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Sigmoid型静态连续反馈神经网络的临界全局指数稳定性

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The Critically Exponential Stability for Static Continuous Recurrent Neural Networks with Sigmoidal Functions

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- 摘要
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全文: PDF (400 KB) HTML (1 KB) 输出: BibTeX | EndNote (RIS) 背景资料

摘要 本文致力于研究Sigmoid型静态连续反馈神经网络在临界条件下的全局指数稳定性. 我们利用矩阵测度理论证明: 对于该类型神经网络, 若其满足临界条件, 即存在正定矩阵 Γ, 使得由网络所确定的判别矩阵 $S(\Gamma,L)$半正定, 则网络具有唯一平衡态 y^*, 且当 y^*不为某一给定点时, y^*在 R^N上全局指数稳定. 所获结论在不增加附加条件的情况下一致地推广了已知Sigmoid型连续反馈神经网络的非临界指数稳定性结论, 同时是已有临界稳定性结果的极大统一和延伸.

关键词: 反馈神经网络 Sigmoid型 临界分析 全局指数稳定性

Abstract: In the paper, we denote to investigate the critically exponential stability of static continuous recurrent neural networks with Sigmoidal functions. By using matrix measure theory, we proved that if there exists a positive definite diagonal matrix Γ, such that $S(\Gamma,L)$, the matrix defined by the network, is nonnegative definite, then the network has a unique equilibrium state y^*, and when y^* is not one given point, then y^* is globally exponential stability on R^N. The obtained results not only improved the existing non-critical conclusions on global stability of the neural networks with sigmoidal functions, but also unified and extended the known critical stability results to a largest extent.

Key words: recurrent neural networks Sigmoidal functions critical analysis globally exponential stability

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[1] Hopfield J J. Neural Networks and Physical Systems with Emergent Collective Computational Abilities. *Proc. Nat. Acad. Sci.*, 1982, 2554-2558

[2] Hopfield J J, Tank D W. Computing with Neural Circuits: a Model. *Science*, 1986, 233: 625-633

[3] Hogg R V. More Light on the Kurtosis and Related Statistics. *J. Amer. Statist. Assoc.*, 1972, 67: 422-424

[4] Uthoff V A. The Most Powerful Scale and Location Invariant Test of Normal Versus Double Exponential. *Ann. Statist.*, 1973, 1: 17(
174

[5] Lehmann E L. Testing Statistical Hypotheses, Second Edition. New York: Wiley, 1986

[6] Almedia L B. Backpropagation in Perceptrons with Feedback. In: R. Eckmiller & C. Malsburg (Eds.), Neural Computers. Berlin: Sprin Verlag, 1988, 199-208

[7] Johnson N L, Kotz S. Distribution in Statistics: Continuous Univariate Distribution-2, Vol.3, New York, Wiley, 1970

[8] Patel J K, Kapadia C H, Owen D B. Handbook of Statistical Distributions. New York: Marcel Dekker, 1976

[9] Pinder F J. Generalization of Back-propagation to Recurrent Neural Networks. *Phys. Rev. Lett.,* 1987, 59: 2229-2232

[10] Patil G P, Boswell M T, Ratnaparkhi M V. A Modern Dictionary and Classified Bibliography of Distribution: Continuous Univariate Mo Vol.1. International Co-operative Publishing House, Fairland, MD, 1982

[11] Kosko, B. Bidirectional Associative Memories. *IEEE Trans. Syst., Man Cybern.,* 1988, 18: 49-60

[12] Shen S Y. A Measure of Information and Its Applications. ???: Hunan Education Press, 1993

[13] Qiao H, Peng J G, Xu Z B, et al. A Reference Model Approach to Stability Analysis of Neural Networks. *IEEE Trans. Syst., Man Cybern.,* 2003, 33: 925-936

[14] Ord J K. Laplace Distribution. In: Encyclopedia of Statistical Sciences (eds by Kotz, S. and Johnson, N.L.), 4: 473-475, Wiley, Ne York, 1983

[15] Lua W L, Chen T P. R_n^+-global Stability of a Cohen-Grossberg Neural Network System with Nonnegative Equilibria. *Neural Netw.,* 2007, 20: 714-722

[16] McGraw D K, Wagner J F. Elliptically Symmetric Distributions. *IEEE Transactions on Information Theory*, 1968, 14: 110-120

