] Y. Li, X. Chen, L. Zhao, Stability and existence of periodic solutions to delayed Cohen-Grossberg BAM neural networks with impulses on time scales, *Neurocomputing*, **72**, (2009) 1621-1630.
- [15] Y. Li, L. Zhao, P. Liu, Existence and exponential stability of periodic solution of high-Order Hopfield neural network with delays on time scales, *Discrete Dynamics in Nature and Society*, **2009**, (2009) Article ID 573534, 18 pages.
- [16] Y. Li, K. Zhao, Robust stability of delayed reaction-diffusion recurrent neural networks with Dirichlet boundary conditions on time scales, *Neurocomputing*, **74**, (2011) 1632-1637.
- [17] Y. Li, C. Wang, Almost periodic solutions of shunting inhibitory cellular neural networks on time scales, *Commun Nonlinear Sci Numer Simulat*, **17**, (2012) 3258-3266.
- [18] Y. Li, C. Wang, Almost periodic functions on time scales and applications, *Discrete Dynamics in Nature and Society*, **2011**, (2011), Article ID 727068, 20 pages.
- [19] Y. Li, C. Wang, Uniformly almost periodic functions and almost periodic solutions to dynamic equations on time scales, *Abstract and Applied Analysis*, **2011**, (2011) Article ID 341520, 22 pages.

- [20] Y. Li, C. Wang, Almost periodic solutions to dynamic equations on time scales and applications, *J. Appl. Math.*, **2012**, (2012) Article ID 463913, 19 pages.
- [21] L. Rong, LMI-based criteria for robust stability of Cohen-Grossberg neural networks with delay, *Physics Letters A*, **339**, (2005) 63-73.
- [22] L. Wang, X.F. Zou, Exponential stability of Cohen-Grossberg neural networks, *Neural Networks*, **15**, (2002) 415-422.
- [23] L. Wang, X.F. Zou, Harmless delays in Cohen-Grossberg neural networks, *Physica D*, **170**, (2002) 162-173.
- [24] W. Xiong, J. Cao, Exponential stability of discrete-time Cohen-Grossberg neural networks, *Neurocomputing*, **64**, (2005) 433-446.
- [25] Y. Xia, J. Cao, Almost-periodic solutions for an ecological model with infinite delays, *Proceedings of the Edinburgh Mathematical Society*, **50**, (2007) 229-249.
- [26] H. Xiang, J. Wang, A. Chen, Existence and attractivity of almost periodic solution for shunting inhibitory cellular neural networks with continuously distributed delays and variable coefficients, *Annals of Differential Equation*, **21**, (2005) 604-615.
- [27] H. Ye, A.N. Michel, K.N. Wang, Qualitative analysis of Cohen-Grossberg neural networks with multiple delays, *Physical Review E*, **51**, (1995) 2611-2618.
- [28] K. Yuan, J. Cao, An analysis of global asymptotic stability of delayed Cohen-Grossberg neural networks via nonsmooth analysis, *IEEE Transactions on Circuits Systems I*, **52**, (2005) 1854-1861.
- [29] K. Yuan, J. Cao, H.X. Li, Robust stability of switched Cohen-Grossberg neural networks with mixed time-varying delays, *IEEE Transactions on Systems, Man, and Cybernetics Part B: Cybernetics*, **36**, (2006) 1356-1363.

Received August 2012; revised April 2013.

<http://monotone.uwaterloo.ca/~journal/>