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*Editorial*

# Location-Related Challenges and Strategies in Wireless Sensor Networks

**Dingyi Fang,[1] Chase Q. Wu,[2] Jie Wang,[3] Lin Cai,[4] and Xiaohong Jiang[5]**

[1]*School of Information Science and Technology, Northwest University, Xi'an 710127, China*
[2]*Department of Computer Science, New Jersey Institute of Technology, Newark, NJ 07102, USA*
[3]*School of Communication and Information Technology, Dalian University of Technology, Dalian 116024, China*
[4]*Department of Electrical & Computer Engineering, University of Victoria, Victoria, BC, Canada V8W 3P6*
[5]*Computer Communications Networks, Future University Hakodate, Hakodate, Hokkaido 041-8655, Japan*

Correspondence should be addressed to Dingyi Fang; dyf@nwu.edu.cn

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With the data gathered by distributed sensor nodes, we are able to obtain an accurate view of the field being monitored for various purposes such as environmental surveillance, object detection, and target tracking. Among all the sensor parameters in wireless sensor networks (WSNs), location information is of crucial importance as it affects almost every stage of the application including node deployment, data collection, information fusion, and decision making. However, determining and utilizing location information face significant challenges such as time synchronization issues, physical layer measurement errors, computation constraints, and lack of GPS reference especially on low-cost sensor nodes that are now made possible by the recent advances in the microelectromechanical systems (MEMS) technology. Meanwhile, modern sensor network applications pose increasingly complex and stringent performance requirements on localization in terms of scalability, robustness, and accuracy. Moreover, many new location-related issues such as security and privacy in WSNs are rapidly emerging and must be carefully considered and addressed.

Given the significance and timeliness of the topic, this special issue has attracted a great deal of attention from researchers around the world, and every accepted paper went through a thorough review process by the invited reviewers and the guest editors. We compile this special issue with the latest research progress and potential solutions to various location-related services.

Some of the papers propose effective solutions to localization. Z. Tang et al. in their paper entitled "CTLL: A Cell-Based Transfer Learning Method for Localization in Large Scale Wireless Sensor Networks" consider a new way for localization, which is robust to the variances of node density and SNR. CTLL combines sample transfer learning and a support vector regression model to obtain a better performance of localization. J. Trogh et al. in their paper entitled "Advanced Real-Time Indoor Tracking Based on the Viterbi Algorithm and Semantic Data" develop a real-time indoor tracking system based on the Viterbi algorithm and semantic data to improve the accuracy. W. Wang et al. in their paper entitled "A Grid-Based Linear Least Squares Self-Localization Algorithm in Wireless Sensor Network" study a novel grid-based linear least squares (LLS) self-localization algorithm for a nonuniform network. Furthermore, by taking into consideration the quasi-uniform distribution of anchors in the area, the authors select suitable anchors to assist in the localization. Z. Xiahou and X. Zhang in their paper entitled "Adaptive Localization in Wireless Sensor Network through Bayesian Compressive Sensing" estimate the location of targets in WSNs within the Bayesian compressive sensing (BCS) framework and provide adaptive iteration BCS localization (AIBCSL) algorithm, which is based on BCS and adaptively chooses measurement sensors according to the environment only with an initial value. Q. Wu et al. in their paper entitled "An All-Time-Domain Moving Object Data

Model, Location Updating Strategy, and Position Estimation" establish an object-oriented all-time-domain data model for moving objects, propose a new dynamic threshold location updating strategy based on the all-time-domain data model, and present several different all-time-domain position estimation methods. J. Liu and Q. Wang in their paper entitled "Position Prediction Based Frequency Control of Beacons in Vehicular Ad Hoc Networks" propose a position prediction based beacon approach to reduce beacon frequency and decrease bandwidth consumption. S. Lee et al. in their paper entitled "Kalman Filter-Based Indoor Position Tracking with Self-Calibration for RSS Variation Mitigation" investigate the indoor position tracking problem under the variation of received signal strength (RSS) characteristic from the changes of device statuses and environmental factors. C. Miao et al. in their paper entitled "RI-MDS: Multidimensional Scaling Iterative Localization Algorithm Using RSSI in Wireless Sensor Networks" propose localization algorithm RI-MDS (RSSI-based Iterative-Multidimensional Scaling) to improve the feasibility and the convenience of localization methods for wireless sensor networks. B. Zhang et al. in their paper entitled "A Hybrid Localization Approach in 3D Wireless Sensor Network" develop a novel hybrid localization scheme which utilizes the range-based attribute RSSI and the range-free attribute hop size to achieve accurate yet low-cost 3D localization. Z. Sun et al. in their paper entitled "Localization Algorithm in Wireless Sensor Networks Based on Multiobjective Particle Swarm Optimization" propose a multiobjective particle swarm optimization based localization algorithm to solve the multiobjective optimization localization issues in WSNs. Y. Chen et al. in their paper entitled "A Fuzzy Similarity Elimination Algorithm for Indoor Fingerprint Positioning" propose a $K$-Means+ clustering algorithm to achieve fine-grained fingerprint positioning, design a linear sequence matching algorithm to improve the outliers positioning, and reduce the impact of fuzzy similarity. S. Kim and J.-W. Chong in their paper entitled "An Efficient TDOA-Based Localization Algorithm without Synchronization between Base Stations" propose an efficient localization algorithm by utilizing the time difference of arrival (TDOA) without synchronization between base stations. X. Yin et al. in their paper entitled "Localizing Wireless Sensors with Diverse Granularities in Wireless Sensor Networks" propose a novel on-demand node localization technology, NLMR, with diverse granularities based on a multiresolution model.

