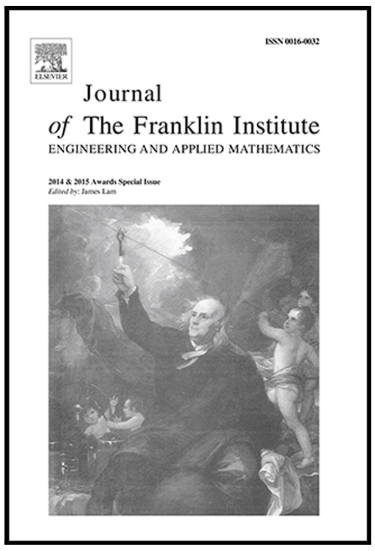

Error-driven nonlinear feedback-based fuzzy adaptive output dynamic surface control for nonlinear systems with partially constrained tracking errors

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Error-driven nonlinear feedback-based fuzzy adaptive output dynamic surface control for nonlinear systems with partially constrained tracking errors[1]

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Abstract

In this paper, a novel error-driven nonlinear feedback technique is designed for partially constrained errors fuzzy adaptive observer-based dynamic surface control of a class of multiple-input-multiple-output nonlinear systems in the presence of uncertainties and interconnections. There is no requirements that the states are available for the controller design by constructing fuzzy adaptive observer, which can online identify the unmeasurable states using available output information only. By transforming partial tracking errors into new error variables, partially constrained tracking errors can be guaranteed to be confined in pre-specified performance regions. The feature of the error-driven nonlinear feedback technique is that the feedback gain self-adjusts with varying tracking errors, which prevents high-gain chattering with large errors and guarantees disturbance attenuation with small errors. Based on a new non-quadratic Lyapunov function, it is proved that the signals in the resulted closed-loop system are kept bounded. Simulation and comparative results are given to demonstrate the effectiveness of the proposed method.

Keywords: Fuzzy adaptive observer, Dynamic surface control, Nonlinear feedback, Partially constrained error, Prescribed performance, Uncertain MIMO nonlinear system.

1. Introduction

Nonlinear control design has been a research hotspot in the past decades due to its general better performance than linear control [1, 2, 3, 4, 5, 6, 7]. Backstepping method was originally proposed to design stabilizing control for nonlinear dynamical systems [8, 9, 10, 11, 12], which laid the research foundation for some subsequent theoretical results in particular for the control of high-order systems with various nonlinearities, including uncertain dynamics, input saturation, unknown control directions, backlash-like hysteresis, and so on [13, 14, 15, 16].

Nevertheless, the problem of "explosion of complexity" is an inherent imperfection of the backstepping method raised by the differentiations of virtual controllers in the recursive design procedures, which worsens particularly in the backstepping-based control of high-order nonlinear systems. Fortunately, a pioneering technique named after dynamic surface control (DSC) was proposed to circumvent such a problem by filtering the intermediate controllers, and as a result, thus the differentiations of virtual

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