SEMINAR NOTICE

Department of Electrical and Systems Engineering

*******T I M E   C H A N G E*******

STATISTICAL SIGNAL PROCESSING FOR RADAR IN COMPOUND-GAUSSIAN SEA CLUTTER

by

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In this dissertation, we address various problems of estimation, detection and optimal design in compound-Gaussian noise. Compound-Gaussian models are used in radar signal processing to describe heavy-tailed clutter distributions. The important problems in compound-Gaussian clutter modeling are choosing the texture distribution, and estimating its parameters. Many texture distributions have been studied, and their parameters are typically estimated using statistically suboptimal approaches. We develop maximum likelihood (ML) methods for jointly estimating the target and clutter parameters in compound-Gaussian clutter using radar array measurements. In particular, we estimate (i) the complex target amplitudes, (ii) a spatial and temporal covariance matrix of the speckle component, and (iii) texture distribution parameters. Parameter-expanded expectation-maximization (PX-EM) algorithms are developed to compute the ML estimates of the unknown parameters. We also compute the Cramer-Rao bounds (CRBs) and related bounds on these parameters. We first derive general CRB expressions under an arbitrary texture model then simplify them for specific texture distributions. We consider the widely used gamma texture model, and propose an inverse-gamma texture model, leading to a complex multivariate-t clutter distribution and closed-form expressions of the CRB. Especially, we apply the inverse-gamma texture model to real radar data and compare its estimation with the results using traditional method-of-moments (MoM). We optimally and adaptively design the polarimetry of the transmitting signal to minimize the determinant of the CRB of the target scattering matrix. We then derive a sequential detection method under compound-Gaussian clutter for two cases: known and unknown target parameters. We examine the relationship between several performance measures for the sequential detector, including the false-alarm rate and the average detection delay. We study and verify the results through numerical examples.

DATE:	Monday, December 4th, 2006
TIME:	9:00 a.m.
PLACE:	Room 305, Bryan Hall

Research advisor:
Arye Nehorai

This seminar is in partial fulfillment
of the Doctor of Science Degree

Washington University in St. Louis
School of Engineering & Applied Science