

Editorial

Stochastic Systems: Modeling, Analysis, Synthesis, Control, and Their Applications to Engineering

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Stochastic optimal control and filtering theory have been at the forefront of modern control theory and communication engineering. Filtering theory has played a significant role in space explorations, navigation, aerospace, radar, satellite and meteorological applications.

In recent years, stochastic control theory has been playing an important role in the study of biomathematics and mathematical finance, as well as adaptive and network controlled systems, which is a vital research field in modern control theory. This is primarily because of the fact that deterministic systems are to a large extent an abstraction, and all practical systems do have a certain degree of random and uncertain behavior in the form of noise, disturbance, and random failures. Moreover, due to this element of randomness, stochastic systems are more complicated than deterministic systems.

Therefore, a satisfactory resolution of many new, challenging, and complicated problems arising in the above areas, other engineering fields and scientific phenomenon, and involving modeling, identification, estimation, analysis and synthesis, require more advanced tools and rigorous investigations than hitherto available.

This special issue aims to introduce new developments in the theory of stochastic control systems with applications to engineering fields such as communication, networked control, system reliability, and mathematical finance. However, the main focus of the special issue is on stochastic modeling, analysis, and control, with particular emphasis on stability and stabilization, adaptive control, robust optimal control and filtering. Close to 50 papers were received, but only 30 could be accepted after a rigorous peer review to guarantee

the highest quality of the special issue. A quick summary of the final accepted papers and therefore the contents of the special issue is as follows.

There are four papers concerning nonlinear stochastic adaptive control listed as follows: "*Nonsmooth adaptive control design for a large class of uncertain high-order stochastic nonlinear systems*," by J. Zhang and Y. Liu; "*Adaptive state-feedback stabilization for high-order stochastic nonlinear systems driven by noise of unknown covariance*," by C.-R. Zhao et al.; "*Adaptive output feedback control for a class of stochastic nonlinear systems with SiISS inverse dynamics*," by N. Duan and H.-K. Liu; "*High-order stochastic adaptive controller design with application to mechanical systems*," by J. Tian et al.

The second set of three papers deal with the application of stochastic control theory to mathematical finance and are listed as follows: "*Arbitrage-free conditions and hedging strategies for markets with penalty costs on short positions*," by O. L. V. Costa and E. V. Queiroz Filho; "*Multi-period mean-variance portfolio selection with uncertain time horizon when returns are serially correlated*," by L. Zhang and Z. Li; "*A fast Fourier transform technique for pricing European options with stochastic volatility and jump risk*," by S.-m. Zhang and L.-h. Wang.

The third set of papers are concerned with stochastic robust optimal control and filtering, and there are five papers in this category listed as follows: "*Robust H_∞ filtering for general nonlinear stochastic state-delayed systems*," by W. Zhang et al.; "*Indefinite LQ control for discrete-time stochastic systems via semidefinite programming*," by S. Zhou and W. Zhang; "*Robust reliable H_∞ control for nonlinear stochastic Markovian jump systems*," by G. Chen and Y. Shen; "*Weighted measurement fusion white noise deconvolution filter with correlated noise for multisensor stochastic systems*," by X. Wang et al.; "*Least-mean-square receding horizon estimation*," by B. Kwon and S. Han.

The fourth category of three papers are devoted to stochastic stability and stabilization and are entitled "*Robust stabilization for stochastic systems with time-delay and nonlinear uncertainties*," by Z. Yan et al.; "*New results on stability and stabilization of Markovian jump systems with partly known transition probabilities*," by Y. Guo and F. Zhu; "*Stochastic stability of damped Mathieu oscillator parametrically excited by a Gaussian noise*," by C. Floris.

Then come the fifth set of four papers dealing entirely with networked control and communication. These are listed as follows: "*Stability and stabilization of networked control systems with forward and backward random time delays*," by Y.-G. Sun and Q.-Z. Gao; "*Iterative learning control for remote control systems with communication delay and data dropout*," by C. Liu et al.; "*Evaluation of network reliability for computer networks with multiple sources*," by Y.-K. Lin and L. C.-L. Yeng; "*Robust distributed Kalman filter for wireless sensor networks with uncertain communication channels*," by Du. Y. Kim and M. Jeon.

In addition, there are two papers that are devoted to queuing systems and one paper to systems reliability. The first one is entitled "*A tandem BMAP/G/1 \rightarrow \bullet /M/N/0 queue with group occupation of servers at the second station*," by C. Kim et al., while the second one is entitled "*Stochastic approximations and monotonicity of a single server feedback retrial queue*," by M. Boualem et al. While the paper dealing with system reliability is entitled "*Probabilistic approach to system reliability of mechanism with correlated failure models*," by X. Huang and Y. Zhang.

The remaining set of papers deal with diverse topics and subjects, ranging from mobile robots to neural networks and from traffic control to navigation. We quickly recall their various titles here. One paper is concerned with the stabilization of nonholonomic mobile robot and is entitled "*Stochastic stabilization of nonholonomic mobile robot with heading-angle-dependent disturbance*," by Z. J. Wu and Y. H. Liu. The next paper deals with the synchronization of stochastic neural networks and is entitled "*Master-slave synchronization*

of stochastic neural networks with mixed time-varying delays," by Y. Ge et al. There is also one paper about BPP (Binomial-Poisson-Pascal) traffic entitled "Properties of recurrent equations for the full-availability group with BPP traffic," by M. Głabowski et al.

In addition, one paper studies population dynamics and is entitled "Existence and uniqueness for stochastic age-dependent population with fractional Brownian motion," by Z. Qimin and L. Xining. Then another paper analyzes the relationship between extreme climate indices in China and is entitled "The use of geographically weighted regression for the relationship among extreme climate indices in China," by C. Wang et al. Further, there is one paper concerning INS/WSN-integrated navigation entitled "INS/WSN-integrated navigation utilizing LS-SVM and H_∞ filtering," by Y. Xu et al., and then a paper dealing with wind-induced vibration control entitled "Wind-induced vibration control of Dalian International Trade Mansion by tuned liquid dampers," by H.-N. Li et al. The last paper discusses multiresolution analysis for random parameter fields and is entitled "Multiresolution analysis for stochastic finite element problems with wavelet-based Karhunen-Loève expansion," by C. Proppe.

Acknowledgments

As the Lead Guest Editor of this special issue, I wish to express my profound gratitude to my three coeditors for accepting to undertake this project with me and the wonderful accomplishment that we have been able to achieve. I hope that the excellent work that has been assembled in this special issue will go a long way in stimulating further research in this important and active research area, as well as answering a lot of questions that were hitherto unanswered. We are also deeply appreciative of the efforts of the authors in submitting to the special issue regardless of the outcome of the review process. Finally, we also want to thank all the referees who have helped us in ensuring the highest quality of papers to be included in the special issue, and without whose help nothing would have been accomplished. The cooperation of the Editor-in-Chief of Mathematical Problems in Engineering and the staff of Hindawi Publishing Corporation is hereby also graciously acknowledged.

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