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Event: Efficient Sensor Networks for Smart Environments
Host: NATEA-SV wirelessSIG / IEEE-SVC ComSoc
Time: 4/08/2009 Wednesday, 6:00**PM** to 8:00**PM**
06:00 – Registration, networking
06:30 – Presentations
07:30 – Q&A
Place: National Semiconductor, Building E, **2900 Semiconductor Dr.**, Santa Clara
Map_Link Building_Map
Fee: Free**, 2$ Donation to cover pizza**
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Abstract:
Wireless sensor networks enable efficient monitoring and control systems required for building a smart environment. Based on the application, the network operations can be either event-driven or time-driven. In this talk, we introduce novel energy-efficient algorithms for both network operation types, and provide a smart building example using a camera sensor network.

For the event-driven operation, we study the sensing and actuating networks that require immediate notification of rare but urgent events and fast delivery of time sensitive actuation commands. We investigate wakeup scheduling and present a new family of wakeup methods, called multi-parent scheme, in which multiple routes for transfer of messages and wakeup schedules for various nodes are crafted to increase longevity while reducing message delivery latencies. A key step to realizing the multi-parent method is to divide the nodes in the network into disjoint groups. We formulate this step as a graph coloring problem and introduce a heuristic algorithm that can partition nodes efficiently.

For the time-driven operation, we investigate the periodic data collection problem and present an energy-efficient and practical solution. During data aggregation, nodes can exploit the correlation of the sensed data and fuse the data from different sensors to eliminate redundant transmissions. In our solution, energy efficiency is achieved by combining two design methods: (a) Considering the network connectivity graph and the data correlation, the optimal flows for balancing the communication load among all nodes is calculated; (b) Instead of using a fixed communication tree, a set of optimized trees is constructed based on the optimal flows and the communication tree varies over different data aggregation cycles. We show that this method achieves an average energy consumption rate close to the optimal value.

Smart homes are conceptualized as environments responsive to user's presence and actions and adaptive to user preferences and behavior models. Visual information plays an enabling role in applications such as interfaces and gesture control. We report on the use of camera networks for automated control of lights in a smart building. The proposed optimization formulation maintains the user's comfort while minimizing the lighting energy cost. Information from camera sensors provides occupancy reasoning and human activity analysis.

By employing the user's positions, activities, and preference as constraints, the light setting can be optimized for the user's satisfaction in the occupied area.

Speaker
Huang Lee, Ph.D. Candidate, Stanford

Biography
Huang Lee is currently a Ph.D. Candidate in the Department of Electrical Engineering at Stanford University. He holds a bachelor's degree in Electrical Engineering from Nation Taiwan University, and two master's degrees, one in Communication Engineering from National Taiwan University, and one in Electrical Engineering from Stanford University.

During 2000-2004, he was a research assistant in Communication System Lab at National Taiwan University, where his research includes multiuser communications, coded DS/CDMA systems, and multi-rate OFDM-CDMA systems. In 2004, he joined Stanford Wireless Sensor Networks Lab, where he is developing data collection and wakeup scheduling algorithms for multi-cluster wireless sensor networks, and vision-based localization and reasoning algorithms for smart camera networks. His current research interests focus on convex optimization and its applications in wireless sensor networks.

His industry experience includes affiliation with Groundhog Technologies as a consultant researcher in 2004, and with Bosch Research and Technology Center during 2005-2008, where he works on the energy-efficient algorithm design for wireless sensor networks.