ORIGINAL ARTICLE

Fractional Quadratic Nonlinearity SprottSliding Mode Synchronization Control of Chaotic System

Xindi Cui

Institute of Aviation Industry Management,Henan, Zhengzhou450015

Abstract: In this paper, the fractional Quadratic nonlinearSprottSynchronization Control of Chaotic Systems.According to the related theory of Fractional Calculus,Sufficient Conditions for synchronization of the system are obtained.,The results show that:Select the appropriate control law,Fractional OrderSprottSliding Mode Chaotic Synchronization for master-slave systems.

Keyword: Fractional OrderSprottSystem;Sliding Mode

1. Introduction

Chaotic Synchronization of control systems has attracted much attention in recent years.[1],With the development of Fractional Calculus, more and more scholars start to study the control and synchronization of fractional chaotic system.[2¡3],Literature[4]Adaptive Sliding Mode chaotic synchronization Problem for a Class of Uncertain fractional order chaotic systems is studied.,Able to synchronize the driver system with the Response System;Literature[5]Synchronization Control of Fractional-order chaotic system based on active Sliding Mode Control;Literature[6]Linear Feedback and active control method are respectively used to study two differentSprottControl and synchronization of Chaotic Systems;Literature[7]A class of simple quadratic nonlinearity is studied.SprottAnalysis and Control of chaotic system,The stability and Stability of the equilibrium point are obtained.HopfBifurcation;Literature[8]Adaptive Sliding Mode Terminal Control for a Class of Uncertain chaotic systems is studied..In this paper, the fractional Quadratic nonlinearSprottSliding Mode synchronization control and terminal control of chaotic system,Got fractional orderSprottSufficient Condition for chaotic synchronization with Sliding Mode.Definition1.[9]CaputoFractional Derivative is defined

2. Fractional Order Sliding Mode Synchronization Control Problem

$E_1(T)!0$:In the same wayBy$D_T{}^{®}E_2=E_1Y_3{}^2¡X_3{}^2U_2$; $U_2(T)$ $=X_3{}^2¡Y_3{}^2¡E_1¡E_2)$ $D_T{}^{®}E_2=¡E_2$;So have$E_2(T)!0$:And$D_T{}^{®}E_3=E_2¡.3U_3$; $U_3(T)$ $=E_{1.3}¡$'SGN (S(T));By sliding mode onS(T) = 0;So'SGN (S(T) = 0;And because$E_1E_2E_3$= 0) $D_T{}^{®}E_3=¡E_3)$ $E_3(T)!0$:When state trajectory don't is located in Sliding Mode on whenSelectLyapunovFunctionV(T) $=^1{}_2S^2(T))V^{Of}$ –(T) =S(T)S(T);S(T) $=D_T{}^{®\,¡\,1}(E_1E_2E_3))$ S(T) $=D_T{}^{®}(E_1E_2E_3)$; V^{Of} –(T) =S(T)S(T) $=S(T)[D_T{}^{®}E_1D_T{}^{®}E_2D_T{}^{®}E_3]=S(T)[¡E_1¡E_2E_1E_2¡$'SGN (S(T)] =¡'JS(T)J<0:SoS(T)Is can be product of and boundedAccording to Lemma1 (Barbalat'sLemma)We can know thatS(T)!0) $E_I(T)!0$:

From the above analysis we can know thatError System will convergence in zero.

3. Fractional Order Sliding Mode Terminal Control Problem

Lemma2[11]The assumption that there is continuous positive definite functionV(T)Meet differential inequality

V^{Of}_{-}(T)In ¡PV'(T); 8 t, a T_0; V(T_0),0;

-InP>0;0<'<1Is two normal numberThe for any givenT_0; V(T)Meet the following inequality

$V^{1¡'}$(T)In $V^{1¡'}$(T_0)¡P(1¡')(T ¡t_0); T_0<T;

AndV(T)'0T.0;Among themT=$T^{V1.¡'(T0)}$:

S_I(T)Is can be product of and boundedAccording to Lemma1 (Barbalat'sLemma)We can know thatS(T)!0) E_I(T)!0:

4. Numerical Simulation

In order to (methods of correctnessUse four order Runge-Kuta method the system the simulation study.

