

Image and video processing in wireless sensor networks

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Published online: 24 March 2009
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Wireless sensor networks (WSNs) are widely applicable to many sophisticated military or industrial applications, including environmental monitoring, surveillance, object tracking or health monitoring. In many practical applications, sensor nodes can be equipped with very tiny video cameras to facilitate the task of tracing a particular object of interest, or the continuous/periodic monitoring of any change in the environment. However, each sensor typically has a very limited battery and processing power. In addition, due to the high costs involved, most sensors are not equipped with the Global Positioning System (GPS) and thus do not have precise knowledge about their own locations during actual deployment. Hence, the challenging issues that need to be addressed in many advanced image, video, and multimedia applications on WSNs include, but are not limited to, the following topics:

- effective image and video capturing;
- object view-angle coverage with visual sensor networks;
- sensor image processing for object tracking;
- in-network pre-processing such as image and video compression;
- collaborative visual information processing;
- distributed vision processing;
- image aggregation in sensor nodes;
- image processing with computational and energy constraints;
- image and video processing with network security;
- image-based localization of sensors;
- image processing and editing, taking into account domain knowledge such as location and angle information.

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The goal of this special issue in the *Multidimensional Systems and Signal Processing* journal is to present the state-of-the-art results and emerging image and video processing approaches that are applicable for WSNs addressing the aforementioned topics or other related issues. It was originated from a special session in the Fifth IEEE Consumer Communications & Networking Conference held in Las Vegas on January 10–12, 2008. The enthusiastic response at the conference provided the impetus for organizing this Special Issue. We have included here both research papers with preliminary versions appearing in the special session, as well as those resulting from our general call for papers.

Four papers have been carefully selected from the contributions to cover different aspects of image and video processing in wireless sensor networks research. In *Wireless Sensor Networks Scheduling for Full Angle Coverage*, Chow et al. (2009) study the scheduling problem to monitor a target continuously by multiple visual sensors with full angle coverage. Several algorithms adopting different cost functions in selecting the sensors are developed to increase network lifetime, and evaluated through extensive simulations. In *Statistical Methods to Estimate Vehicle Count Using Traffic Cameras*, Zhuang et al. (2009) present a very interesting investigation on using a network/system of traffic cameras, which can potentially be wireless cameras/sensors, for traffic monitoring and control, especially to estimate vehicle counts. When there are only a limited number of cameras in the system, a heuristic method is considered. Their results are carefully compared and analyzed. In *Wireless Image Sensor Networks: Event Acquisition in Attack-prone and Uncertain Environments*, Czarlinska and Kundur (2009) describe several techniques to distinguish an event at camera sensors. To reduce the energy and computation requirement in sensor nodes, lightweight image processing is adopted. The approaches are analyzed in terms of the probabilities of successful detection and false alarm. In *Resource Optimization in Distributed Biometric Recognition Using Wireless Sensor Network*, Muraleedharan et al. (2009) consider a wireless face recognition system with limited resources such as energy, memory and bandwidth in WSNs. Based on the Ant Colony Optimization, they propose a meta-heuristic approach to form the cognitive routing protocol for wireless image transmission, with its performance including the energy consumption and response time carefully evaluated through simulations.

Last but not least, we would like to thank Professor Nirmal K. Bose, Editor-in-Chief of the *Multidimensional Systems and Signal Processing* journal, for his keen support of this Special Issue. We would also like to thank the many reviewers for their constructive comments to help improve the quality of the papers.

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