Design of a CMAC-based smooth adaptive neural controller with a saturation compensator

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Abstract

In the conventional CMAC-based adaptive controller design, a switching compensator is designed to guarantee system stability in the Lyapunov stability sense but the undesirable chattering phenomenon occurs. This paper proposes a CMAC-based smooth adaptive neural control (CSANC) system that is composed of a neural controller and a saturation compensator. The neural controller uses a CMAC neural network to online mimic an ideal controller and the saturation compensator is designed to dispel the approximation error between the ideal controller and neural controller without any chattering phenomena. The parameter adaptive algorithms of the CSANC system are derived in the sense of Lyapunov stability, so the system stability can be guaranteed. Finally, the proposed CSANC system is applied to a Chua's chaotic circuit and a DC motor driver. Simulation and experimental results show the CSANC system can achieve a favorable tracking performance. It should be emphasized that the development of the proposed CSANC system doesn't need the knowledge of the system dynamics.

Keyword：Chua's chaotic circuit; DC motor driver;CMAC neural network; Adaptive control; Neural control