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Sundarapandian Vaidyanathan
Chang-Hua Lien *Editors*

Applications of Sliding Mode Control in Science and Engineering

 Springer

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Contents

Sliding Mode Control Design for Some Classes of Chaotic Systems	1
Yi-You Hou, Cheng-Shun Fang and Chang-Hua Lien	
Sliding Mode Based Control and Synchronization of Chaotic Systems in Presence of Parametric Uncertainties	35
Moez Feki	
Chattering Free Sliding Mode Controller Design for a Quadrotor Unmanned Aerial Vehicle.	61
Nour Ben Ammar, Soufiene Bouallègue, Joseph Haggège and Sundarapandian Vaidyanathan	
Terminal Sliding Mode Controller Design for a Quadrotor Unmanned Aerial Vehicle.	81
Rabii Fessi, Soufiene Bouallègue, Joseph Haggège and Sundarapandian Vaidyanathan	
Insensibility of the Second Order Sliding Mode Control via Measurement Noises: Application to a Robot Manipulator Surveillance Camera.	99
Marwa Fathallah, Fatma Abdelhedi and Nabil Derbel	
Robust Control of a Photovoltaic Battery System via Fuzzy Sliding Mode Approach.	115
Alessandro Baldini, Lucio Ciabattoni, Riccardo Felicetti, Francesco Ferracuti, Alessandro Freddi, Andrea Monteriù and Sundarapandian Vaidyanathan	
Particle Swarm Optimization Based Sliding Mode Control Design: Application to a Quadrotor Vehicle	143
Alessandro Baldini, Lucio Ciabattoni, Riccardo Felicetti, Francesco Ferracuti, Alessandro Freddi, Andrea Monteriù and Sundarapandian Vaidyanathan	

Global Stabilization of Nonlinear Systems via Novel Second Order Sliding Mode Control with an Application to a Novel Highly Chaotic System	171
Sundarapandian Vaidyanathan	
Complete Synchronization of Chaotic Systems via Novel Second Order Sliding Mode Control with an Application to a Novel Three-Scroll Chaotic System	193
Sundarapandian Vaidyanathan	
Novel Second Order Sliding Mode Control Design for the Anti-synchronization of Chaotic Systems with an Application to a Novel Four-Wing Chaotic System	213
Sundarapandian Vaidyanathan	
Control and Synchronization of a Novel Hyperchaotic Two-Disk Dynamo System via Adaptive Integral Sliding Mode Control	235
Sundarapandian Vaidyanathan	
Adaptive Integral Sliding Mode Controller Design for the Control and Synchronization of a Rod-Type Plasma Torch Chaotic System	263
Sundarapandian Vaidyanathan	
Adaptive Integral Sliding Mode Controller Design for the Regulation and Synchronization of a Novel Hyperchaotic Finance System with a Stable Equilibrium	289
Sundarapandian Vaidyanathan	
Adaptive Integral Sliding Mode Controller Design for the Control of a Novel 6-D Coupled Double Convection Hyperchaotic System	319
Sundarapandian Vaidyanathan	
A Memristor-Based Hyperchaotic System with Hidden Attractor and Its Sliding Mode Control	343
Sundarapandian Vaidyanathan	
Adaptive Integral Sliding Mode Control of a Chemical Chaotic Reactor System	371
Sundarapandian Vaidyanathan	
Adaptive Integral Sliding Mode Controller Design for the Control and Synchronization of a Novel Jerk Chaotic System	393
Sundarapandian Vaidyanathan	
Sliding Mode Control Design for a Sensorless Sun Tracker	419
Ahmed Rhif and Sundarapandian Vaidyanathan	

Super-Twisting Sliding Mode Control of the Enzymes-Substrates Biological Chaotic System.	435
Sundarapandian Vaidyanathan	
Super-Twisting Sliding Mode Control and Synchronization of Moore-Spiegel Thermo-Mechanical Chaotic System	451
Sundarapandian Vaidyanathan	

A Memristor-Based Hyperchaotic System with Hidden Attractor and Its Sliding Mode Control

Sundarapandian Vaidyanathan

Abstract Memristor-based systems and their potential applications, in which memristor is both a nonlinear element and a memory element, have been received significant attention in the control literature. In this work, we study a memristor-based hyperchaotic system with hidden attractors. First, we study the dynamic properties of the memristor-based hyperchaotic system such as equilibria, Lyapunov exponents, Kaplan-Yorke dimension, etc. We obtain the Lyapunov exponents of the memristor-based system as $L_1 = 0.2205$, $L_2 = 0.0305$, $L_3 = 0$ and $L_4 = -10.7862$. Since there are two positive Lyapunov exponents, the memristor-based system is hyperchaotic. Also, the Kaplan-Yorke fractional dimension of the memristor-based hyperchaotic system is obtained as $D_{KY} = 3.0233$, which shows the high complexity of the system. We show that the memristor-based hyperchaotic system has no equilibrium point, which shows that the system has a hidden attractor. Control and synchronization of chaotic and hyperchaotic systems are important research problems in chaos theory. Sliding mode control is an important method used to solve various problems in control systems engineering. In robust control systems, the sliding mode control is often adopted due to its inherent advantages of easy realization, fast response and good transient performance as well as insensitivity to parameter uncertainties and disturbance. Next, using integral sliding mode control, we design adaptive control and synchronization schemes for the memristor-based hyperchaotic system. The main adaptive control and synchronization results are established using Lyapunov stability theory. MATLAB simulations are shown to illustrate all the main results of this work.

Keywords Memristor • Hidden attractor • Chaos • Hyperchaos • Adaptive control • Synchronization • Sliding mode control

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343