Fuzzy-identification-based adaptive backstepping control using a self-organizing fuzzy system

許駿飛, 陳品成, 李祖添, 王啟旭
Electrical Engineering
Engineering
fei@chu.edu.tw

Abstract

In this paper, a fuzzy-identification-based adaptive backstepping control (FABC) scheme is proposed. The FABC system is composed of a backstepping controller and a robust controller. The backstepping controller, which uses a self-organizing fuzzy system (SFS) to on-line estimate controlled system dynamics with the structure and parameter learning phases, is the principal controller, and the robust controller is designed to dispel the effect of approximation error introduced by the SFS. The developed SFS automatically generates and prunes the fuzzy rules by the proposed structuring adaptation algorithm and the parameters of the fuzzy rules and membership functions tunes on-line in the Lyapunov sense. Thus, the overall closed-loop FABC system can guarantee that the tracking error and parameter estimation error are uniformly ultimately bounded; and the tracking error converges to a desired small neighborhood around zero. Finally, the proposed FABC system is applied to a chaotic dynamic system to show its effectiveness. The simulation results verify that the proposed FABC system can achieve favorable tracking performance even with unknown controlled system dynamics.

Keyword：Adaptive control, backstepping control, chaotic dynamic system, self-organizing fuzzy system, structuring adaptation.