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CALL FOR PAPERS

IEEE TRANSACTIONS ON AUTOMATIC CONTROL

Special Issues

on

Security and Privacy of Distributed Algorithms and Network Systems

The integration of computation, communication and control technologies has led to the emergence and burgeoning of large scale engineering systems, a.k.a., the network systems. These systems find various applications in different fields, including electric and smart grids, transportation and smart cities, healthcare and manufacturing, etc. Distributed control and optimization algorithms are more promising and desirable to operate and guarantee the well-functioning of the systems, and have the advantages of being flexible, scalable, robust and efficient. Yet, due to their very nature, distributed algorithms are particularly vulnerable to cyber and physical attacks. Because distributed control and optimization algorithms usually operate based on predefined rules, attackers can obtain private information by compromising a portion of the participants or eavesdropping broadcast information. Thus, security and privacy issues of distributed control and optimization algorithms are critical in network systems and, if not addressing properly, can result in critical economic losses or even threaten human safety. However, it is usually difficult to design secure distributed control and optimization algorithms for network systems. On the one hand, because each participant only knows its own parameters or settings in distributed control and optimization problems, it is challenging to identify the compromised participants. On the other hand, since practical optimization and control problems in network systems are usually complicated, the attack space is extremely large. Thus, these algorithms inevitably become more complicated. Designing privacy-preserving distributed algorithms while guaranteeing system performance, e.g., high accuracy, fast convergence speed, low computational cost, is another challenging issue for network systems.

Recently, researchers have made great efforts to tackle significant security and privacy problems in different network systems. However, most of these results apply the specific settings, and have limited extensions. With the development of new technologies and the emergence of new demand requirements, existing theoretical results cannot be applied to the distributed networks directly. Meanwhile, the distributed network system has its special properties, e.g., decentralized resources, complicated algorithm and system structure, which make the attack space much huge. As a result, security and privacy problems in distributed algorithms in network systems, such as attack modeling, defense strategy and privacy analysis, can be more challenging.

Such a special issue is expected to link practical challenges with the most recent theoretical advances in this hot research area. Some urgent research questions to be answered include but are not limited to the following questions.

- Application-driven models of cyber-physical attacks in network systems
- Secure distributed state estimation and control of network systems
- Effective verification/validation and mechanism design
- Detection, isolation, and classification of attacks
- Self-healing and self-recovery
- Novel privacy notions and properties for network systems
- Privacy preserving distributed algorithms
- Group decision making under security and privacy constraints
- Trading off security, privacy and system performance
- Unified approaches to security and privacy in distributed algorithms and network systems
- Validation of control-theoretic security and privacy methods in real-world applications

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