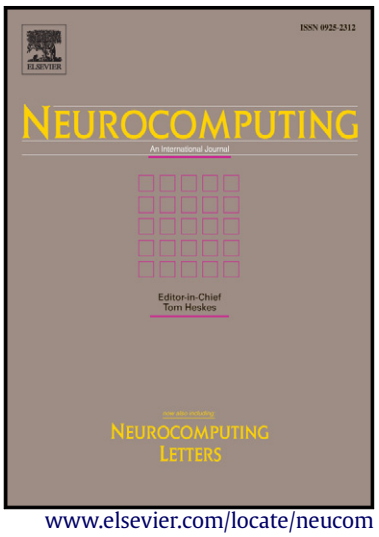

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Robust stability analysis for discrete-time genetic regulatory networks with probabilistic time delays

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Abstract

This paper investigates the robust stability problem of a class of discrete-time genetic regulatory networks (GRNs) with probabilistic time delays. Different from the previous works, at each instant the feedback regulation delay and translation delay are assumed to take values in two given finite sets with deterministic probability distributions, respectively. By utilizing a class of indicator functions and discrete-time Jensen inequality, delay-probability-distribution-dependent sufficient conditions are obtained in terms of linear matrix inequalities (LMIs) such that the discrete-time GRNs are robustly asymptotically stable in the mean-square sense for all admissible uncertainties and random delays. Three numerical examples are given to demonstrate the effectiveness of our theoretical results.

Keywords: Genetic regulatory networks (GRNs), Probabilistic time delays, Linear matrix inequalities (LMIs), Asymptotically mean-square stable.

1. Introduction

Genetic regulatory networks (GRNs) consisting of DNA, RNA, proteins, small molecules and their mutual regulatory interactions, have become an important new area of research in the biological and biomedical sciences and received widely attention recently [1-6]. Several useful models have been proposed for GRNs, for example, Boolean models [7], the differential equation models [8,9], the Petri net models [10], and discrete-time piecewise affine model [11,12]. Among these models, GRNs in the form of differential equation models have been intensively studied recently and fruitful results have been published (see, e.g., [13-15]).

It is revealed that time-delay is an important factor in dynamics of GRNs due to slow biochemical reactions such as gene transcription, translation, diffusion, and translocation processes [16,17]. Many valuable results for GNRs with time delays have been reported (see e.g., [2,4,13-15]). In [2], a nonlinear model for GRNs with SUM regulatory functions was presented, and the cases of GRNs with time-varying delays and stochastic perturbations were studied.

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