Editorial

Recent Developments on the Stability and Control of Stochastic Systems

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It is well known that stochastic models have come to play an increasingly important role in a wide range of research and application fields including engineering, physics, biology, finance, mechanics, electronics, and mathematics. The study of stochastic systems has attracted a large number of researchers. Various problems such as the stability, stabilization, state feedback control, adaptive control, filtering design, tracking control, state estimation, passivity, and adaptive synchronization have been investigated in the literature.

The accepted papers in this special issue include stochastic stability, finance and computation, stochastic H_∞ control, state estimation, state feedback control, robust filtering, multiagent systems, networked control systems, time-delayed systems, and neural networks.

The problem of stochastic stability is one of the most important problems in the fields of stochastic systems. There are 10 papers relating to this topic in this special issue. More precisely, the paper entitled “Further Results on Stability Analysis for Markovian Jump Systems with Time-Varying Delays” by O. M. Kwon et al. presents an improved delay-dependent stability criterion for a class of Markovian jump systems with time-varying delays by constructing a newly augmented Lyapunov-Krasovskii functional and combining Wirtinger-based integral inequality. The paper entitled “Globally Asymptotic Stability of Stochastic Nonlinear Systems by the Output Feedback” by W. Cheng et al. investigates the problem of the globally asymptotic stability for a class of stochastic nonlinear systems with the output feedback control

by developing a new method. The paper entitled “The Mean Stability Criteria in terms of Two Measures for Stochastic Differential Equations with Coefficient’s Uncertainty” by Rui Zhang et al. studies the stochastic stability criteria of two measures to the mean stability by applying optimal control approaches. The paper entitled “Exponential Stability of Jump-Diffusion Systems with Neutral Term and Impulses” by H. Yang et al. deals with the mean square and almost surely exponential stability for a class of jump-diffusion systems with neutral term and impulses. The paper entitled “Stochastic Stability of Discrete-Time Switched Systems with a Random Switching Signal” by K. Liu et al. presents a necessary and sufficient condition for stochastic stability of discrete-time linear switched system, where the switching signal allows fixed dwell time before a Markov switch occurs. The paper entitled “The Stationary Distribution and Extinction of Generalized Multispecies Stochastic Lotka-Volterra Predator-Prey System” by F. Yin and X. Yu establishes the existence of stationary distribution and extinction for multispecies stochastic Lotka-Volterra predator-prey system by using the Lyapunov method and space decomposition technique. The paper entitled “Stability Analysis of R&D Cooperation in a Supply Chain” by L. Xu et al. investigates the opportunistic behavior in the vertical R&D cooperation and analyzes the equilibrium of the cooperation. The paper entitled “Evolutionary Game-Theoretic Solution for Virtual Routers with Padding Misbehavior in Cloud Computing” by X. Bi et al. considers a detailed solution and analysis for describing the

normal behavior and padding misbehavior of virtual routers through analyzing the stability of the equilibrium points. The paper entitled “Finite-Time Boundedness of Markov Jump System with Piecewise-Constant Transition Probabilities via Dynamic Output Feedback Control” by B. Yan et al. studies the problem of finite-time boundedness of Markovian jump system with piecewise constant transition probabilities via dynamic output feedback control, which leads to both stochastic jumps and deterministic switches. The paper entitled “Consensus of Noisy Multiagent Systems with Markovian Switching Topologies and Time-Varying Delays” by Y. Shang presents some necessary and sufficient consensus conditions for two classes of multiagent systems: delays affecting only the output of the agents’ neighbors and delays affecting both the agents’ own outputs and the outputs of their neighbors.

