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Editorial

Collaborative Wireless Sensor Networks and Applications

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Wireless sensor networks (WSNs) architectures involve many power-limited sensor nodes to enable a large class of applications, such as environmental and building monitoring and surveillance, pollution monitoring, agriculture, health care, home-automation, energy management, and earthquake and eruption monitoring. In most cases, harsh environment and energy constraints represent issues that impede or slow down the deployment of such networks. However, based on collaboration (infrastructure-based and P2P-based), WSNs can organize efficiently or even self-organize, prolong system lifetime, handle dynamics, and detect and correct errors, all with the final goal of eventually executing reliably the user application. In spite of the increasing demand for all kinds of sensing services and applications, we are still lacking a clear understanding of collaborative techniques, as well as best practices, to design collaborative architectures, protocols, algorithms, sensing, query, data processing, localization, and tracking for WSNs. In particular, dynamic spectrum access, machine to machine, cognitive radio, ultrawideband, and cooperative communications, among other techniques like radar identification techniques, will have a profound impact on our ability to flexibly and predictably design collaboration in WSNs. The objective of this special issue is to bring together state-of-the-art research contributions that address these key aspects of collaborative WSNs and applications.

The papers included in this special issue are categorized into the following areas.

Cooperative spectrum sensing is an efficient way to improve spectrum utility in wireless networks, which uses cooperation among multiple nodes to overcome the shortcomings of single-node to improve detection performance and save energy. The paper titled "Cooperative Spectrum Sensing in Cognitive Wireless Sensor Networks," by X. Zhang et al., investigates the performance of cooperative and noncooperative schemes comprehensively in cognitive WSNs (CWSNs), which classifies cooperative spectrum sensing (CSS) into three categories: censoring, clustering, and sensor selection based on energy consumption. A novel decentralized scheme for cooperative compressed spectrum sensing is proposed in distributed cognitive radio (CR) networks in the paper titled "A Novel Decentralized Scheme for Cooperative Compressed Spectrum Sensing in Distributed Networks," by H. Jijun and Z. Song, which uses Karcher mean as a statistic indicating the spectrum occupancy status, thereby eliminating the compressed reconstruction stage and significantly reducing the computational complexity.

In power-limited WSNs, cooperation among nodes can help sensors to perform complex tasks, which can make nodes more powerful. A collaborative data gathering mechanism is presented based on fuzzy decision in the paper titled "A Collaborative Data Gathering Mechanism Based on Fuzzy Decision for Wireless Sensor Networks," by W. Si et al., which integrates nodes' residual energy level, the number of neighbours, centrality degree, and distance to the sink into fuzzy decision. To avoid the hot spot problem, a cooperative sensor selection and power-efficient gathering (CSSPEG) strategy is proposed in multihop WSNs in the paper titled "Cooperative Sensor Selection Optimization and Power-Efficient Gathering for Multihop Wireless Sensor Networks," by Y. Hu et al., which uses cooperative sensor selection and power-efficient gathering strategy to improve system performance. The paper titled "Determining Sensor

Locations in Wireless Sensor Networks," by Z. Li and W. Xiao, explores the problem of prolonging lifetime of WSNs by introducing additional sensors at proper locations to achieve the goal of minimizing the length of the longest edge in the network, which tries to find a Steiner tree minimizing the length of the longest edges for the given terminals in the Euclidean plane by introducing Steiner points.

Effective protocol design and resource allocation schemes will refine system performance greatly. In order to improve routing performance, a collaborative hydrodynamics routing (HR) protocol is proposed based on hydrodynamic theory to prolong the network lifetime and adapt to the variety of network scales in the paper titled "Collaborative Routing Protocol Based on Hydrodynamics for Wireless Sensor Networks," by Z. Wei et al. A sensors grouping hierarchy structure (GHS) is proposed in the paper titled "Sensors Grouping Hierarchy Structure for Wireless Sensor Network," by A. Hawbani et al., to split the nodes into groups to assist the collaborative, dynamic, and distributed computing and communication of the system, which partitions the nodes according to their geographical maximum covered regions such that each group contains a number of nodes and a number of leaders. A heuristic evaluation postdecision state learning algorithm (HE-PDS) is presented in cross-layer cooperation in the paper titled "Energy-Efficient Policy Based on Cross-Layer Cooperation in Wireless Communication," by J. Zhang et al., which exploits the determinate state information and jointly considers the transmitting power and channel state condition at the physical layer and the buffer congestion control at the media access control layer.

