Robust fuzzy-neural sliding-mode controller design via network structure adaptation

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Abstract

In this paper, a robust fuzzy-neural sliding-mode control (RFSC) scheme for unknown nonlinear systems is proposed. The RFSC system is composed of a computation controller and a robust controller. The computation controller containing a self-structuring fuzzy neural network (SFNN) identifier is the principal controller, and the robust controller is designed to achieve tracking performance. The SFNN identifier uses the structure and parameter learning phases to perform the estimation of the unknown system dynamics. The structure learning phase consists of the growing of membership functions, the split of fuzzy rules, and the pruning of fuzzy rules; and thus the SFNN identifier can avoid the time-consuming trial-and-error tuning procedure for determining the network structure of fuzzy neural network. Finally, the proposed RFSC system is applied to three nonlinear dynamic systems. The simulation results show that the proposed RFSC system can achieve favorable tracking performance by incorporating SFNN identifier, sliding-mode control, and robust control techniques.

Keyword：fuzzy neural network, parameter adaptation algorithm, structure adaptation algorithm, adaptive control, robust control, sliding-mode control