[17] Cao J, Wang J. Global Asymptotic and Robust Stability of Recurrent Neural Networks with Time Delays. *IEEE Trans. Circuits Syst.* 2005, 52: 417-426

[18] Fang K T, Anderson T W. Statistical Inference in Elliptically Contoured and Related Distributions. New York: Allerton Press, 1990

[19] Qiao C, Xu Z B. On the P-critical Dynamics Analysis of Projection Recurrent Neural Networks. *Neurocomputing*, 2010, 73: 2783-2

[20] 乔琛, 徐宗本. 局部域反馈神经网络的全局收敛性. 应用数学学报, 2009, 32: 536-545 (Qiao C, Xu Z B. Analysis on Global Convergence for Local Field Recurrent Neural Networks. *Acta Mathematicae Applicatae Sinica,* 2009, 32: 536-545)

[21] Barlow R E, Mendel M B. The Operational Bayesian Approach. In: Aspects of Uncertainty (eds by Freeman, P.R. and Smith, A.F.M New York: Wiley, 1994, 19-28

[22] Xu Z B, Qiao C. Towards a Unified Feedback Neural Network Theory: the Uniformly Pseudo-projection-anti-monotone Net. *Acta Mathematica Sinica* (English Series), 2011, 27: 377-396

[23] Mendel M B. Development of Bayesian Parametric Theory with Applications to Control. MIT Ph.D Dissertation, 1968

[24] Chen T P, Amari S I. New Theorems on Global Convengence of Some Dynamical Systems. *Neural Netw.,* 2001, 14: 251-255

[25] Chen T P. Global Convergence of Delayed Dynamical Systems. *IEEE Trans. Neural Netw.,* 2001, 12: 1532-1536

[26] Liu X W, Chen T P. A New Result on the Global Convergence of Hopfield Neural Networks. *IEEE Trans. Circuits Syst.,* 2002, 49: 15 1516

[27] Peng J G, Xu Z B, Qiao H, et al. A Critical Analysis on Global Convergence of Hopfield-type Neural Networks. *IEEE Trans. Circuits Syst.*, 2005, 52: 804-814

[28] Chen T P, Amari S I. Stability of Asymmetric Hopfield Networks. *IEEE Trans. Neural Netw.,* 2001, 12: 159-163

[29] Fang Y, Kincaid T G. Stability Analysis of Dynamical Neural Networks. *IEEE Trans. Neural Netw.,* 1996, 7: 996-1006

[30] Ng K W, Fraser D A S. Inference for Linear Models with Radially Decomposable Error. In: Multivariate Analysis and Its Applications (eds by Anderson, T.W., Fang, K.T. and Olkin, I.), 359-367. IMS Lecture Notes Monograph Series, Vol.24, 1994

[31] Ernst M D. A Multivariate Generalized Laplace Distribution. *Comput. Statist*, 1998, 13: 227-232

[32] Xu Z B, Qiao H, Peng J G, Zhang B. A Comparative Study of Two Modeling Approaches in Neural Networks. *Neural Netw.,* 2004, 1 73-85

[33] Kotz S, Kozubowski T J, Podgórski K. The Laplace Distribution and Generalizations: a Revisit with Applications to Communications, Economics, Engineering and Finance. Boston: Birkhaüser, 2001

[34] Wang L S, Zhang R, Xu Z B, Peng J G. Some Characterizations of Global Exponential Stability of a Generic Class of Continuous-tim Recurrent Neural Networks. *IEEE Trans. Syst., Man Cybern.,* 2009, 39: 763-772

[35] Gentle J E. Least Absolute Values Estimation: an Introduction. *Commun. Stat. - Simul. Comput.*, 1977, B6(4): 313-328

[36] Storm T. On Logarithmic Norms. *SIAM J. Numer. Anal.*, 1975, 2: 741-753

[1] 孟益民, 黄立宏, 郭振远. 具不连续激励函数Cohen-Grossberg神经网络周期解的全局指数稳定性[J]. 应用数学学报, 2009, 32(1): 154-168.

[2] An Ping CHEN, Jin De CAO, Li Hong HUANG. 时滞BAM神经网络周期解的存在性和全局指数稳定性[J]. 应用数学学报, 2005, 28(2): 193-209.

[3] 王利生, 陈白丽. 非线性系统稳定分析的特征函数法及其应用[J]. 应用数学学报, 2001, 24(4): 495-501.