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New stability results for delayed neural networks. (English) Zbl 1426.34103

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Summary: This paper is concerned with the stability for delayed neural networks. By more fully making use of the information of the activation function, a new Lyapunov-Krasovskii functional (LKF) is constructed. Then a new integral inequality is developed, and more information of the activation function is taken into account when the derivative of the LKF is estimated. By Lyapunov stability theory, a new stability result is obtained. Finally, three examples are given to illustrate the stability result is less conservative than some recently reported ones.

MSC:

34K20 Stability theory of functional-differential equations
92B20 Neural networks for/in biological studies, artificial life and related topics

Keywords:

neural networks; Lyapunov-krasovskii functional; integral inequality; asymptotic stability

Full Text: DOI

References:

[1] Michel, A. N.; Liu, D., Qualitative analysis and synthesis of recurrent neural networks, (2002), Marcel Dekker, Inc. New York, NY, USA · Zbl 1026.68115

[2] Zhang, L.; Yi, Z., Selectable and unselectable sets of neurons in recurrent neural networks with saturated piecewise linear transfer function, IEEE Trans. Neural Netw., 22, 7, 1021-1031, (2011)

[3] Kwon, O.; Park, M.; Park, J. H.; Lee, S.; Cha, E., New and improved results on stability of static neural networks with interval time-varying delays, Appl. Math. Comput., 239, 346-357, (2014) · Zbl 1334.93135

[4] Zhang, B.; Lam, J.; Xu, S., Stability analysis of distributed delay neural networks based on relaxed Lyapunov-krasovskii functionals, IEEE Trans. Neural Netw. Learn. Syst., 26, 7, 1480-1492, (2015)

[5] Raja, R.; Zhu, Q.; Senthilraj, S.; Samidurai, R., Improved stability analysis of uncertain neutral type neural networks with leakage delays and impulsive effects, Appl. Math. Comput., 266, 1050-1069, (2015) · Zbl 1410.34222

[6] Shao, H., Improved delay-dependent globally asymptotic stability criteria for neural networks with a constant delay, IEEE Trans. Circuits Syst. II: Expr. Br., 55, 10, 1071-1075, (2008)

[7] Mathiyalagan, K.; Park, J. H.; Sakthivel, R.; Anthoni, S. M., Delay fractioning approach to robust exponential stability of fuzzy Cohen-Grossberg neural networks, Appl. Math. Comput., 230, 451-463, (2014) · Zbl 1410.93071

[8] Li, T.; Zheng, W. X.; Lin, C., Delay-slope-dependent stability results of recurrent neural networks, IEEE Trans. Neural Netw., 22, 12, 2138-2143, (2011)

[9] Shao, H.; Zhang, Z., Delay-dependent state feedback stabilization for a networked control model with two additive input delays, Appl. Math. Comput., 265, 748-758, (2015) · Zbl 1410.93097

[10] Zhang, B.; Xu, S.; Lam, J., Relaxed passivity conditions for neural networks with time-varying delays, Neurocomputing, 142, 299-306, (2014)

[11] Shao, H., Delay-dependent approaches to globally exponential stability for recurrent neural networks, IEEE Trans. Circuits Syst. II: Expr. Br., 55, 6, 591-595, (2008)

[12] Tian, J.; Xiong, W.; Xu, F., Improved delay-partitioning method to stability analysis for neural networks with discrete and distributed time-varying delays, Appl. Math. Comput., 233, 152-164, (2014) · Zbl 1334.92025

[13] Shao, H., Delay-dependent stability for recurrent neural networks with time-varying delays, IEEE Trans. Neural Netw., 19, 9, 1647-1651, (2008)

[14] Ji, M. D.; He, Y.; Wu, M.; Zhang, C. K., Further results on exponential stability of neural networks with time-varying delay, Appl. Math. Comput., 256, 175-182, (2015) · Zbl 1338.92020

[15] Cheng, W.; Zhu, X.; Deng, Y., A delay composition approach to stability analysis of neural networks with time-varying delay, Proceedings of the International Conference on Intelligent Computation Technology and Automation (ICICTA), 1, 69-72, (2010)

[16] Shao, H.; Han, Q. L., New delay-dependent stability criteria for neural networks with two additive time-varying delay com-

ponents, IEEE Trans. Neural Netw., 22, 5, 812-818, (2011)

[17] Zhang, H.; Yang, F.; Liu, X.; Zhang, Q., Stability analysis for neural networks with time-varying delay based on quadratic convex combination, IEEE Trans. Neural Netw. Learn. Syst., 24, 4, 513-521, (2013)

[18] Ji, M. D.; He, Y.; Zhang, C. K.; Wu, M., Novel stability criteria for recurrent neural networks with time-varying delay, Neurocomputing, 138, 383-391, (2014)

[19] Zhu, X.; Yue, D.; Wang, Y., Delay-dependent stability analysis for neural networks with additive time-varying delay components, IET Control Theory Appl., 7, 3, 354-362, (2013)

[20] Li, T.; Wang, T.; Song, A.; Fei, S., Combined convex technique on delay-dependent stability for delayed neural networks, IEEE Trans. Neural Netw. Learn. Syst., 24, 9, 1459-1466, (2013)

[21] Zhang, C. K.; He, Y.; Jiang, L.; Wu, M., Stability analysis for delayed neural networks considering both conservativeness and complexity, IEEE Trans. Neural Netw. Learn. Syst., 27, 7, 1486-1501, (2016)

[22] Zhang, X. M.; Han, Q. L., Global asymptotic stability for a class of generalized neural networks with interval time-varying delays, IEEE Trans. Neural Netw., 22, 8, 1180-1192, (2011)

[23] Gu, K., An integral inequality in the stability problem of time-delay systems, Proceedings of the Thirty-Ninth IEEE Conference on Decision and Control, 3, 2805-2810, (2000)

[24] Sun, J.; Liu, G. P.; Chen, J., Delay-dependent stability and stabilization of neutral time-delay systems, Int. J. Robust Nonlinear Control, 19, 12, 1364-1375, (2009) · Zbl 1169.93399

[25] Park, P.; Ko, J. W.; Jeong, C., Reciprocally convex approach to stability of systems with time-varying delays, Automatica, 47, 1, 235-238, (2011) · Zbl 1209.93076

[26] Seuret, A.; Gouaisbaut, F., Wirtinger-based integral inequality: application to time-delay systems, Automatica, 49, 9, 2860-2866, (2013) · Zbl 1364.93740

[27] Zeng, H. B.; He, Y.; Wu, M.; She, J., Free-matrix-based integral inequality for stability analysis of systems with time-varying delay, IEEE Trans. Autom. Control, 60, 10, 2768-2772, (2015) · Zbl 1360.34149