Acta Mathematicae Applicatae Sinica (Chinese Series)
ISSN 0254-3079
CN 11-2040/O1

应用数学学报 » 2012, Vol. 35 » Issue (5): 879-891 DOI:

时变线性分布参数系统的鲁棒指数稳定性分析

张为元[1,2], 李俊民[1], 夏志乐[1,3]

1. 西安电子科技大学理学院, 西安 710071;
2. 咸阳师范学院数学与应用数学研究所, 咸阳 712000;
3. 浙江省台州学院数信学院, 台州 317000

Robust Exponential Stability Criteria for Linear Distributed Parameter Systems with Time-varying Delay

ZHANG Weiyuan[1,2], LI Junmin[1], XIA Zhile[1,3]

1. School of Science, Xidian University, Xi'an 710071;
2. Institute of Math. and Applied Math., Xianyang Normal University, Xianyang 712000;
3. School of Mathematics and Information Engineering, Taizhou University, Taizhou 317000

- 摘要
- 参考文献
- 相关文章

全文: PDF (358 KB) HTML (1 KB) 输出: BibTeX | EndNote (RIS) 背景资料

摘要 研究了一类不确定性分布参数系统的鲁棒指数稳定性和稳定化问题. 利用推广到Hilbert空间的Lyapunov-Krasovskii方法和不等式技巧, 证明了线性时滞系统的鲁棒指数稳定性, 并且依赖时滞的鲁棒指数稳定性和稳定化的充分条件可以表示成线性算子不等式(LOI)形式, 其中决策变量是Hilbert空间的算子. 把得到的结果应用到一个抛物型方程, 这些条件归结为线性矩阵不等式(LMI). 最后, 一个数值例子说明了稳定性分析的有效性.

关键词: 分布参数系统 不确定性 指数稳定性 Lyapunov泛函

Abstract: This paper presents robust exponential stability and stabilization conditions for uncertain linear distributed parameter time-delay systems. Based on the Lyapunov-Krasovskii method extended to a Hilbert space, robust exponential stability criteria are derived and linear matrix inequality (LMI) technique. Sufficient delay-dependent conditions for robust exponential stability are obtained in the form of linear operator inequalities (LOI), where the decision variables are operators in the Hilbert space. Being applied to a parabolic equation, these conditions are reduced to standard Linear Matrix Inequalities (LMI). Finally, an example is provided to demonstrate the effectiveness of the proposed criteria.

Key words: distributed parameter systems uncertainty exponential stability Lyapunov functional

收稿日期: 2010-06-17;

基金资助:国家自然科学基金(60974139), 中央高校基本科研业务费专项资金(72103676) 和陕西省教育厅专项科研项目(2010JK896, 01JK060)资助项目.

服务
- 把本文推荐给朋友
- 加入我的书架
- 加入引用管理器
- E-mail Alert
- RSS

作者相关文章
- 张为元
- 李俊民
- 夏志乐

引用本文:

张为元,李俊民,夏志乐. 时变线性分布参数系统的鲁棒指数稳定性分析[J]. 应用数学学报, 2012, 35(5): 879-891.

ZHANG Weiyuan,LI Junmin,XIA Zhile. Robust Exponential Stability Criteria for Linear Distributed Parameter Systems with Time-varying Delays[J] Acta Mathematicae Applicatae Sinica, 2012, 35(5): 879-891.

[1] Kolmanovskii V, Myshkis A. Applied Theory of Functional Differential Equations. Boston: Kluwer Academic Publishers, 1999

[2] Datko R. Not all Feedback Stabilized Hyperbolic Systems are Robust with Respect to Small Time Delays in Their Feedbacks. *SIAM Journal on Control and Optimization*, 1988, 26: 697-713

[3] Logemann H, Rebarber R, Weiss G. Conditions for Robustness and Nonrobustness of the Stability of Feedback Systems with Resp to Small Delays in the Feedback Loop. *SIAM Journal on Control and Optimization*, 1996, 34(2): 572-600

[4] Nicaise S, Pignotti C. Stability and Instability Results of the Wave Equation with a Delay Term in the Boundary or Internal Feedba *SIAM Journal on Control and Optimization*, 2006, 45(5): 1561-1585

[5] Wang T. Stability in Abstract Functional-differential Equations, I!I Applications. *Journal of Mathematical Analysis and Applications* 1994, 186: 835-861

[6] Wu J. Theory and Applications of Partial Functional Differential Equations. New York: Springer-Verlag, 1996

[7] Fridman E, Orlov Y. Exponential Stability of Linear Distributed Parameter Systems with Time-varying Delays. Automatica, 2009, 45 194-201

[8] Qiua J, Cao J. Delay-dependent Exponential Stability for a Class of Neural Networks with Time Delays and Reaction-diffusion Term *Journal of the Franklin Institute*, 2009, 346: 301-314

[9] 廖晓昕, 杨叔子, 程时杰等. 具有反应扩散的广义神经网络的稳定性. 中国科学, E辑, 2002, 32(1): 87-94 (Liao X X, Yang S Z, Cheng S J, et a Stability of General Neural Networks with Reaction-diffusion. *J. Science in China (Series E)*, 2002, 32(1): 87-94)

[10] 王林山, 徐道义. 变时滞反应扩散 Hopfield 神经网络的全局指数稳定性. 中国科学, E辑, 2003, 33(6): 488-495 (Wang L S, Xu D Y. Global Exponential Stability of Hopfield Reaction-diffusion Neural Networks with Time-varying Delays. *Science in China (Series E)*, 2003, (6): 488-495)

[11] Phat V N, Nam P T. Exponential Stability and Stabilization of Uncertain Linear Time-varying Systems Using Parameter Dependent Lyapunov Function. *Control*, 2007, 80: 1333-1341

[12] Xu S, Lam J, Zou Y. Further Results on Delay-dependent Robust Stability Conditions of Uncertain Neutral Systems. Robust Nonlin Control, 2005, 15: 233-246

[13] Wang Y, Xie L, C E de Souza. Robust Control of a Class of Uncertain Nonlinear Systems. *Syst. Control Lett.*, 1992, 22: 139-149

[14] Hien L V, Phat V N. Exponential Stability and Stabilization of a Class of Uncertain Linear Time-delay Systems. *of the Franklin Institute*, 2009, 346: 611-625

[15] Chen W H, Guan Z H, Lu X. Delay-dependent Output Feedback Guaranteed Cost Control for Uncertain Time-delay Systems. *Automatica*, 2004, 40: 1263-1268

[16] Curtain R, Zwart H. An Introduction to Infinite-dimensional Linear Systems. New York: Springer-Verlag, 1995

[17] Pazy A. Semigroups of Linear Operators and Application to Partial Differential Equations. New York: Springer-Verlag, 1983

[18] Gu K, Kharitonov V, Chen J. Stability of Time-delay Systems. Boston: Birkhauser, 2003

[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] 王英楠, 韩继业, 孙华. 一种不确定需求下库存-定价模型的鲁棒优化方法[J]. 应用数学学报, 2008, 31(5): 910-921.

[3] 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.

[4] 李春发, 冯恩民 , 胡建国. 三维种群生态动力系统的参数识别[J]. 应用数学学报, 2004, 27(1): 64-71.

[5] 赵春山, 李开泰. 描述地球物理流动的磁流体型发展方程定常解的L~r指数稳定性[J]. 应用数学学报, 2002, 25(4): 604-616.

[6] 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.