Adaptive asymmetric fuzzy neural network controller design via network structuring adaptation

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Abstract

This paper proposes a self-structuring fuzzy neural network (SFNN) using asymmetric Gaussian membership functions in the structure and parameter learning phases. An adaptive self-structuring asymmetric fuzzy neural-network control (ASAFNC) system which consists of a SFNN controller and a robust controller is proposed. The SFNN controller uses a SFNN with structure and parameter learning phases to online mimic an ideal controller, simultaneously. The structure learning phase consists of the growing and pruning algorithms of fuzzy rules to achieve an optimal network structure, and the parameter learning phase adjusts the interconnection weights of neural network to achieve favorable approximation performance. The robust controller is designed to compensate for the modeling error between the SFNN controller and the ideal controller. An online training methodology is developed in the Lyapunov sense, and thus the stability of the closed-loop control system can be guaranteed. Finally, the proposed ASAFNC system is applied to a second-order chaotic dynamics system. The simulation results show that the proposed ASAFNC can achieve favorable tracking performance.

Keyword：Fuzzy neural network, asymmetric Gaussian membership function, structure adaptation algorithm, adaptive control