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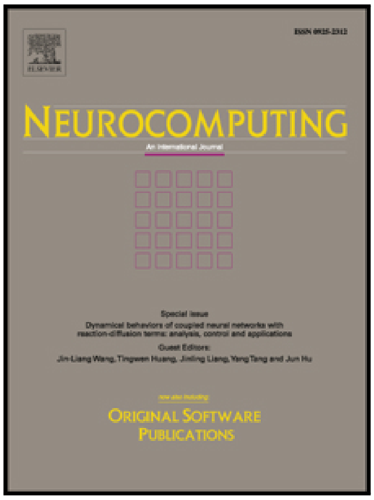

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Event-triggered non-fragile state estimation for delayed neural networks with randomly occurring sensor nonlinearity

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Abstract

This paper is concerned with event-triggered non-fragile state estimator design for delayed neural networks subject to randomly occurring sensor nonlinearity. Different from the existing event-triggered scheme, a new event-triggered scheme is designed which is dependent on the incomplete measurement. The adopted event-triggered scheme is introduced between the neural networks and state estimator for the purpose of energy saving. Considering the sensor nonlinearity and using the event-triggered scheme, a new estimation error system is modeled. Based on this model, a sufficient condition is derived to guarantee the asymptotical stability of estimation error system. Furthermore, a desired event-triggered non-fragile estimator is designed by solving a set of linear matrix inequalities. Finally, a numerical example is provided to illustrate the usefulness of the proposed method.

Key words: Event-triggered scheme; neural networks; sensor nonlinearity; state estimation

1. Introduction

In the past several decades, neural networks have received considerable attention due to the fact that they have widely applications in signal processing, target tracking, pattern recognition and so on. Many outstanding results have been achieved [1–4]. It is well known that understanding the neuron states is an essential step to apply the neural networks and realize the desired performance in practice. However, it is often difficult to acquire the complete information immediately of all the neuron states, and only a series of observations can we obtain. Therefore, much effort has been devoted to the neuron state estimation problem [5–7].

In many practical systems, there exist many unavoidable factors such as drastic variations of flow rates, pressures, and temperatures. Such harsh environments can make the sensor measurement imperfect, which result in nonlinear characteristic of sensors. The method based on linear measurements can not deal with the sensor nonlinearity effectively. Therefore, how to solve sensor nonlinearity on filter and controller design has been paid much attention [8–14]. For example, in [8], the authors are concerned with the problem of asynchronous $l_2 - l_\infty$ filtering for discrete-time stochastic Markov jump systems with sensor nonlinearity. In [10], the issue of finite state estimation is investigated for coupled Markovian neural networks subject to sensor nonlinearities. The filter design is discussed in [9] for Markov jump systems with incomplete transition probabilities subject to sensor nonlinearities. The H_∞ filtering problem is considered for discrete time-delay systems with quantization and stochastic sensor nonlinearity in [14]. However, in most aforementioned literatures, communication constraints between the system plant and the state estimator is not considered. All the sampled sensor measurements will be transmitted to the estimator leading to an unnecessary transmission of sampled data. In some cases, the network bandwidth is limited, it is of great necessity to make high utilization of the precious communication resources in neural networks with sensor nonlinearity, which is the first motivation of this paper.

In recent years, the event-triggered communication strategy dependent on state or output measurements has attracted considerable attention in control community [15–18]. Different from the time-triggered case where the sampled signals are executed periodically, the sampled data under event-triggered scheme can be transmitted only if the predefined triggering condition is violated. The main advantage of the event-triggered scheme is that

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