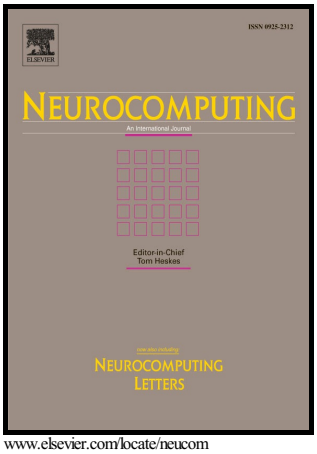

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Adaptive Neural Tracking Control for Uncertain Nonlinear Systems with Input and Output Constraints Using Disturbance Observer

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Abstract: This paper investigates the tracking control problem for a class of strict-feedback nonlinear uncertain systems in the presence of unknown disturbance, input and output constraints. By using backstepping approach, an adaptive tracking controller is developed on the basis of neural network and disturbance observer. The Nussbaum function is introduced to tackle the problem of the nonlinear term arising from the input saturation, and the barrier Lyapunov function is employed to prevent the outputs from violating the constraints. The disturbance observer is developed to estimate unknown external disturbances. The proposed control scheme can guarantee that all signals of the closed-loop system are bounded by using the Lyapunov analysis method. Finally, the simulation results for three degrees of freedom (3-DOF) model helicopter are given to illustrate the effectiveness of the developed control scheme.

Keywords: Backstepping control; Input constraint; Output constraint; Neural network; Disturbance observer

1 Introduction

In physical systems, the control input and output cannot be unlimited as a result of the limitations of actuators and requirements for control performance. Hence, control systems are often subject to corresponding constraints on their input and output variables. Fortunately, the constraint control problem has received considerable attention and many significant results have been obtained in the recent years. In [1], a systematic Lyapunov approach was proposed for the regional stability and performance analysis of saturated systems. A robust model predictive control algorithm was provided for the output feedback control problem of constrained linear discrete-time systems in the presence of unknown disturbances in [2]. A control algorithm combined with invariant set theory and tube-based

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