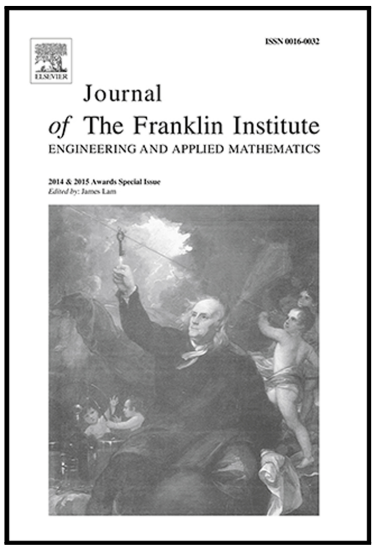

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PII: S0016-0032(17)30329-0
DOI: 10.1016/j.jfranklin.2017.07.015
Reference: FI 3054

To appear in: *Journal of the Franklin Institute*

Received date: 23 January 2017
Revised date: 14 June 2017
Accepted date: 1 July 2017

Please cite this article as: Xinghua Liu, Alessandro N. Vargas, Xinghuo Yu, Long Xu, Stabilizing two-dimensional stochastic systems through sliding mode control, *Journal of the Franklin Institute* (2017), doi: 10.1016/j.jfranklin.2017.07.015

Stabilizing two-dimensional stochastic systems through sliding mode control ☆

Xinghua Liu[a], Alessandro N. Vargas[b,c,*], Xinghuo Yu[d], Long Xu[d]

[a] *School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore, 639798*
[b] *Universidade Tecnológica Federal do Paraná, UTFPR, Av. Alberto Carazzai 1640, 86300-000 Cornelio Procópio-PR, Brazil.*
[c] *Universitat Politècnica de Catalunya Barcelona Tech, Escola d'Enginyeria de Barcelona Est, CoDAlab (Control, Dynamics and Applications), Carrer d'Eduard Maristany, 10-14, 08930 Barcelona, Spain.*
[d] *School of Engineering, RMIT University, Melbourne VIC 3001, Australia*

Abstract

This paper presents a stabilizing control for two-dimensional stochastic differential equations. The stability concept in this study is the stability in probability. To ensure such a stability, the control is designed based on the sliding mode technique, and applied to account stochastic systems. This finding has a practical implication—the proposed control can be used to stabilize a real-time automotive electronic throttle valve. The proposed approach is verified by data collected from experiments.

Keywords: stochastic systems, stability in probability, sliding mode control, control applications, automotive applications.

1. Introduction

Stability of stochastic differential equations has been investigated intensively during the past decades, showing a rich literature, see [2, 10, 17, 28, 29] for a brief account. Despite the progress made, stability results rely on general conditions based on n-dimensional systems, having n as either finite [17] or infinite [12]. That general conditions, though, do not apply in some practical circumstances—the case in which real-time control devices are modeled as two-dimensional systems (see an example in Section 3).

This paper contributes towards the stability of two-dimensional stochastic systems.

To clarify the contribution, some notations are now introduced. Given a complete filtered probability space $(\Omega, \mathscr{F}, \{\mathscr{F}_t\}_{t\geq 0}, \mathbb{P})$, consider the next two-dimensional stochastic

☆Research supported in part by the National Key Scientific Research Project of China (61233003) and by the Brazilian agencies FAPESP Grants 03/06736-7; CNPq Grant 304856/2007-0; and CAPES Grant Programa PVE 88881.030423/2013-01.

*Corresponding author
Email address: avargas@utfpr.edu.br (Alessandro N. Vargas)