自动化学报 2010 36 (6): 865-872 ISSN: 0254-4156 CN: 11-2109/TP

论文与报告

RBF神经网络的结构动态优化设计

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收稿日期 2009-8-27 修回日期 2009-10-23 网络版发布日期 接受日期

摘要

针对径向基函数(Radial basis function, RBF)神经网络的结构设计问题, 提出一种结构动态优化设计方法. 利用敏感度法(Sensitivity analysis, SA)分析隐含层神经元的输出加权值对神经网络输出的影响, 以此判断增加或删除RBF神经网络隐含层中的神经元, 解决了RBF神经网络结构过大或过小的问题, 并给出了神经网络结构动态变化过程中收敛性证明; 利用梯度下降的参数修正算法保证了最终RBF网络的精度, 实现了神经网络的结构和参数自校正. 通过对非线性函数的逼近与污水处理过程中关键参数的建模结果, 证明了该动态RBF具有良好的自适应能力和逼近能力, 尤其是在泛化能力、最终网络结构等方面较之最小资源神经网络(Minimal resource allocation networks, MRAN)与增长和修剪RBF 神经网络(Generalized growing and pruning radial basis function, GGAP-RBF) 有较大提高.

关键词 径向基函数神经网络 动态设计 动态结构RBF 化学需氧量建模

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Optimal Structure Design for RBFNN Structure

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Abstract

Due to the fact that the conventional radial basis function (RBF) neural network cannot change the structure on-line, a new dynamic structure RBF (D-RBF) neural network is designed in this paper. D-RBF is based on the sensitivity analysis (SA) method to analyze the output values of the hidden nodes for the network output, then the hidden nodes in the RBF neural network can be inserted or pruned. The final structure of D-RBF is not too large or small for the objectives, and the convergence of the dynamic process is investigated in this paper. The grad-descend method for the parameter adjusting ensures the convergence of D-RBF neural network. The structure of the RBF neural network is self-organizing, and the parameters are self-adaptive. In the end, D-RBF is used for the non-linear functions approximation and the non-linear systems modelling. The results show that this proposed D-RBF obtains favorable self-adaptive and approximating ability. Especially, comparisons with the minimal resource allocation networks (MRAN) and the generalized growing and pruning RBF (GGAP-RBF) reveal that the proposed algorithm is more effective in generalization and finally neural network structure.

Key words Radial basis function (RBF) neural network dynamic design dynamic structure RBF (D-RBF) chemical oxygen demand (COD) modelling

DOI: 10.3724/SP.J.1004.2010.00865

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