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Protocol-Based State Estimation for Delayed Markovian Jumping Neural Networks

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***Abstract*—This paper is concerned with the state estimation problem for a class of Markovian jumping neural networks (MJNNs) with sensor nonlinearities, mode-dependent time delays and stochastic disturbances subject to the Round-Robin (RR) scheduling mechanism. The system parameters experience switches among finite modes according to a Markov chain. As an equal allocation scheme, the RR communication protocol is introduced for efficient usage of limited bandwidth and energy saving. The update matrix method is adopted to deal with the periodic time-delays resulting from the RR protocol. The objective of the addressed problem is to construct a state estimator for the MJNNs such that the dynamics of the estimation error is exponentially ultimately bounded in the mean square with a certain upper bound. Sufficient conditions are established for the existence of the desired state estimator by resorting to a combination of the Lyapunov stability theory and the stochastic analysis technique. Furthermore, the estimator gain matrices are characterized in terms of the solution to a convex optimization problem. Finally, a numerical simulation example is exploited to demonstrate the effectiveness of the proposed estimator design strategy.**

***Index Terms*—Markovian jumping neural networks, exponentially ultimately bounded estimator, Round-Robin protocol, sensor nonlinearities, mode-dependent time delays.**

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I. Introduction

For decades, due to their extraordinary capabilities in parallel information processing, adaptable data processing and dynamical learning as well as imitation, the artificial neural networks (ANNs) have been extensively applied in a variety of subject areas such as brain science, cognitive science and computer science. The successful applications of ANNs are largely reliant on the dynamical behaviors (e.g. convergence and stability) of the ANNs and, accordingly, the dynamics analysis issues for ANNs have become a hot topic of research attracting an ever-increasing interest with many interesting results reported in the literature, see e.g., [7], [25], [32], [40], [50], [53]–[56] and the references therein. On the other hand, time delays inevitably occur in hardware implementation of the ANNs for a number of reasons including inherent restriction on physical devices during information transmission and limited processing speeds among the units of networks. It is well known that time delays, if not adequately handled, might lead to performance degradation of the underlying system or even undesirable behaviors such as oscillation or even instability. As such, dynamical behaviors of delayed ANNs have been thoroughly investigated in the past few years. For example, delay-dependent criteria have been established in [16], [36], [58] to estimate the neuron states of a class of delayed neural networks through the