SEMINAR NOTICE

Department of Electrical and Systems Engineering

ESTIMATING EXTENDED BRAIN SOURCES USING EEG AND DIFFUSE OPTICAL TOMOGRAPHY

by

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We develop methods for estimating extended brain sources using electroencephalography (EEG) and diffuse optical tomography (DOT). We provide solutions to both the forward and inverse problems, aiming to improve the modeling accuracy and reconstruction performance. Our methods can be useful for studying brain functions and localizing epilepsy foci.

We first propose parametric modeling of extended brain sources using EEG. In contrast to commonly used source imaging techniques, we directly parameterize the source extent information and use basis functions to incorporate prior information on the source distribution. We assume a realistic head model and solve the EEG forward problem using the boundary element method. We estimate the source parameters using the maximum likelihood method and analyze the estimation accuracy using the Cramer-Rao (CRB). We test our models using numerical examples, phantom data, as well as real EEG measurements of N20 responses.

We then propose two DOT image reconstruction methods to estimate extended brain activations as well as breast tumors. We first design a spatial filter technique to localize tissue abnormalities by using linearly constrained minimum variance (LCMV) beamforming. This filter has better computational efficiency than the Newton-type reconstruction approaches and is robust against modeling errors. We develop an inverse solution to DOT based on sparsity regularization. This solution incorporates the sparse nature of the abnormality and provides higher resolution than the Tikhonov-type regularization method. We formulate the inverse problem by regularizing the L1 norm of the unknown parameters and solve it iteratively using the expectation-maximization (EM) algorithm. We validate our methods using numerical examples and show the performance advantage compared with existing ones.

DATE: Wednesday, October 24, 2007
TIME: 11:00 a.m.
PLACE: Bryan Hall, Room 305

Thesis advisor:
Arye Nehorai

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

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SCHOOL OF ENGINEERING & APPLIED SCIENCE