

论文与报告

基于自适应动态规划的一类带有时滞的离散时间非线性系统的最优控制策略

魏庆来, 张化光, 刘德荣, 赵琰

1. 中国科学院自动化研究所 北京 100190
2. 东北大学信息科学与工程学院 沈阳 110004
3. 沈阳工程学院控制工程系 沈阳 110136

收稿日期 2008-9-5 修回日期 2009-3-3 网络版发布日期 接受日期

摘要

针对一类状态和控制变量均带有时滞的非线性系统的带有二次性能指标函数最优控制问题, 本文提出了一种基于新的迭代自适应动态规划算法的最优控制方案. 通过引进时滞矩阵函数, 应用动态规划理论, 本文获得了最优控制的显式表达式, 然后通过自适应评判技术获得最优控制量. 本文给出了收敛性证明以保证性能指标函数收敛到最优. 为了实现所提出的算法, 本文采用神经网络近似性能指标函数、计算最优控制策略、求解时滞矩阵函数、以及给非线性系统建模. 最后本文给出了两个仿真例子说明所提出的最优策略的有效性.

关键词

[自适应动态规划\(ADP\)](#) [近似动态规划](#) [时滞](#) [最优控制](#) [非线性系统](#) [神经网络](#)

分类号

An Optimal Control Scheme for a Class of Discrete-time Nonlinear Systems with Time Delays Using Adaptive Dynamic Programming

WEI Qing-Lai, ZHANG Hua-Guang, LIU De-Rong, ZHAO Yan

1. Key Laboratory of Complex Systems and Intelligence Science, Institute of Automation, Chinese Academy of Sciences, Beijing 100190, P.R. China
2. School of Information Science and Engineering, Northeastern University, Shenyang 110004, P.R. China
3. Department of Automatic Control Engineering, Shenyang Institute of Engineering, Shenyang 110136, P.R. China

Abstract

In this paper, an optimal control scheme for a class of nonlinear systems with time delays in both state and control variables with respect to a quadratic performance index function is proposed using a new iterative adaptive dynamic programming (ADP) algorithm. By introducing a delay matrix function, the explicit expression of the optimal control is obtained using the dynamic programming theory and the optimal control can iteratively be obtained using the adaptive critic technique. Convergence analysis is presented to prove that the performance index function can reach the optimum by the proposed method. Neural networks are used to approximate the performance index function, compute the optimal control policy, solve delay matrix function, and model the nonlinear system, respectively, for facilitating the implementation of the iterative ADP algorithm. Two examples are given to demonstrate the validity of the proposed optimal control scheme.

扩展功能

本文信息

- ▶ [Supporting info](#)
- ▶ [PDF\(777KB\)](#)
- ▶ [\[HTML全文\]\(0KB\)](#)
- ▶ [参考文献\[PDF\]](#)
- ▶ [参考文献](#)

服务与反馈

- ▶ [把本文推荐给朋友](#)
- ▶ [加入我的书架](#)
- ▶ [加入引用管理器](#)
- ▶ [复制索引](#)
- ▶ [Email Alert](#)

相关信息

- ▶ [本刊中 包含 “](#)

[自适应动态规划\(ADP\)的 相关文章](#)

▶ 本文作者相关文章

- [魏庆来](#)
- [张化光](#)
- [刘德荣](#)
- [赵琰](#)

Key words [Adaptive dynamic programming \(ADP\)](#) [approximate dynamic programming](#) [time delay](#) [optimal control](#) [nonlinear system](#) [neural networks](#)

DOI: 10.3724/SP.J.1004.2010.00121

通讯作者 魏庆来 qinglaiwei@gmail.com

作者个人主页 魏庆来; 张化光; 刘德荣; 赵琰