The paper titled "Energy Aware Optimal Resource Allocation in Backhaul Constraint Wireless Networks: A Two Base Stations Scenario," by Y. Gao et al., addresses the issue of energy aware resource allocation with limited backhaul capacity in uplink cooperative reception. And energy-efficient cooperative scheme based on compress-and-forward and user pairing is proposed to maximize system throughput and increase energy efficiency under the limited backhaul capacity constraint. The paper titled "A Task Allocation Algorithm Based on Score Incentive Mechanism for Wireless Sensor Networks," by F. Wang et al., develops a task allocation algorithm based on score incentive mechanism (TASIM) for WSNs, which adopts score to reward or punish sensor nodes' task execution in cluster-based WSNs. In addition, the uncompleted tasks on failed nodes can be timely migrated to other cluster members for further execution.

Cooperation among nodes also can enhance security effectively in WSNs. The paper titled "A Collaborative Self-Governing Privacy-Preserving Wireless Sensor Network Architecture Based on Location Optimization for Dynamic Service Discovery in MANET Environment," by C. Gao et al., presents a collaborative self-governing privacy-preserving WSN architecture to address the issue of service discovery in MANET, which is able to dynamically adjust the working modes between directory-based and directory-less modes according to the network status. The paper titled "A Security Data Forwarding Mechanism for Sparse Social Sensor Networks," by X. Guan, considers incentivizing nodes to cooperate with others by using a virtual bank mechanism, which introduces the Gini coefficient to measure the inequality of the social distribution and avoid the internal threats caused by social selfishness with taxation strategy. The paper titled "Securing Body Sensor Networks with Biometric Methods: A New Key Negotiation Method and a Key Sampling Method for Linear Interpolation Encryption," by H. Zhao et al., proposes two approaches that exploit biometric data to address security problems in the body sensor networks: a new key negotiation scheme based on the fuzzy extractor technology and an improved linear interpolation encryption method.

Cooperative schemes can be adopted in many applications. The paper titled "Cooperative Transmission for Satellite Wireless Sensor Networks," by Y. Lin et al., investigates the performance of WSNs-based satellite collocation system with cooperative transmission, which considers the scenario of satellite cluster. The paper titled "Modeling the Dynamic Evolution of the Vehicular Ad Hoc Networks under the City Scenario," by L. Zhang et al., analyzes the dynamic evolution of topology characteristics based on the real data collected by the GPS devices installed on vehicles and models the network evolution by the dynamic topology characteristics in vehicular ad hoc network (VANET).

The paper titled "Vibration Sensor Based Intelligent Fault Diagnosis System for Large Machine Unit in Petrochemical Industries," by Q. Zhang et al., proposes an intelligent fault diagnosis system using artificial immune algorithm and dimensionless parameters to achieve accurate and fast fault diagnosis, in dynamic real-time vibration monitoring and vibration signal analysis for large machine unit in petrochemical industry. The paper titled "Uncoordinated Cooperative Multihop Forwarding in 2D Highly Dynamic Networks," by X. Zhang et al., considers cooperative forwarding in two-dimensional highly dynamic wireless networks and proposes an uncoordinated cooperative forwarding scheme based on a forwarding probability determined by its own location, the locations of the destination, and the transmitter from which it receives the packet. The paper titled "Energy Efficient Cooperative Sleep Control Using Small Cell for Wireless Networks," by Y. Gao et al., proposes a semistatic energy-efficient method to find out the optimal on-off pattern considering the interference from adjacent base stations using integer convex optimization in wireless networks.

