ACOUSTICS2008/107
Analytical prediction of sample eigenvector quality deterioration in large arrays due to SNR or sample size constraints

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It is well-known that subspace-based estimation methods in adaptive array processing suffer a rapid degradation in performance as either the signal-to-noise ratio (SNR) or the number of available snapshots drops below a certain threshold value. In the large system, relative large sample size limit, one can use random matrix theory to analytically predict this threshold and the degradation in the "quality" of the corresponding subspace estimates. In certain settings, one observes a "phase transition" phenonemon so that if the signals are too weak or there are insufficient number of snapshots or both, the subspace estimates are, statistically speaking, noise-like. We discuss the implication of these results for the subspace based detection of signals in white and colored noise using large arrays and illustrate the accuracy of the predictions with numerical simulations.