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Guest Editorial: Special Issue on Wireless Sensor Networks, Cyber-Physical Systems, and Internet of Things

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Recent convergence of information communications technology and sensing equipment is creating new demands and opportunities for wireless sensor networks without technological restrictions, such as cyber-physical systems and internet of things. The fast-growing number of wireless sensor networks, the variety of sensors, the different granularity of time control in cyber-physical systems, and the heterogeneous devices and networks in internet of things impose several challenges in both traditional research problems and new research agendas, such as channel estimation, network protocol design, resource management, system design, application development, integration of multiple systems, and smooth transition from legacy systems. The objective of this special issue is to gather recent advances addressing networks, systems, algorithms, and applications that support the symbiosis of wireless sensor networks, cyber-physical systems, and internet of things.

This special issue is the second special issue launched by Tsinghua Science and Technology after it narrowed its scope to information technology. All selected papers may be classified into four categories: (1) networks lifetime and energy efficiency; (2) network resource allocation; (3) wireless algorithm design and analysis; and (4) navigation applications. A detailed description of the corresponding selected works in each category is given below.

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Networks Lifetime and Energy Efficiency

One of the fundamental challenges in designing a Wireless Sensor Network (WSN) is how to maximize the network lifetime, as each sensor node of the network is powered by battery with limited energy. In the first paper, *Efficient Algorithm for Prolonging Network Lifetime of Wireless Sensor Networks*, Rahman and Matin study how to find the optimal position for the sink node using Particle Swarm Optimization based method such that the sensor nodes close to the sink do not need to suffer heavily data traffic. The second paper, entitled *Optimal Power Control for OFDM Signals over Two-Way Relay with Physical Network Coding* by Yang et al., proposes an optimal power allocation scheme for an Orthogonal Frequency Division Multiple Access (OFDMA) two-way relay networks with Physical Network Coding (PNC) such as to increase the achievable sum rate of the terminals under the total transmit power constraint. The third paper, named *Fuzzy Control of LED Tunnel Lighting and Energy Conservation* by Zeng et al., studies a more specific case, the current highway tunnel lighting illumination control system, and a fuzzy control based algorithm is proposed to save energy consumption.

Network Resource Allocation

Due to the limited bandwidth and heavy interference in the wireless sensor network, network resources need to be efficiently allocated. In the forth paper, *GSM Co-Channel and Adjacent Channel Interference*

Analysis and Optimization, Lan et al. propose a novel method to analyze and optimize the GSM co-channel and adjacent channel interference in order to utilize channels more efficiently and effectively. In the fifth paper, *An MID-Based Load Balancing Approach for Topic-Based Pub-Sub Overlay Construction*, Shi et al. present the strategy which can balance the network traffic for a topic-based pub-sub overlay network by introducing the minimum idle degree model capturing the heterogeneity of overlay nodes. In the sixth paper, *Measuring Available Bandwidth for Smart Cyber-Physical Applications*, Zhou focuses on measuring available network bandwidth for smart cyber physical applications such as smart phones and other mobile devices, which enables the gateway node to measure the available bandwidth of paths with a low cost. In the seventh paper, *Attacking Simulation Model and Channel Statistics in Underwater Acoustic Sensor Networks*, Jing et al. propose a shallow underwater acoustic channel simulation model based on acoustic propagation characteristics, including path attenuation, ambient noise, multipath and the Doppler effects.

Wireless Algorithm Design and Analysis

Besides these research articles on wireless sensor networks and cyber-physical systems, we also include three articles on coverage, time synchronization and security. The eighth paper, entitled *Coverability of Wireless Sensor Networks* by Wang and Huang, presents three evaluation algorithms named CRM, TWS, and CSM, which utilize search techniques to verify the coverage of a given wireless sensor network. In addition, an open-source software project named TravelPlane is given. The ninth paper, *Clapping and Broadcasting Synchronization in Wireless Sensor Networks* by Shen et al., provides a clapping and broadcasting synchronization based algorithm using broadcasting rather than pairwise communication to accomplish synchronization. They further demonstrate that CBS outperforms current state-of-art approach FTSP in both single-hop and multi-hop scenarios, in terms of synchronous precision and energy consumption on the TelosB platform. In the tenth paper, *Lightweight Privacy-Aware Yet Accountable Secure Scheme for SM-SGCC Communications in Smart Grid*, Ren et al. study the secure scheme for smart grid control and schedule centers. Their work is helpful to maintain the anonymity of data originality so as to protect the privacy of customers.

Navigation Applications

In the last category, we accept two papers focusing on navigation applications of wireless sensor network. In the eleventh paper, entitled *Distributed Dynamic Navigation for Sensor Networks*, Wu et al. design an efficient dynamic routing algorithm to guide the user to the destination exit successfully when some emergency happens. By predicting the dynamic changes which affect the navigation path, the algorithm ensures the security of the navigation path when the locations of all deployed wireless sensor node are unknown. In the last paper, *Navigability and Reachability Index for Emergency Navigation Systems using Wireless Sensor Networks*, Wang and Liu provide the solution to "what kind of navigation protocol is more safe in different environment?" by means of introducing two new quantitative indicators: navigability and reachability. They further give a large number of simulation results showing that these two indicators can effectively identify different performance of navigation protocol in the environment changes.

In conclusion, this issue offers an overview of the recent advances in several areas of WSN, CPS, and IoT. We hope that this excellent collection of articles will help interested readers to identify a number of key challenges and opportunities that lie within these research areas. We hope you enjoy and benefit from this special issue.

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