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EMERGING AND SELECTED TOPICS IN CIRCUITS AND SYSTEMS

CALL for PAPERS

Complex Cyber-Multitudinal-Physical Systems: Analysis, Decision-Making, and AI Applications

Guest editors

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Scope and purpose

Modern society is greatly dependent on the efficient and safe operation of various complex networked systems, such as power systems, transportation systems, communication systems, financial systems, etc. A complex system is composed of numerous interacting components, and its overall functionality is determined by the dynamic characteristics of all the components and their interactions. With the deepening deployment of emerging technologies, real-world complex systems keep evolving and are growing into complex cyber-multitudinal-physical systems (CMPS). The word "multitudinal" indicates that new kinds of components with distinct dynamic characteristics are added to the system, whose addition can significantly change the collective behavior of the complex system from top to bottom. The words "cyber" and "physical" indicate that a cyber network is coupled and computer, control, and communication techniques are widely deployed to enhance the coordination of the physical components in the complex system. The integration of cyber and physical networks alters the interaction manners of the system components, thus changing the overall properties of the original complex system.

The classical approach to handling a complex system has resorted to mathematical and physical models, and designing classical control and optimization strategies. However, there lies a great dilemma with the classical approach: Simple models are tractable but sometimes oversimplify the mechanisms and the behaviors of complex systems which may result in non-negligible errors. On the other hand, detailed models that include more realistic features could be very complicated and often analytically intractable. Novel classical approaches are encouraged that seek an appropriate tradeoff between tractability and applicability for handling a complex cyber-multitudinal-physical system.

In recent years, the availability of big data and artificial intelligence (AI) technologies catalyze new ideas and methods to handle complex cyber-multitudinal-physical systems. In contrast to the classical approach, AI-based methods use black-box models and take advantage of massive calculations to learn from complex systems and make appropriate decisions. The cutting-edge research on applying appropriate AI technologies to the analysis and decision-making in complex cyber-multitudinal-physical systems shows great prosperities, thus drawing interests from worldwide scholars. A new research paradigm for investigating modern complex systems is very likely to be developed. In the process of establishing this new research paradigm, we should stress the appropriate use of novel AI methods and avoid random wildcard attempts of using AI techniques without clear understanding of the capabilities and

limitations of specific AI solution approaches.

To address the emerging challenges of modern complex systems and to promote the development of both novel classical and new AI-based research paradigms, we seek original papers with the latest research results and practical applications in the study of the analysis and decision-making of complex cyber-multitudinal-physical systems and the application of AI techniques.

Topics of interest

Topics of interest to this special issue include, but are not limited to:

- Modeling and analysis of real-world complex cyber-multitudinal-physical systems, both bottom-up and top-down methodologies;
- Control and decision-making strategies for real-world infrastructures in terms of complex cyber-multitudinal-physical systems;
- Effects of coupling of heterogeneous multitudinal subsystems on system stability and operational robustness;
- Novel stability and robustness assessment metrics and methods applicable to complex cyber-multitudinal-physical systems;
- Applications of artificial intelligence techniques to stability improvement, robustness enhancement, and operational improvement of complex cyber-multitudinal-physical systems;
- Applications of novel complex network-based analytical/control techniques to complex cyber-multitudinal-physical systems;
- Novel applications in power grids, transportation systems, economics, social networks, communications networks, and other real-world complex connected systems.

Submission procedure

Prospective authors are invited to submit their papers following the instructions provided on the JETCAS website: https://mc.manuscriptcentral.com/jetcas. The submitted manuscripts should not have been previously published, nor should they be currently under consideration for publication elsewhere.

Important dates

• Manuscript submissions due	2023-02-28
• First round of reviews completed	2023-04-15
• Revised manuscripts due	2023-05-31
• Second round of reviews completed	2023-06-30
• Final manuscripts due	2023-07-31

Request for information

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