Title: Distributed Algorithms for Localization and Management in Wireless Ad-Hoc Sensor Networks

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Abstract:
One of the most needed and challenging components in an ad-hoc wireless network is the development of practical localized algorithms for the automatic discovery of sensor position. More recent approaches to location discovery often require the availability of GPS on some reference sensors, assume some sensors with prior position information, or use centralized processing to locate the sensor positions. For a wireless ad-hoc network, these assumptions may not be reasonable because the required information may not be available or because of the large amount of communication required between sensors.

We propose a decentralized algorithm that assumes a number of sensors are scattered about the landscape. Initially, all of the sensor positions are unknown and must deduce their positions based on the limited information that they receive. The basic strategy is to allow group of nearby sensors to deduce their positions relative to each other, forming clusters. These clusters are defined by their shared ‘local’ coordinate system. A communication protocol allows nearby clusters (those which share ‘border sensors’) to merge into larger clusters until eventually the complete network is referenced to the same coordinate system. The calculations must be done in a decentralized manner since the cost of communication (in terms of power consumption) is high. The algorithms exploit the information flow while coping with distributed signal processing and the requirements of network scalability. For sensor location problems, once the estimation procedure and communication protocol are performed, sensor clusters can be merged to establish a single global coordinate system.

Chih-Yu Wen received his B.S.E.E. and M.S.E.E. with high honors from National Cheng Kung University in Taiwan in 1995 and 1997, respectively. He received an M.S.E.E. from the University of Wisconsin-Madison in 2002 and expects to finish his Ph.D. degree in Electrical Engineering from the University of Wisconsin-Madison in August 2005. From 1995 to 1997, he worked on cellular mobile systems emphasizing on capacity of wireless channels and networks, modulation, and error control coding. His current research areas include wireless communications, adaptive signal processing, software-defined radio, and adaptive distributed algorithms for wireless ad hoc sensor networks. He has served as a referee for EURASIP Journal on Wireless Communications and Networking.