Notice and Invitation
Doctoral Research Seminar Presentation
The Volgenau School of Engineering, George Mason University

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Probabilistic model for DMR-whitened eigenvalues using high dimension, low sample size asymptotics, and random matrix theory

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WebEx Link:
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Abstract

Source enumeration algorithms typically rely on an eigendecomposition of the spatial sample covariance matrix (SCM) to estimate the number of signals. Most classical source enumeration methods assume a white noise background and large numbers of snapshots to estimate the spatial SCM. However, many non-stationary environments, e. g., the underwater channel, are characterized by strong noise with complicated structure that can change rapidly. Low levels sources are often masked in those environments. Source enumeration using an array in a colored noise environment relies on a whitening transformation as a preprocessing stage to mitigate the effects of colored noise. Whitening requires the estimation of the noise-only sample SCM, which is a challenging problem for large arrays in nonstationary environments due to the limited number of snapshots available. The amount of data required to estimate the spatial covariance scales with array size. The dominant mode rejection (DMR) whitening transform [Diaz-Santos & Wage, 2015], based on Abraham and Owsley's DMR beamformer [1990], replaces the small eigenvalues of the SCM by their average, thereby reducing the number of snapshots required to estimate an invertible noise-only SCM. Using random matrix theory (RMT) and high dimension, low sample size (HDLSS) asymptotics, this seminar derives the probability distribution of the largest DMR-whitened eigenvalue and defines a threshold for the source enumeration algorithm that guarantees a specified probability of false alarm. Specifically, the derivation builds on Jung et al.'s results on HDLSS asymptotics for principal component analysis [2012]. The approach assumes a generalized spiked covariance model for the narrowband noise received by the array. The proposed probabilistic model predicts the largest DMR-whitened eigenvalue as a function of the array dimension and number of snapshots. Simulations demonstrate the accuracy of the new model. [Work supported by ONR and NSWCDD.]