The problem of H_∞ control is studied by a number of researchers, and new results are reported in these papers. The paper entitled “Asynchronous H_∞ Estimation for Two-Dimensional Nonhomogeneous Markovian Jump Systems with Randomly Occurring Nonlocal Sensor Nonlinearities” by R. Zhang et al. discusses the problem of asynchronous H_∞ estimation for a class of two-dimensional nonhomogeneous Markovian jump systems with nonlocal sensor nonlinearity, where the nonlocal measurement nonlinearity is governed by a stochastic variable satisfying the Bernoulli distribution. The paper entitled “ H_2/H_∞ Control Design of Detectable Periodic Markov Jump Systems” by T. Hou and H. Ma studies the infinite horizon H_2/H_∞ control problem for a class of discrete-time periodic Markov jump systems with (x, u, v) -dependent noise by using the spectral criterion of detectability and game theoretic approach. The paper entitled “ H_∞ Gain-Scheduled Control for LPV Stochastic Systems” by C.-C. Ku and G.-W. Chen investigates the robust control problem for a class of discrete-time uncertain stochastic systems by applying the gain-scheduled control scheme and linear parameter varying modeling approach as well as linear matrix inequality approach. The paper entitled “Robust H_∞ Filtering for Uncertain Neutral Stochastic Systems with Markovian Jumping Parameters and Time Delay” by Y. Li and Z. Huang considers the robust H_∞ filter design problem for a class of uncertain neutral stochastic systems with Markovian jumping parameters and time delay by using the Lyapunov-Krasovskii theory and generalized Finsler lemma. The paper entitled “Study on $\mathcal{H}_\infty$ -Index of Stochastic Linear Continuous-Time Systems” by Y. Li et al. presents a necessary and sufficient condition of $\mathcal{H}_\infty$ -index larger than $\gamma > 0$ and proves that the solvability of generalized differential equation and the feasibility of the $\mathcal{H}_\infty$ -index are equivalent.

In recent years, the applications of stochastic systems in finance and operations management have received much attention. The paper entitled “Dynamic Inventory and Pricing Policy in a Periodic-Review Inventory System with Finite Ordering Capacity and Price Adjustment Cost” by B. Yang et al. studies a dynamic inventory control and pricing optimization problem in a periodic-review inventory system with price adjustment cost. The paper entitled “A Random Parameter Model for Continuous-Time Mean-Variance Asset-Liability Management” by H. Ma et al. investigates

a continuous-time mean-variance asset-liability management problem in a market with random market parameters based on the theories of stochastic linear-quadratic optimal control and backward stochastic differential equations. The paper entitled “Concession Period Decision Models for Public Infrastructure Projects Based on Option Games” by Z. Wang et al. seeks out concession period decision models for public infrastructure with option game theory and studies the influence of minimum government income guarantee and government investment on concession period. The paper entitled “Multivariate Time-Varying G - H Copula GARCH Model and Its Application in the Financial Market Risk Measurement” by Q. Chen et al. depicts the return distribution of financial asset and constructs the multivariate time-varying G - H Copula GARCH model which can simultaneously describe “asymmetric, leptokurtic, heavy-tail” characteristics, the time-varying volatility characteristics, and the extreme-tail dependence characteristics of financial asset return by employing the strengths of G - H distribution, Copula function, and GARCH model. The paper entitled “Maximum Principle for Forward-Backward Stochastic Control System Driven by Lévy Process” by X. Wang and H. Huang studies some stochastic optimal control problems including the maximum principle and the linear quadratic problem, where the controlled system is described by a forward-backward stochastic differential equation, driven by Lévy process.

In addition, stochastic systems in other areas are considered in this special issue. The paper entitled “Optimal Design of Stochastic Distributed Order Linear SISO Systems Using Hybrid Spectral Method” by D. Pham et al. studies stochastic distributed order systems by using the operational matrix technique, the existing Monte-Carlo, polynomial chaos, and frequency methods. The paper entitled “The Impact of Aging Agricultural Labor Population on Farmland Output from the Perspective of Farmer Preferences” by G. Guo et al. investigates some factors to better understand the impact of an aging agricultural labor population on agricultural production. The paper entitled “On Two-Level State-Dependent Routing Polling Systems with Mixed Service” by G. Zheng et al. discusses an $N + 1$ that queues single-server two-level polling system which consists of one key queue and N normal queues based on priority differentiation and efficiency of the system. The paper entitled “Microstructure Models with Short-Term Inertia and Stochastic Volatility” by M. A. Kouritzin shows that all the price data sets exhibit strong evidence of both inertia and Heston-type stochastic volatility for a class of partially observed microstructure models, containing stochastic volatility, dynamic trading noise, and short-term inertia. The paper entitled “The Particle Filter Sample Impoverishment Problem in the Orbit Determination Application” by P. C. P. M. Pardal et al. discusses techniques for administering one implementation issue that often arises in the application of particle filters: sample impoverishment.

Finally, we remark that the selected topics and published papers may not be a comprehensive representation of recent developments on the stability and control of stochastic systems, but we strongly hope that the reader will find the special issue very useful.

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