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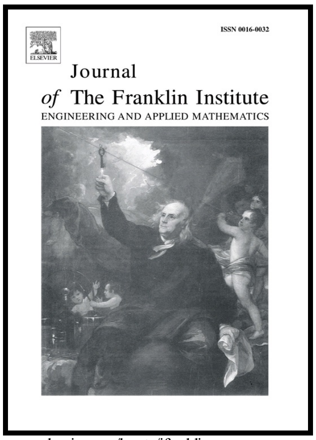

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Passivity of Linearly Coupled Neural Networks With Reaction-Diffusion Terms and Switching Topology

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Abstract

In this paper, we first propose a general array model of coupled reaction-diffusion neural networks with switching topology. Then, by utilizing the Lyapunov functional method combined with some inequality techniques, several sufficient conditions are established to ensure the input strict passivity and output strict passivity of the proposed network model. Furthermore, we reveal the relationship between passivity and stability of the proposed model. Based on the obtained passivity results and relationship between passivity and stability, a synchronization criterion is presented. Finally, two numerical examples are provided to demonstrate the correctness and effectiveness of the theoretical results.

Keywords: Coupled Reaction-Diffusion Neural Networks, Input Strict Passivity, Output Strict Passivity, Switching Topology

1. Introduction

Recently, neural networks (NNs) have been extensively studied in various fields due to their broad applications such as optimization [1], signal processing [2], wind speed prediction [3] and associative memory [4]. Moreover, many NNs complete a task through interplay or communication with each other in many circumstances [2]. Therefore, coupled NNs have received much attention in recent years. So far, a great many important results on coupled NNs have been obtained [5–12]. In [5], the authors investigated robust synchronization for the coupled neural networks with mixed delays and uncertain parameters by utilizing the intermittent pinning control idea. Wang et al. [6] studied exponential synchronization for an array of N randomly coupled neural networks with Markovian jump and mixed model-dependent time delays via impulsive control. Yang et al. [7] investigated the global chaotic synchronization of general coupled neural networks, in which both discrete and distributed delays have been considered.

Unfortunately, in these existing works [10–12], the diffusion effects have not been considered. Strictly speaking, the diffusion phenomena could not be ignored in NNs and electric circuits once electrons transport in a nonuniform electromagnetic field [13]. However, very few researchers have investigated the coupled NNs with reaction-diffusion terms [14–17]. In [14], the author investigated the $\mu-$synchronization of linearly coupled NNs with reaction-diffusion terms, in which the time delay can be unbound and non-differential. Wang et al. [15] studied the synchronization of coupled NNs with reaction-diffusion, and established several criteria for synchronization by utilizing adaptive feedback control technique. In [16], the authors designed some adaptive strategies to tune the coupling strengths among network nodes. By using the designed adaptive laws, several sufficient conditions were established for reaching synchronization. Yang et al. [17] studied the synchronization of coupled reaction-diffusion NNs with time-varying delays via pinning-impulsive controller. Unfortunately, in these existing works on coupled reaction-diffusion NNs, they always assume the topology structure is fixed [14–17]. However, the fixed topology is very restrictive and only reflects a few ideal situations. In many real-world networks, the connection topology may change very quickly by switches [18, 19]. Therefore, it is very meaningful to take switching topology in a network into consideration. To the best of our knowledge, the coupled reaction-diffusion NNs with switching topology has not yet been investigated.

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