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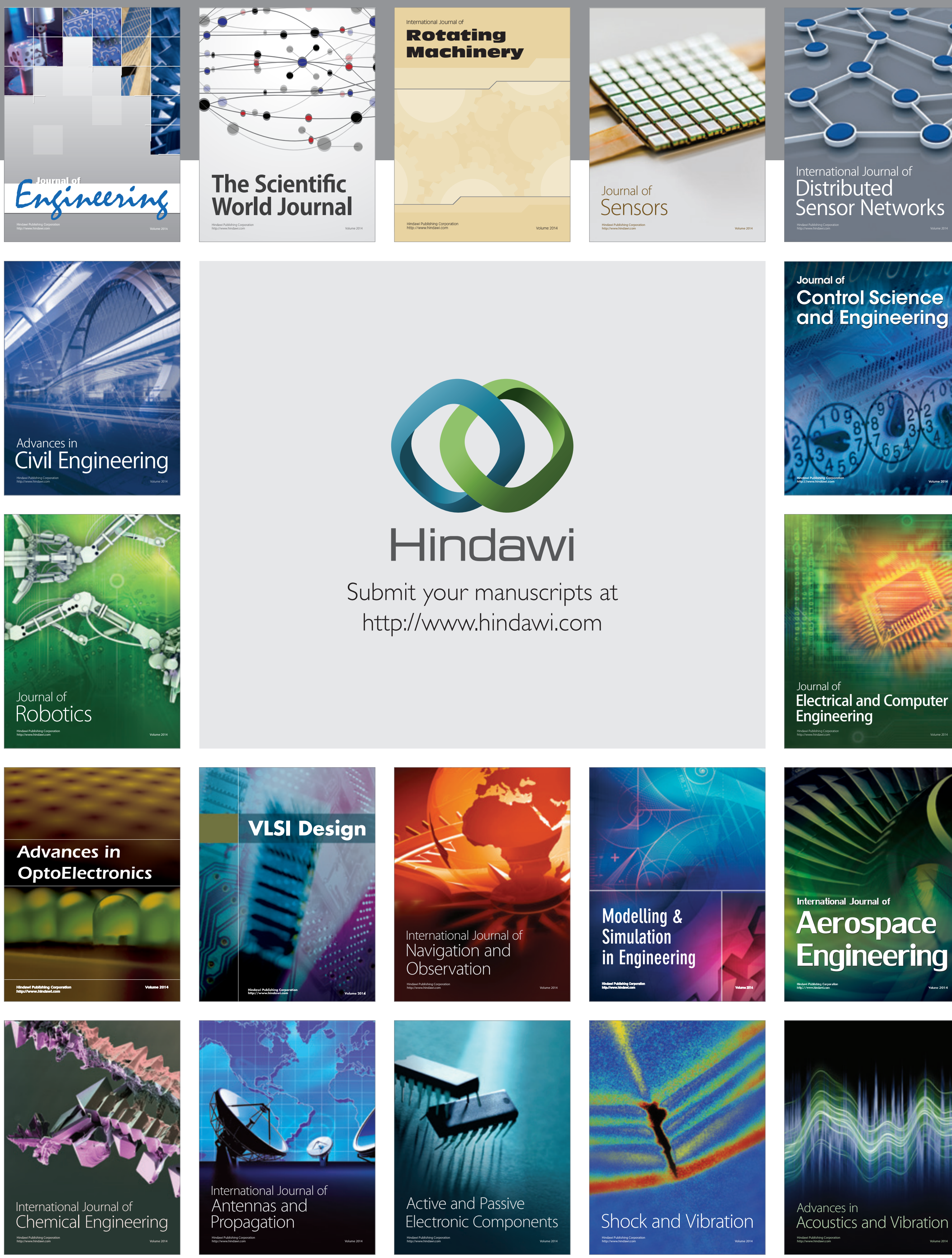
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