PhD ECE Seminar

Random Matrix Theory Predictions of Dominant Mode Rejection Beamformer Performance

Presenter: Christopher Hulbert

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Location: ENGR 2901 / Zoom:
https://gmu.zoom.us/j/92463894184?pwd=akVJSVU1RkxlRzE3UjFObEpjckpiQT09

Abstract:

Adaptive beamformers use a sensor covariance matrix estimated from data snapshots to mitigate directional interference and attenuate uncorrelated noise. Dominant mode rejection (DMR) is a variant of the classic minimum variance distortionless response (MVDR) algorithm that replaces the smallest eigenvalues in the covariance estimate by their average while leaving the largest ones unmodified. Since DMR does not invert the small eigenvalues of the sample covariance, it achieves a higher white noise gain than MVDR while still suppressing loud interferers, thereby yielding a higher signal-to-interference-plus-noise ratio (SINR). Reed et al. showed that MVDR requires twice as many snapshots as sensors to achieve an output SINR within 3 dB of the SINR achievable with the true covariance. Prior empirical analyses showed that achieving the same SINR with DMR only requires twice as many snapshots as interferers. This seminar presents new analytical models of white noise gain and interference leakage for DMR that leverage random matrix theory (RMT) results, specifically the eigenvalue and eigenvector limiting results of the spiked covariance model. Applying the new analytical models confirms the empirical DMR snapshot requirement. To handle finite cases with a large number of interferers relative to the array size, this seminar introduces a modified spiked covariance model that improves the accuracy of RMT results, and hence DMR performance predictions.