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EDITORIAL

IEEE ACCESS SPECIAL SECTION EDITORIAL: ANALYSIS AND SYNTHESIS OF LARGE-SCALE SYSTEMS

The last few decades have witnessed the rapid growth of research & development on large-scale systems (LSSs) due to the increasing complexity and the growing demand of modern engineering systems. The LSSs can normally be viewed as interconnections of multiple subsystems. Many practical systems can be described by the LSSs such as power systems, multi-robot systems, communication networks, transportation networks, and supply chains. In such large-scale systems, the centralized control framework may become impossible for its implementation. The decentralized and distributed controls have emerged as the attractive control methodologies to handle the scale and interactions of large-scale complex systems. However, the interactions among different subsystems introduce many challenges in the analysis and synthesis of such systems. Therefore, it is of significance to address several fundamental problems regarding real-time analysis, estimation and control of these systems.

The primary objective of this Special Section in IEEE Access is to provide up-to-date discussions on technical trends and advanced methodologies in system analysis and control design of large-scale systems. Of particular interest, the articles in this Special Section are devoted to the development of advanced communication technology of LSSs, decentralized/distributed state estimation and control of LSSs, scheduling and control co-design of LSSs, cooperation control of networked LSSs and their applications onto industrial process systems. Based on this focus the Special Section has accepted seventeen high-quality articles after a rigorous peer-review process, the contents of which are summarized as follows.

In the work done by Li *et al.* “Random time delay effect on out-of-sequence measurements”, the authors investigated the influence of random time delays and data fusion on the positioning accuracy and real-time performance of multi-agent systems. In the work by Zhang *et al.* “PBM-CFD investigation of the gas holdup and mass transfer in a lab-scale internal loop airlift reactor”, the authors investigated the problem of overall gas holdup and the oxygen mass transfer in the internal loop airlift reactor by numerical modeling and experimental validation. Yang *et al.* “Adaptive control for large-scale nonlinear systems with time delays and unmodeled dynamics”, proposed the problem of global stabilization

for a class of large-scale nonlinear systems with time delays and unmodeled dynamics. Zhong *et al.* “Robust decentralized static output-feedback control design for large-scale nonlinear systems using Takagi-Sugeno fuzzy models” studied the problem of robust decentralized output-feedback control for a class of continuous-time large-scale nonlinear systems. Cui *et al.* “Consensus analysis of second-order multi-agent networks with sampled data and packet losses” proposed the consensus problem of second-order multi-agent system with sampled-data and packet losses. Ahn and Zhan proposed the problem of “Using proxies for node immunization identification on large graphs.” Specifically, the authors illustrated effectiveness of the proposed problem experimentally and it was shown that the proposed algorithm ensures that more nodes are safe from infection in dealing with the strength of the virus.

The work entitled “Distributed adaptive formation control for linear swarm systems with time-varying formation and switching topologies,” by Wang *et al.* studied distributed time-varying formation control problems for general linear swarm systems with switching interaction topologies using an adaptive dynamic protocol. Ji *et al.* in “Decentralized fixed-order piecewise affine dynamic output feedback controller design for discrete-time nonlinear large-scale systems” proposed a novel decentralized robust H_∞ fixed-order dynamic output feedback (DOF) controller design approach for discrete-time nonlinear large-scale systems via Takagi-Sugeno fuzzy-affine models. Cheng *et al.* in “ H_∞ Stabilization for sampling fuzzy systems with asynchronous constraints on membership functions” studied the problem of H_∞ stabilization for nonuniform sampling fuzzy systems using a parallel distributed compensation scheme in controller design. In “Robust passivity control for 2-D uncertain Markovian jump linear discrete-time systems,” Li *et al.* discussed the problem of robust controller design for two-dimensional (2-D) Markovian jump linear systems. The work entitled “Convergence analysis on multi-AUV systems with leader-follower architecture” by Xing *et al.* focuses on an overview of influences on convergence rate of the second-order consensus algorithm for multi-autonomous underwater vehicle (multi-AUV) systems. Zhang *et al.* in the work entitled “On the capacity scaling of large multipair relay

networks with successive relaying protocol” investigated the problem of large multi-pair relay networks with K fixed source-destination pairs and M relays randomly distributed in a given area, where each node is equipped with a single antenna and works on half duplex. Zhong *et al.* in the work entitled “Dynamic output feedback fuzzy control of large-scale nonlinear networked systems: A two-channel triggering approach” develop a decentralized output-feedback (DOF) event-triggering control methodology for large-scale nonlinear networked systems. Li *et al.* in “Cache coherence scheme for HCS-based CMP and its system reliability analysis,” introduced a new network switch architecture, hybrid circuit-switched (HCS) network for application in a multi-processor system, with a focus on power and throughput.

In the work entitled “A holistic approach to reconstruct data in ocean sensor network using compression sensing” Wu *et al.* proposed a holistic method by considering both raw signal processing and signal reconstruction factors: a node re-ordering scheme based on compression sensing and an improved sparse adaptive tracking algorithm. In the work by Seo *et al.* “Achieving data interoperability of communication interfaces for combat system engineering” they deal with the following twofold challenge in regards to the achievement of the interoperability for an System of systems (SoS)-based combat system: 1) the validation of the interface specifications against the specified requirements at the system-design phase and 2) the verification of the subsystems against the interface specifications at the system-integration phase. In the work entitled “Duty ratio modulation strategy to minimize torque and flux linkage ripples in ipmsm dtc systems,” Yuan *et al.* focused on active vector effects

on torque and flux linkage in interior permanent magnet synchronous motor (IPMSM) systems under direct torque control (DTC).

Finally, it is understood that the selected topics and articles are not a comprehensive representation of the area of this Special Section on modeling, analysis and control design methods for large scale systems; they represent the rich and many-faceted knowledge that we have the pleasure of sharing with the readers. We would like to express appreciation to the authors for their excellent contributions, to the reviewers for the quality check of the Special Section, and to the IEEE Access Editor-in-Chief, Managing Editor and the Editorial office staff for their great support.

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