SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

THROUGH-THE-WALL IMAGING AND MULTIPATH EXPLOITATION

DISSERTATION DEFENSE
by

Marija Nikolic
PhD Candidate
Preston M. Green Department of Electrical and Systems Engineering
Washington University in St. Louis

Abstract: We consider the problem of using electromagnetic sensing to estimate targets in complex environments, such as when they are hidden behind walls and other opaque objects. The often unknown electromagnetic interactions between the target and the surrounding area, make the problem challenging. To improve our results, we exploit information in the multipath of the objects surrounding both the target and the sensors.

First, we estimate building layouts by using the jump-diffusion algorithm and employing prior knowledge about typical building layouts. We also take advantage of a detailed physical model that captures the scattering by the inner walls and efficiently utilizes the frequency bandwidth.

We then localize targets hidden behind reinforced concrete walls. The sensing signals reflected from the targets are significantly distorted and attenuated by the embedded metal bars. Using the surface formulation of the method of moments, we model the response of the reinforced walls, and incorporate their transmission coefficients into the beam forming method to achieve better estimation accuracy. In a related effort, we utilize the sparsity constraint to improve electromagnetic imaging of hidden conducting targets, assuming that a set of equivalent sources can be substituted for the targets. We derive a linear measurement model and employ l_1 regularization to identify the equivalent sources in the vicinity of the target surfaces. The proposed inverse method reconstructs the target shape in one or two steps, using single-frequency data. Our results are experimentally verified.

Finally, we exploit the multipath from sensor-array platforms to facilitate direction finding. This in contrast to the usual approach, which utilizes the scattering close to the targets. We analyze the effect of the multipath in a statistical signal processing framework, and compute the Cramer-Rao bound to obtain the system resolution. We conduct experiments on a simple array platform to support our theoretical approach.

DATE: Tuesday, November 22, 2011
TIME: 11:00 a.m.
PLACE: Green Hall, Room 0120

Dissertation advisor:
Dr. Arye Nehorai

This seminar is in partial fulfillment
of the Doctor of Philosophy degree

Washington University in St. Louis
SCHOOL OF ENGINEERING & APPLIED SCIENCE