Editorial

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Jie Li is a Professor at University of Tsukuba, Japan. His research interests are in mobile distributed multimedia computing and networking, OS, network security, modelling and performance evaluation of information systems. He is a senior member of IEEE and ACM, and a member of IPSJ. He has served on several editorial boards, and on Steering Committees of the SIG of System EVAluation (EVA) of IPSJ, the SIG of DataBase System (DBS) of IPSJ, and the SIG of MoBiLe computing and ubiquitous communications of IPSJ.

Alan Marshall is a Professor of Telecommunications Engineering at Queen's University Belfast and Director of the Advanced Networks Group. He is a senior member of IEEE, a member of ComSoc, IFIP TPC6 and a Fellow of the IET. He has spent over 20 years working in the Telecommunications and Defence Industries. He holds joint patents in the areas of spread spectrum communications, packet scheduling and wireless network architectures and has formed two successful spin-out companies. His research interests include network architectures and protocols; mobile and wireless networks; quality of service (QoS) architectures; network security and management architectures, and distributed haptics.

Yao Ma has been with the Electrical and Computer Engineering (ECE) Department at the Iowa State University as an Assistant Professor since August 2002. He received the PhD degree from National University of Singapore in year 2000. He has performed research at wireless communication and signal processing, specialising on topics including cross-layer design,

multicarrier and OFDM, resource allocation, MIMO and space-time processing, high-level modulation with imperfect channel knowledge, hybrid diversity and ultra-wideband communication. He is currently an Editor of the *IEEE Transactions on Wireless Communication* and an Associate Editor of the *IEEE Transactions on Vehicular Technology*. He acted as a TPC Co-chair of Wireless Communication Symposium of IEEE GlobeCom 2007 and a TPC Co-Chair for Transmission Technologies Track of IEEE VTC Fall 2009.

Recent technology advances in micro-electro-mechanical systems, embedded microprocessors and wireless communication have led to the development of Wireless Sensor Networks (WSNs). While sensor networks provide ample opportunities to provide various services, their effective deployment in large scale is still challenging due not only to limited battery supply, but also because of various other constraints such as time-varying fading effects, limited bandwidth, different protocols and application requirements. The design of sensor network algorithms using methodologies and mechanisms from other disciplines holds great promise for addressing these challenges and providing more flexible and robust algorithms in WSNs.

This special issue presents a number of key state-of-the-art approaches and technical solutions for the design of WSN algorithms and protocols which specifically utilise the techniques or methodologies borrowed from other disciplines, such as control theory, spatial-temporal mapping, computational geometry, etc. This collection of papers each addresses a different WSN problem such as energy-aware routing, data forwarding, sensing coverage problem, sensor location and sink mobility. In response to the call for contributions, we have received a large number of papers from both academia and industries that covered a variety of interesting topics related to WSNs. Two rounds of careful review by the guest editors and experts in the field led to five papers for inclusion in this special issue. It is our belief that these papers complement each other in terms of the cross-disciplinary techniques utilised while providing a rounded perspective of some important topics in WSNs.

The paper 'Spatio-Temporal relation-based Energy-Efficient Reliable Routing Protocol in wireless sensor networks' by M. Chen et al. proposes a Spatio-Temporal relation-based Energy-Efficient Reliable (STEER) routing protocol. STEER reverses the two steps typically employed in traditional routing protocols in WSNs, i.e. the next-hop-selection-first, data-relay-next approach. In STEER, each data packet is relayed by broadcasting, and, among the neighbours (closer to the sink) that receive the data, one next-hop node will be elected. The eligibility of a node being a relaying node in next hop is evaluated via its temporal gradient, i.e. its location closeness to the sink. To quantify the temporal gradient systematically, a spatio-temporal mapping function is proposed in this paper. Comprehensive simulation experiments are carried out to show that the performance of STEER provides efficient and robust routing in highly unreliable WSNs.

In the paper 'Design of timeout-based wireless microsensor network protocols: energy and latency considerations' by W. Jeong et al., the authors propose a new sensor network protocol based on Timeout-based Information Forwarding (TIF) protocol. In order to reduce the overall network energy consumption and end-to-end response latency, the TIF protocol is based on a geometry-specific data forwarding logic with a multi-hop communication method. Communication energy consumption and network latency of the TIF protocol are analysed to provide design guidelines for the emerging sensor network systems. The performance of TIF has been evaluated through specific simulations, applying the Teamwork Integration Evaluator (TIE).

The next paper, 'Distributed coordinate-free algorithm for full sensing coverage' by X. Li et al., shows how a distributed algorithm, derived and justified through computational geometry, can detect and recover holes in the coverage provided by WSNs. The algorithm does not require coordinates or location information, and requires only minimal connectivity information. Most holes can be detected with very low probability of error, and simulation results suggest that redundant nodes are selected efficiently for activation when recovering the hole. Another benefit of this algorithm is that its complexity does not depend on the overall size of the network, and no flooding is required.

A. Gasparri et al., in the paper 'An Interlaced Extended Kalman Filter for sensor networks localisation', propose a new approach based on an Interlaced Extended Kalman Filter (IEKF) to obtain an accurate knowledge about nodes position in WSNs. This algorithm, working in a distributed fashion, provides an accurate estimation of node poses with a reduced computational complexity. Moreover, no prior knowledge for any nodes is required to produce estimation in a relative coordinate system. Exhaustive experiments are shown to prove the effectiveness of the proposed IEKF.

In the last paper 'BoSS: a moving strategy for mobile sinks in wireless sensor networks" by Y. Bi et al., the authors discuss another interesting research issue in WSNs – sink mobility. They propose an autonomous moving strategy for the mobile sinks in periodically data-gathering applications. This paper suggests a data-gathering scheme for low-duty cycle sensor networks and then presents a mechanics-inspired moving strategy, called BoSS. The moving strategy drives a sink to move towards the nodes with high residual energy, and meanwhile, balances energy consumption among the nodes with low energy. The BoSS strategy is compared with three near-optimal fixed-track strategies via simulations. The results have shown that the BoSS strategy can not only extend network lifetime notably, but also provide scalability and topology adaptability.

We would like to thank all the reviewers for their effort and constructive comments. We would in particular like to thank Professor Yang Xiao, the Editor-in-Chief, for his support and helpful suggestions during the very delicate stages of concluding the special issue. Finally, we would like to thank all the authors who submitted their precious research work to this special issue.