Some of the papers deal with privacy preserving for localization. N. Nguyen et al. in their paper entitled "URALP: Unreachable Region Aware Location Privacy against Maximum Movement Boundary Attack" propose an algorithm to prevent the adversary from effectively compromising the user's location privacy while achieving $k$-anonymity requirements as well as minimum acceptable cloaked-region size. D. Song et al. in their paper entitled "A Privacy-Preserving Continuous Location Monitoring System for Location-Based Services" propose a cloaking system model called anonymity of motion vectors (AMV) that provides anonymity for spatial queries.

Some of the papers develop potential solutions to location-based route finding and planning. Y. Chen et al. in their paper entitled "Lifetime Optimization Algorithm with Mobile Sink Nodes for Wireless Sensor Networks Based on Location Information" propose a lifetime optimization algorithm with mobile sink nodes for wireless sensor networks (LOA_MSN). In LOA_MSN, movement path constraints, flow constraint, energy consumption constraint, link transmission constraint, and other constraints are analyzed based on location information. P. Duan et al. in their paper entitled "A Cross Layer Video Transmission Scheme Combining Geographic Routing and Short-Length Luby Transform Codes" combine geographic routing in the network layer and short-length Luby Transform (LT) codes in the transport layer, design a routing metric for geographic routing, and propose a cross layer transmission scheme, which adaptively adjusts payload length to encapsulate short-length LT encoded symbols and selects routes based on the new routing metric. X. Niu et al. in their paper entitled "An Online-Traffic-Prediction Based Route Finding Mechanism for Smart City" propose an innovative online-traffic-prediction based route finding mechanism, O-Sense, which utilizes large-scale taxi GPS traces and environmental information.

Some of the papers tackle other important issues related to localization. X. Liu et al. in their paper entitled "Robust Monitor Assignment with Minimum Cost for Sensor Network Tomography" propose a robust monitor assignment algorithm to assign monitors in large-scale sensor networks with dynamically changing topology. S. Kim and J.-W. Chong in their paper entitled "Chirp Spread Spectrum Transceiver Design and Implementation for Real Time Locating System" design and implement a chirp spread spectrum (CSS) transceiver architecture for IEEE 802.15.4a. J. Yang et al. in their paper entitled "A Group Mining Method for Big Data on Distributed Vehicle Trajectories in WAN" propose a distributed parallel clustering method, MCR-ACA, by integrating the Ant Colony Algorithm with the Map-Combine-Reduce computing framework for mining groups with the same or similar features from big data on vehicle trajectories stored in wide area networks. J. Luo et al. in their paper entitled "Location-Based Data Aggregation in 6LoWPAN" propose a novel location-based data aggregation model, LDAA, which aggregates data from the network layer according to the MAC layer queuing delay. X. Jiao et al. in their paper entitled "On Minimum-Latency Broadcast in Multichannel Duty-Cycled Wireless Sensor Networks" investigate the MLB problem in multichannel duty-cycled WSNs, prove that MLBCD problem is NP-hard, and propose a new concept of active interference graph (AIG). Y. Xing et al. in their paper entitled "Time Synchronization for Wireless Sensor Networks using Adaptive Linear Prediction" present an Adaptive Linear Prediction Synchronization (ALPS) scheme for WSNs by applying linear prediction on synchronization errors and adaptively adjusting prediction coefficients.

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timely responses. Finally, we hope that the papers published in this special issue would be helpful to other researchers with a common interest in these location-related topics.

*Dingyi Fang*
*Chase Q. Wu*
*Jie Wang*
*Lin Cai*
*Xiaohong Jiang*