Adaptive recurrent neural network control using a structure adaptation algorithm

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Abstract

This paper proposes an adaptive recurrent neural network control (ARNNC) system with structure adaptation algorithm for the uncertain nonlinear systems. The developed ARNNC system is composed of a neural controller and a robust controller. The neural controller which uses a self-structuring recurrent neural network (SRNN) is the principal controller, and the robust controller is designed to achieve tracking performance with desired attenuation level. The SRNN approximator is used to online estimate an ideal tracking controller with the online structuring and parameter learning algorithms. The structure learning possesses the ability of both adding and pruning hidden neurons, and the parameter learning adjusts the interconnection weights of neural network to achieve favorable approximation performance. And, by the control design technique, the worst effect of approximation error on the tracking error can be attenuated to be less or equal to a specified level. Finally, the proposed ARNNC system with structure adaptation algorithm is applied to control two nonlinear dynamic systems. Simulation results prove that the proposed ARNNC system with structure adaptation algorithm can achieve favorable tracking performance even unknown the control system dynamics function.

Keyword：Adaptive control, robust control, recurrent neural network, structure adaptation.