



## Guest Editorial: Wireless Sensor Networks

Recent advances in digital electronics, embedded systems, and wireless communications have motivated a lot of research in the direction of distributed wireless sensor networks. Such networks may have a wide range of applications, including security and surveillance, control, actuation and maintenance of complex systems, and fine-grain monitoring of indoor and outdoor environments. Wireless sensor networks differ from conventional network systems in many aspects. They usually involve a large number of spatially distributed, energy-constrained, and self-configuring nodes. The wireless sensor networks are bringing a lot of new challenges and design considerations, which go much beyond conventional network systems. This special issue is to foster the dissemination of high quality research in topology control, communication protocols, data management and access techniques, and applications of wireless sensor networks.

This special issue of *Telecommunication Communication* grew out of selected best papers from the second *International Workshop on Information Processing in Sensor Networks* (IPSN), that took place at Palo Alto, CA, USA in April 2003, and high quality papers from external submissions. This event was an effort to take up the challenges and to bring together an international community in the area.

The accepted papers can be grouped into three main themes. The first set of papers deals with routing protocols in wireless sensor networks. The second set reports topology control and management mechanisms. The final set of papers reports some interesting applications of wireless sensor networks.

In the first set of papers, network protocols are reported. In the first paper, *Qingfeng Huang, Chenyang Lu, and Gruia-Catalin Roman* design and analyze a “spatiotemporal multicast protocol” for wireless sensor networks. They propose a new multicast communication paradigm called “spatiotemporal multicast” for supporting applications which require spatiotemporal coordination in wireless sensor networks. They focus on a special class of spatiotemporal multicast called “mobicast” featuring a message delivery zone that moves at a constant velocity.

The second paper by *Hyung Seok Kim and Wook Hyun Kwon* introduces the spatial and temporal multi-aggregation for state-based sensor data in wireless sensor networks. A spatial and temporal multiple aggregation (STMA) is described to minimize energy consumption and traffic load when a single or multiple users gather state-based sensor data from various sub-areas through multi-hop paths.

The third paper by *Maxim A. Batalin and Gaurav S. Sukhatme* discusses convergence, exploration, and development by a mobile robot and communication network. Sim-

ulation experiments are presented which show the collaboration between the deployed network and mobile robot for the tasks of coverage/exploration, network deployment and maintenance (repair), and mobile robot recovery (homing behavior). The deployed network can also be used for applications other than coverage, such as multi-robot task allocation.

The fourth paper by *Shun-Te Wang* and *Jean-Lien C. Wu* designs a simple attribute-based addressing and GPS-aided routing protocol for applications in wireless sensor networks. This work mainly aims to develop a new data-centric routing protocol.

The second part contains papers that report the topology control and management of wireless sensor networks. *Jonathan Bachrach*, *Radhika Nagpal*, *Michael Salib*, and *Howard Shrobe* discuss experimental results and theoretical analysis of a self-organizing global coordinate system for ad hoc sensor networks. They report an algorithm for achieving robust and reasonably accurate localization in a randomly placed wireless sensor networks, without the use of global control, globally-accessible beacon signals, or accurate estimates of inter-sensor distances.

*Juan Liu*, *Jie Liu*, *James Reich*, *Patrick Cheung*, and *Feng Zhao* report a distributed group management in sensor networks for localization and tracking. A novel scheme is presented to efficiently organize and utilize network resource for target localization. A dynamic group management method is described to initiate and maintain multiple tracks in a distributed manner.

The work by *Eric Nettleton*, *Matthew Ridley*, *Salah Sukkarieh*, *Ali Goktogan*, and *Hugh Durrant-Whyte* describes the implementation of a decentralized sensing network aboard multiple UAVs. This article presents a decentralized airborne data fusion system that can track multiple ground based targets. These results are then used to construct a composite map of the environment.

*Budhaditya Deb*, *Sudeept Bhatnagar* and *Badri Nath* report a distributed parameterized algorithm for sensor topology retrieval at multiple resolutions, which makes a tradeoff between topology details and resources expanded. *Henri Koskinen* describes a simulation-based method for predicting  $k$ -connectivity in a wireless multi-hop network. Knowing the distribution of the random variable under the circumstances of interest allows us to easily determine the number of nodes, the transmission range, and the network area of the wireless sensor network.

The third part reports some interesting applications of wireless sensor networks. *Marco Duarte* and *Yu-Hen Hu* consider a target classification fusion problem in a distributed, wireless sensor network. A distance-based decision fusion scheme is developed to exploit the relationship between sensor to the target distance, signal to noise ratio and classification rate, which requires less communication while achieving higher region classification rate when compared to conventional majority-vote based fusion schemes.

*Shuoqi Li*, *Ying Lin*, *Sang H. Son*, *John A. Stankovic*, and *Y. Wei* propose an event detection service using data service middleware in distributed sensor networks. *Carla-Fabiana Chiasserini* and *Enrico Magli* report energy-efficient coding and error control mechanisms for wireless sensor networks. Finally, *Boris Jan Bonfils* and *Philippe*

*Bonnet* report an adaptive and decentralized operator placement for in-network query processing.

With this Special Issue we hope to bring forth advancements in science and technology as well as improve practices and applications of wireless sensor networks.

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