Introduction

This first issue of ACM *Transactions on Sensor Networks* (TOSN) marks a significant milestone in the evolution of sensor network research and technology. The field of sensor networks has seen a number of conferences and workshops in the past six years, for example, the ACM/IEEE Conference on Information Processing in Sensor Networks (IPSN), the ACM Conference on Embedded Networked Sensor Systems (Sensys), the IEEE Communications Society Conference on Sensor and Ad Hoc Communications and Networks, the International Conference on Distributed Computing in Sensor Systems, among others. As the field matures, it is natural for researchers to report their results in a more permanent, archival venue. Just as in other scientific and engineering disciplines, the journal editorial process allows authors to iterate their work, often based on a conference or workshop publication, and to significantly improve the organization and completeness of the exposition through a refereeing and revision process.

The recent rapid advances in miniturization and new radio technology have fueled the tremendous interest in micro-sensor networks. In the US, funding agencies such as DARPA has played an important role in the germination of the field with programs such as Sensor Information Technology (SensIT) and Networked Embedded Systems Technology (NEST), and the NSF has funded a number of cross-directorate programs in sensor technology, networking, and systems. However, the roots of the field can be traced further back, perhaps to a DARPA IPTO Program on Distributed Sensor Networks in the early 1980s. The program, led by Bob Kahn, also an Internet pioneer, envisioned that one day smart sensors could self-organize into collectives to autonomously perform macro-tasks, though the sensor networks at that time comprised truck-sized processing nodes (e.g., PDP11/34) linked together by Ethernet and microwave radio.

Concurrently, interests in exploiting micro-sensor technology for scientific uses and industrial, consumer, and other commercial applications have led researchers and practitioners to investigate new architectures to seamlessly integrate sensor network technology with other IT and physical infrastructures in, for example, the European Ambient Intelligence Initiative, activities in automotive safety and industrial automation in Asia, and Xerox PARC's Smart Matter research in blending sensors and actuators with ordinary materials and structures to create a responsive environment. This new multitier ecosystem, as envisioned, connects data centers, PCs, and cell phones together with sensors embedded in homes, factories, warehouses, cars, even human bodies, to enable 24/7 real-time visibility to the physical world. This heterogeneous platform, moving beyond just mote-class sensors, encompasses other devices such as RFID as well as higher data rate camera sensors and employes a variety of networking technologies. Other applications include managing emergency responses to tsunamis, hurricanes, or security threats; increasing safety on roads; improving quality of life in under-developed regions; and providing better elderly care.

The research community has responded to the application pull by creating large-scale, more realistic testbeds for applications such as habitat monitoring (e.g., at UCLA CENS) and several generations of hardware and software platforms with hundreds of user groups (e.g., TinyOS). These valuable experiences have shown the data from sensor networks is incredibly rich and dynamic, and, at the same time, is highly uncertain due to the physical embedding of these systems, demanding processing and reasoning techniques beyond those found on the Internet. The disaggregated nature of sensor network operation represents a new computing paradigm in which system autonomy, self-awareness, and self-repair are needed to address the high-level uncertainty about the system operational status. There is also an increasing realization that we must address the security and privacy issues associated with the use of the technology, regardless of whether it is in a consumer, industrial, or battlefield application.

TOSN publishes high-quality articles reporting significant results in the research and applications of distributed, wireless, or wireline sensor and actuator networks. As an interdisciplinary field, sensor networks draw upon advances in many disciplines including signal processing, networking and protocols, embedded systems, information management, and distributed algorithms. Potential synergies among these fields are expected to open up new research directions. TOSN serves as a central, archival venue for the interdisciplinary sensor network research community. It covers research contributions that introduce new concepts, techniques, analyses, or architectures, as well as applied contributions that report on the development of new tools and systems or experiences and experiments with high-impact, innovative applications. TOSN places special attention on contributions to systemic approaches to sensor networks. A list of topic areas that TOSN covers is available on the TOSN web page at http://www.acm.org/tosn.

This first issue has five articles, covering integrated sensing and actuation, network management, security, data indexing, and localization. Li et al. develop a decentralized protocol to guide a mobile robot safely through a sensor field to its goal, using techniques of artificial potential fields. Xing et al. present a coverage and connectivity configuration protocol to provide different degrees of sensing coverage as requested by applications. Lazos et al. propose a range-independent distributed localization algorithm which is robust against various known attacks on wireless sensor networks. He et al. addresse the time-indexing problem arising from in-network storage and query of time-stamped sensor data and present a lightweight solution to the problem. Nguyen et al. apply a kernel-based learning method, support vector machine, to the localization problem in sensor networks formalized as a classification problem.

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Editor-In-Chief