短文

规则可生长与修剪的非线性系统T-S模糊模型辨识

廖龙涛, 李少远, 黄广斌

1. 上海交通大学自动化系 上海 200240

2. 南洋理工大学电机与电子工程学院 新加坡 639798, 新加坡

摘要
通常离线提取 T-S 模糊模型的规则后, 规则数无法在模型使用中进行调整, 而这成为表达非线性系统复杂性的一个瓶颈. 针对这一问题, 本文引入一种神经网络的生长和修剪方法, 从实时数据中提取 T-S 模型的规则, 并定义其对应局部模型对输出的影响, 以此作为在线调整规则数的依据, 从而更准确地表达了非线性系统的复杂性和运行中的变化. 再加上基于竞争性 EKF(Extended Kalman filter) 的模型参数在线学习, T-S 模型的建模精度也得到了保证. 整个算法完全实现了 T-S 模糊模型的在线辨识, 使模型的结构和参数具有很好的自适应能力. 对 CSTR(Continuously stirred tank reactor) 系统的辨识, 表明了该算法在处理非线性系统辨识问题上的优越性能.
关键词   T-S模型   模糊规则   生长与修剪   平均响应   在线辨识
分类号   TP273

T-S Fuzzy Model Identification with Growing and Pruning Rules for Nonlinear Systems

LIAO Long-Tao, LI Shao-Yuan, HUANG Guang-Bin

1. Department of Automation, Shanghai Jiao Tong University, Shanghai 200240

2. School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore 639798, Singapore

Abstract
Offline rule extraction for the T-S fuzzy systems usually gives a fixed number of fuzzy rules, which make it a bottleneck for revealing the complexity of nonlinear systems. Thus, due to a growing and pruning strategy of the neural network, in this paper the fuzzy rules are extracted from real-time data and their number is adjusted online by the impact degree of one local model, such that the rules vary with the system dynamically and more precisely reflect the character of nonlinear systems. Furthermore, the accuracy of the T-S model is guaranteed by the parameter learning based on a competitive extended Kalman filter (EKF). The entire algorithm presents a completely online identification of the T-S model and gains a structural and parameter adaptability. An example for CSTR identification illustrates its good performance.
Key words   T-S model   fuzzy rule   growing and pruning   average response   online identification

通讯作者   李少远 syli@sjtu.edu.cn
作者个人主页   廖龙涛; 李少远; 黄广斌