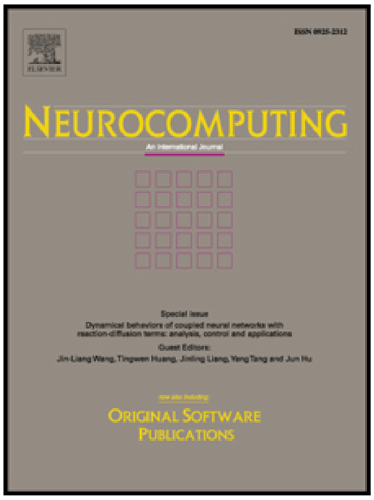
Communicated by Dr xianming zhang

Accepted Manuscript



Switching Event-triggered Network-synchronization for Chaotic Systems with Different Dimensions

Qiaoping Li, Sanyang Liu

PII: S0925-2312(18)30614-3
DOI: 10.1016/j.neucom.2018.05.039
Reference: NEUCOM 19592

To appear in: *Neurocomputing*

Received date: 26 December 2017
Revised date: 4 May 2018
Accepted date: 15 May 2018

Please cite this article as: Qiaoping Li, Sanyang Liu, Switching Event-triggered Network-synchronization for Chaotic Systems with Different Dimensions, *Neurocomputing* (2018), doi: 10.1016/j.neucom.2018.05.039

Switching Event-triggered Network-synchronization for Chaotic Systems with Different Dimensions

Qiaoping Li[a,b,*], Sanyang Liu[a]

[a] School of Mathematics and Statistics, Xidian University, Xi'an 710071, China
[b] School of Mathematical Sciences, Henan Institute of Science and Technology, Xinxiang 453003, China

Abstract

In this paper, a novel switching event-triggered synchronization scheme is established for chaotic networked control systems with different dimensions. First, a reduced-dimension observer is constructed to help the response system estimate all the states of the drive system. Next, a switching event-triggered networked control method which depends both on relative error and absolute error of the sampled-data is designed to reduce the burden of network bandwidth effectively while ensuring the desirable synchronization performance. On the basis of the above, some sufficient synchronization criterions are derived in the form of linear matrix inequalities. Finally, the numerical simulation is carried out to demonstrate the effectiveness and superiority of the synchronization method.

Keywords: Norm event-triggered mechanism, Exponential event-triggered mechanism, Switching Event-triggered mechanism, Networked control system, Reduced-dimension observer, Chaotic system, Network bandwidth.
2010 MSC: 93C10

1. Introduction

Due to their non-periodicity of trajectory, sensitivity to initial value, boundedness of state, long-term behavior unpredictability and other special characteristics, chaotic systems have become active research objects. Meanwhile, due to its potential applications in secure communication, the synchronization of chaotic systems has also attracted increasing attentions [1, 2, 3, 4, 5, 6, 7].

However, most of the existing synchronization works focus on structurally equivalent systems, such as identical systems or nonidentical systems whose nonidentity is resulted from a rather small parameter mismatch [8]. Practically, in many real systems, the synchronization is carried out through the oscillators with different dimensions. Especially for the network secure communication, the greater the structural difference between the drive system and the response system, the better the secrecy performance. Therefore, the hybrid synchronization between different dimensional chaotic systems becomes a new meaningful and challenging topic. In [9, 10], by establishing an output function of the drive system, the chaotic synchronization between the response system and partial states of the drive system is realized. In [11], by constructing a nonlinear observer, all states of the drive system can be successfully tracked by the augmented response system.

However, all the chaotic synchronization schemes mentioned above are based on the traditional time-triggered control method which means all the sampled-data will be transmitted. In fact, for network secure communication, the network in networked control systems (NCSs) is a shared band-limited digital communication network, thus a valuable problem is how to reduce the network bandwidth utilization without damaging the stability and the other desired control performance of the NCSs [12, 13, 14, 15, 16, 17, 18]. If the traditional time-triggered control method is used in NCSs, it will result in a lot of useless data being transmitted and many network resources being wasted. To avoid this problem, the event-triggered communication scheme has been proposed whose basic idea is the sampled-data being transmitted only when a threshold is reached, which ensures less network sampled-data is transmitted and the burden of network bandwidth occupation is relieved. Due to the advantages mentioned above, event-triggered control has been applied in many real systems in which resources are scarce, such as networked control system, wireless sensor networks, embedded systems and multi-agent systems.

So far, there are two types of event-triggered communication scheme in the existing literatures, which are the norm event-triggered mechanism (NETM) and the exponential event-driven mechanism (EETM).

The norm event-triggered mechanism (NETM) is the most commonly used one. In this communication scheme, the next transmission instant is determined by

$$\begin{aligned} t_{k+1}h &= t_kh + \min_{l\in Z^+}\{lh|\delta_k^T(t)\Phi\delta_k(t) \\ &\geq \sigma x^T(t_kh+lh)\Phi x(t_kh+lh)\}, \end{aligned} \quad (1)$$

*Corresponding author
Email address: liqiaoping1981@126.com (Qiaoping Li)