Theorem1InSystem Parameters select®= 0:95; B= 2:1; C= 1:2,Select sliding mode SurfaceS(T) =$D_T^{®}$ ¡ ^{1}($E_1E_2E_3$);Controller

U_1(T) = 2E_2¡E_1; U_2(T) =X_3^2¡Y_3^2¡E_1¡E_2; U_3(T) =$E_{1.3}$¡'SGN (S(T));Drive System and Response System of initial value respectively is set

(X_1; X_2; X_3) = (7/:3;6:4;9:2);(Y_1; Y_2; Y_3) = (8:5;5:7/;3:6);'= 3;

Its system of error curve as shown in Figure1Shown in.Figure2 3Respectively on don't additive with controller two conducted simulationError System(2.3)In not sure the respectively

4f_1(Y) = Cos (2¼ Y_2); 4f_2(Y) = 0:5 cos (2¼ Y_3); 4f_3(Y) = 0:3 cos (2¼ Y_2);

External disturbance takeD_1(T) = 0:2 cosT; d_2(T) = 0:6 sinT; d_3(T) = Cos 3T;The initial value of Driver System and Response System

Do not set($X_{1.}$; $X_{2.}$; $X_{3.}$) = (7):3.;6.:4.;9.:2);($Y_{1.}$$Y_{2.}$$Y_{3.}$) = (8):5.;5.:7.;3.:6)No controller and Controller System

Two simulation results of2,3Shown,If sliding mode surface parameters take,$_1$= 3;,$_2$= 4;,$_3$= 7/; R= 0:6;Control

Controller in parameters select^1= 3; K_1= 9; K_2= 8; K_3= 5;(M^$_1$; M^$_2$; M^$_3$) = (0:3;0:5;1);(^N_1; N^$_2$; N^$_3$) =

(0:8;0:6;0:3);At this time of system error curve and simulation results as shown in Figure4Shown inFigure4See System of error soon reaching in zero.

5. Conclusion

Based on Stability Theory Study the fraction order secondary nonlinearSprottSystem of Sliding Mode chaotic synchronous control and sliding mode terminal Synchronous Control ProblemAnd given the strict of proveNumerical simulation clear methods of effectivenessThis paper Fractional Order Sliding Mode of design can be used to solve a kind of fractional order chaotic system of Sliding Mode Terminal Synchronous Control Problem.

References

1. Lee Deok-kyuEven Ngoc Binh.Single Time-Delay classLorenzSystemHopfBifurcation Analysis[J].Journal of Mathematics2015 35 (3): 635 {642.
2. Mohammad p. robust-time stabilization of Fractional-order stochastic items based on frac-tional Lyapunov stability theory [J]. j. comp. nonl. dyn ., 2012, 7: 1011 {1015.
3. Sun Ning,Zhang Huaguang,Wang zhiliang.Sliding Mode projective synchronization of uncertain fractional Chaotic Systems[J].Journal of Zhejiang University(Engineering Edition), 2010, 44 (7): 1288 {1291.
4. Yu Mingzhe,Zhang youan.Sliding Mode Adaptive Synchronization for a Class of Uncertain fractional Chaotic Systems[J].Journal of Beijing University of Aeronautics and Astronautics, 2014, 40 (9): 1276 {1280.
5. Zhong qilong,Shao Yonghui,Cheng yongai.Active sliding mode synchronization of Fractional-order Chaotic Systems[J].Journal of dynamics and Control, 2015, 13 (1): 18 {22.
6. Xu dengguo.Two differentSprottResearch on Control and synchronization of chaotic system[J].Journal of dynamics and Control, 2007, 5 (4): 330 {333.
7. Grigoras V, grigoras C. A novel chaotic systems for Random Pulse Generation [J]. adv. Elec. Comp. Engin., 2014, 14 (2): 109 {112.
8. Fu jingchao,Sun Jing,Li Peng song.A class of simple quadratic NonlinearitySprottAnalysis and Control of chaotic system[J].Journal of Jilin University(Science Edition), 2015, 53 (3): 395 {400.
8. Podlubny. fractional di®Erential equation [M]. New York: Academic Press, 1999.
9. Mei shengwei,Shin tielong,Liu zhikang.Modern Robust Control Theory and Application[M].Beijing:Tsinghua

University Press, 2003.
10. Bhat s p Bernstein d s. geometric homogeneity. applications. ¯ Nite-time stability [J]. math. control Sign. SYS ., 2005 17 (2): 101 {127.
11. Mohammad p a? Sohrab? K. Finite-time synchronization. Two di®Erent chaotic systems with UN-"Parameters via sliding mode technique [J]. Appl. Math. Model. 2011 35 (6): 3080 {3091.