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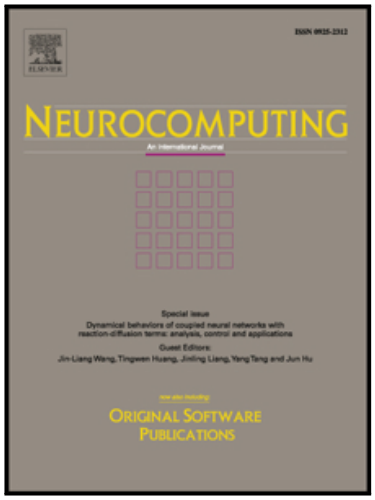


Stochastic finite-time synchronization for discontinuous semi-Markovian switching neural networks with time delays and noise disturbance

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# Stochastic finite-time synchronization for discontinuous semi-Markovian switching neural networks with time delays and noise disturbance

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**Abstract**

This paper deals with the global stochastic finite-time synchronization in probability for discontinuous semi-Markovian switching neural networks with time delays and noise disturbance. Firstly, the formula for calculating the global stochastic settling time of semi-Markovian switching nonlinear system with Brown motion is developed. Secondly, the novel state-feedback controllers, which include discontinuous factors and integral terms, are designed to realize the global stochastic finite-time synchronization goal. Under Filippov stochastic differential inclusion framework, by applying Lyapunov-Krasovskii functional approach, stochastic analysis theory, inequality analysis technique and the developed stochastic finite-time stability theorem, the global stochastic finite-time synchronization conditions are addressed in terms of linear matrix inequalities (LMIs). Moreover, the expressions about the upper bound of stochastic settling time are explicitly proposed. In addition, the relativity among the obtained results is analytically interpreted. Finally, two numerical examples are provided to demonstrate the validity of the proposed design methods and theoretical results.

*Keywords:* Neural networks; Stochastic finite-time synchronization; Semi-Markovian switching; Noise disturbance; Discontinuous activation function; Time delays

## 1. Introduction

In the past decades, dynamical neural networks (NNs) have been found extensive applications in optimization, image and signal processing, parallel computation, automatic control, associative memories and so on, see [1-5]. Such applications bring the considerable attention from a lot of scholars to the dynamic behavior of the network, such as stability, periodic oscillation and chaos, etc., see [6-15], and references therein.

Recently, the synchronization of NNs with discontinuous activations receives the increasing interest from many researchers due to its potential applications in secure communication [16], cryptography [17] and so on.

In [18], Cai et al. investigated exponential synchronization of NNs with discontinuous activations and time-varying delays by designing discontinuous state-feedback controller. In [19], Liu et al. discussed the dissipativity and quasi-synchronization for NNs with discontinuous activations and parametermis-matches. In [20], Wu et al. considered generalized lag synchronization for a class of NNs with discontinuous activation functions and bounded external disturbances under the framework of Filippov solutions. Non-fragile chaotic synchronization for discontinuous NNs with time delays and random feedback gain uncertainties was studied in [21]. In [22], the authors addressed global anti-synchronization of a class of discontinuous chaotic memristive NNs with time-varying delays by utilizing differential inclusions theory and the inequality technique. In [23], Liu et al. discussed the complete periodic synchronization of delayed NNs with discontinuous activations. General decay synchronization for a class of delayed chaotic NNs with discontinuous activations was investigated in [24].

It is well known that, among the different types of synchronization, the maximum of synchronization time can be only calculated under the finite-time synchronization, see [25-29]. Very recently, a lot of research efforts have focused on solving the finite-time synchro-

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