SEMINAR NOTICE

Department of Electrical and Systems Engineering

Detection and Estimation Of Diffusive Sources
Using Sensor Arrays and Wireless Sensor Networks

by

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In this dissertation we address the problems of detection and estimation of a diffusive source using sensor arrays and wireless sensor networks. These problems appear in applications such as homeland security and environment monitoring. We develop both centralized and distributed processing methods. The proposed distributed processing also provides a general framework for other applications in wireless sensor networks.

We first derive physical models for substance dispersion under various source and environmental conditions. We then study centralized processing methods to detect and estimate diffusive sources. A maximum likelihood algorithm is used to estimate the diffusive source, and the Cramer-Rao bound is computed to analyze its performance. We derive two detectors, namely a generalized likelihood ratio test as well as a mean-difference detector; we determine their performances in terms of the probability of detection and probability of false alarm. The results can be used to design the sensor array for optimal performance.

After that, we continue our work of estimating a diffusive source by developing distributed processing methods for applications in wireless sensor networks. We derive the energy-efficient distributed estimation methods under two frameworks. We first develop a distributed sequential Bayesian estimation method to estimate a diffusive source. We then extend the sensing model to a general statistical measurement model that fits other applications in wireless sensor networks. Based on this measurement model, we derive a distributed maximum likelihood estimation using incremental Gauss-Newton methods. For both of these methods we implement information-driven sensor collaboration signal processing and select the next sensor node according to certain criteria, which provides an optimal subset and an optimal order of incorporating the measurements into the information processing, reduces response time, and saves energy consumption of the sensor network.

DATE: Monday, May 8th, 2006
TIME: 2:00 p.m.
PLACE: Room 305, Bryan Hall

Research advisor:
Arye Nehorai

This seminar is in partial fulfillment
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