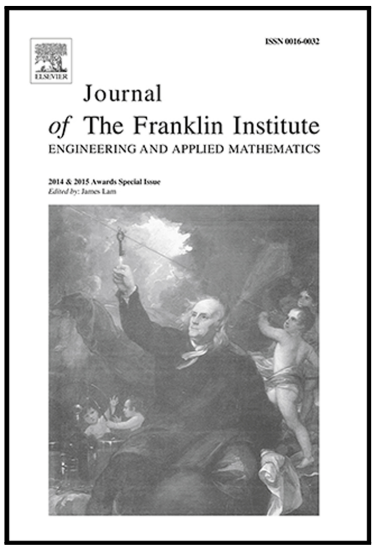

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Adaptive Finite-Time Control for Stochastic Nonlinear Systems Subject to Unknown Covariance Noise

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Abstract: This paper is devoted to the adaptive finite-time control for a class of stochastic nonlinear systems driven by the noise of covariance. The traditional growth conditions assumed on the drift and diffusion terms are removed through a technical lemma, and the negative effect generated by unknown covariance noise is compensated by combining adaptive control technique with backstepping recursive design. Then, without imposing any growth assumptions, a smooth adaptive state-feedback controller is skillfully designed and analyzed with the help of the adding a power integrator method and stochastic backstepping technique. Distinctive from the global stability in probability or asymptotic stability in probability obtained in related work, the proposed design algorithm can guarantee the solution of the closed-loop system to be finite-time stable in probability. Finally, a stochastic simple pendulum system is skillfully constructed to demonstrate the effectiveness of the proposed control scheme.

Keywords: Stochastic nonlinear systems; Finite-time stable in probability; Adaptive state-feedback; Backstepping; Covariance noise.

1 Introduction

In practical plants, many systems can be modeled by nonlinear differential equations such as the simple pendulum systems, tunnel diode circuit, mechanical systems and robot systems, etc., which render nonlinear control play an increasing crucial role in the field of engineering. To make nonlinear control design implementable, the backstepping recursive technique [1], control Lyapunov function [2], nonlinear stability theory [3]-[4] and other design methods have emerged and been well developed in [5]-[12] and the references therein. On the other hand, it is well-known that stochastic noises extensively occur in real plants including parameter perturbations, stochastic errors, external environment variations and so on. Due to this fact and practical systems are largely nonlinear, the investigation on stochastic nonlinear systems has been a hot topic in control fields. Considering the well transient response performance, backstepping technique has been successfully extended to stochastic nonlinear systems by [13], which lays a solid foundation for the control design of stochastic nonlinear

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