Analysis and control of complex cyber-physical networks

Complex cyber-physical network refers to a new generation of complex networks whose normal functioning significantly relies on interactions between its physical and cyber components. The networks could model a number of critical modern infrastructures, which provide opportunities to analyze and control them. Typical examples of such infrastructures are public transportation systems, electrical power grids, state financial networks, and the Internet. Understanding how the system operates would greatly benefit the development of society as well as economy.

This special issue focuses on analysis and control of complex cyber-physical systems. It seeks to not only understand the characteristics of the system behaviors but also design the control strategies such that the systems could achieve desired objectives.

Call for paper has been carefully prepared by the guest editors and posted on the journal's web page, which has received much attention from researchers in different scientific communities. We have received quite a few papers in this research fields. All manuscripts submitted to this special issue went through a thorough peer-refereeing process. Based on the reviewers' reports, 27 original research articles are finally accepted. The contents of this special issue contain three parts, modeling and control of complex cyber-physical networks, collective behavior in multi-agent systems, and analysis and synthesis of complex networked systems. The contents are summarized as follows.

1. Modeling and control of complex networks

"Consensus of multiagent systems with time-varying delays: An observer-based distributed periodic event-triggered control approach" by H.W. Liu et al. presents a consensus strategy for multi-agent networked system with time-varying delays. In "Secure state estimation for unmanned aircraft cyber-physical systems under multiple attacks" by X. Feng et al., the secure state estimation for unmanned aircraft under cyber-physical attacks is studied, where the data-injection attacks for controller and sensor are modeled as dual unknown disturbance inputs. "A novel cooperative searching architecture for multi-unmanned aerial vehicles under restricted communication" by H. Ran et al. proposes a novel searching approach for multi-unmanned aerial vehicles with restricted communication. In "Distributed liquid crystal reflectivity control device network for momentum wheel unloading" by H. Ji et al., an attitude control scheme utilizing momentum wheels as actuators and a reflectivity control device network for unloading is proposed. "Distributed cooperative control for parallel direct current–direct current buck converters based on multi-agent consensus theory" by M. Zhu et al. studies the voltage regulation and power sharing for parallel (DC–DC) buck converters using the multi-agent consensus theory. "Robust prescribed-time consensus of multi-agent systems with actuator saturation and actuator faults" by J. Zhou et al. investigates the prescribed-time leader-following consensus problem of multi-agent system with actuator saturation. In "Recent progress on the study of multi-vehicle coordination in cooperative attack and defence: An overview" by J. Zhou et al., a detailed overview of the theoretical advances toward multi-vehicle coordination for cooperative attack and defense is provided. "Security and privacy with opacity-based state observation for finite state machine" by Z. Zhang et al. investigates the impact of state observation on the opacity of IoT, which is modeled by Moore-type finite state machine. In "Distributed Nash equilibrium seeking for noncooperative games in nonlinear multi-agent systems: An event-triggered neuro-adaptive approach" by K. Zhang, a distributed Nash equilibrium seeking strategy for non-cooperative games over strongly connected topologies is proposed, where the player suffer from unmodeled nonlinearities and external disturbances. "Decentralized targeting control of collinear agents" by J. Wu et al. studies the decentralized targeting control problem of collinear agents in three-dimensional space. "Event-based impulsive consensus for delayed multi-agent systems" by Y. Wang et al. focuses on the average consensus problem for delayed nonlinear multi-agent systems. In "Distributed impulsive control for secure consensus of nonlinear dynamical networks with node delay under denial-of-service attacks" by Y.L. Shi and Z.W. Liu, the secure consensus problems of nonlinear dynamical

networks with node delay under DoS attacks are investigated. "Distributed Nash equilibrium seeking of aggregative games under networked attacks" by G. Shao et al. investigates the distributed Nash equilibrium seeking problem of aggregative games in the presence of networked attacks. "Deception attack monitoring in vulnerable hydroelectric generator system" by B. Sari and M.A. Sid studies the unknown deception attacks detection of hydroelectric generator, where the generator dynamics are modeled as an augmented state model. "Finite-time leader–follower consensus control of multiagent systems with mismatched disturbances" by L. Gu et al. studies the robust finite-time leader–follower output consensus problems for second-order multi-agent systems with mismatched disturbances. "Distributed adaptive online learning for convex optimization with weight decay" by X. Shen et al. investigates an adaptive gradient-based online convex optimization problem over decentralized networks.

2. Collective behaviors in multi-agent systems

"Bipartite consensus tracking for antagonistic topologies with leader's unknown input" by X. Nan et al. studies the bipartite consensus tracking problem of linear multi-agent systems on leader–follower signed directed graph. In "Iterative learning heterogeneous trajectory tracking for partially interdependent networks" by T. Guo et al., the heterogeneous trajectory tracking of partially interdependent networks is investigated in a given finite time interval. "Fixed-time extended state observer-based trajectory tracking control for autonomous underwater vehicles" by J. Zheng et al. investigates the trajectory tracking control problem for autonomous underwater vehicles with time-varying external disturbances of currents and waves in the sea. In "Formation control for unmanned surface vessels: A game-theoretic approach" by X. Fang et al., two types of formation control problems for a group of unmanned surface vessels are investigated by using a game-theoretic approach.

3. Analysis and synthesis of complex dynamical systems

"Group controllability of discrete-time second-order multi-agent systems with two-time-scale feature" by M. Gu et al. investigates the group controllability of discrete-time second-order multi-agent systems with two-time-scale feature. "A decentralized Nesterov gradient method for stochastic optimization over unbalanced directed networks" by J. Hu et al. studies optimization problems over unbalanced directed networks, where the mutual goal of agents in the network is to optimize a global objective function expressed as a sum of local objective functions. "Moment-based analysis of pinning synchronization in complex networks" by L. Xiang et al. investigates the pinning synchronization of complex networks from a moment-based analysis approach. In "Robust fault-tolerant consensus control for nonlinear multi-agent systems with prescribed transient and steady-state performance" by Y. Jiang et al., the finite-time consensus tracking problem for second-order nonlinear multi-agent systems subject to the actuator bias fault is investigated. "Distributed consensus control for networked linear agents via event-triggered communications" by L. Rong et al. studies the distributed consensus of networked linear agents via event-driven communications by exploring relative-state and relative-output feedbacks. "Model-based fault diagnosis of networked systems: A survey" by J. Song and X. He reviews the latest development of fault diagnosis techniques of networked systems. In "Observer-based decentralized robust H∞ output tracking control with preview action for uncertain and disturbed nonlinear interconnected systems" by X. Yu et al., the problem of observer-based decentralized robust H∞ output tracking control with preview action in a class of uncertain and disturbed nonlinear interconnected systems is investigated.

Note that the selected topics and papers are not a comprehensive representation of the area of the special issue. It is also worth noting that the published papers in this special issue do provide some recent advances in the field of networked dynamical systems, which could benefit the current research more or less.

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