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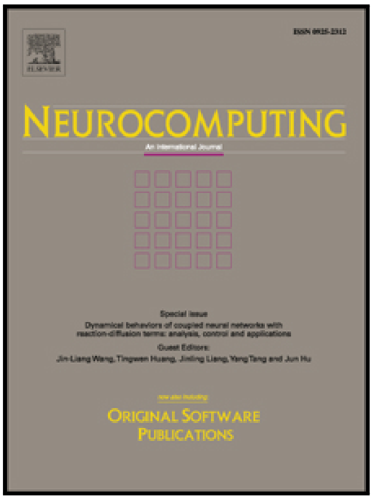

Adaptive neural control of constrained strict-feedback nonlinear systems with input unmodeled dynamics

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Adaptive neural control of constrained strict-feedback nonlinear systems with input unmodeled dynamics

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Abstract: In this paper, adaptive neural dynamic surface control(DSC) is developed for a class of constrained strict-feedback nonlinear systems with input unmodeled dynamics. By introducing a one to one nonlinear mapping, the output constrained strict feedback system in the presence of unmodeled dynamics is transformed into a novel unconstrained strict-feedback system. Neural networks (NNs) are employed to approximate unknown nonlinear continuous functions. A normalization signal and an updating parameter are used to handle the uncertain term which input unmodeled dynamics brings about in the design final step. By adding the normalization signal to the whole Lyapunov function and using the defined compact set in stability analysis, all the signals in the closed-loop system are proved to be semi-globally uniformly ultimately bounded (SGUUB), and output constraint is not violated. Two numerical examples are used to illustrate the effectiveness of the proposed adaptive DSC method in handling input unmodeled dynamics.

Keywords: Output constraint; Input unmodeled dynamics; Adaptive control; Neural networks; Dynamic surface control; Strict-feedback nonlinear systems

1 Introduction

It is well known that backstepping design [1, 2, 3, 4] and dynamic surface control(DSC) [5, 6, 7, 8, 9, 10, 11, 12] have become two kinds of popular design tools for the adaptive control of nonlinear systems. They have been recently used to design adaptive control of nonlinear systems with output or full state constraints in [10–20]. Based on backstepping method, adaptive control schemes were developed by using barrier Lyapunov function (BLF) and integral barrier Lyapunov functionals (iBLF) for strict-feedback nonliner systems with static output constraint or time-varying output constraint or partial state constraints in [13, 14, 15, 16]. Furthermore, the problem of adaptive control was discussed by using iBLF for a class of uncertain constrained pure-feedback systems in [17]. However, the virtual control gains were assumed to be known in the above results. Adaptive neural control was

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