ECEn 665
Antennas and Propagation for Wireless Communication

Homework #25
Due April 19, 2023 at the beginning of class (may be turned in after class for half credit)

1. (a) Implement the max-SNR beamformer. Let the noise model consist of azimuthally isotropic blackbody radiation with correlation matrix $R_{mn} = \sigma_n^2 J_0(kr_{mn})$ where r_{mn} is the distance between array elements m and n. The interferer is a point source with direction of arrival (DOA) ϕ_i and received power σ_i^2. The signal is a point source with DOA ϕ_s and power σ_s^2. Let the powers be ordered something like $\sigma_i^2 = 10\sigma_s^2 = 100\sigma_n^2$ (interferer dominated). For five isotropic elements spaced $0.5\,\lambda$ apart, plot the array radiation pattern for the max-SNR beamformer. Put markers on the curve at ϕ_i and ϕ_s. (b) What happens to the beamformer as σ_n^2 becomes very small or very large?
2. Superimpose on this plot the pattern obtained with a maximum gain beamformer, which can be obtained by setting the noise correlation matrix in the max-SNR beamformer equal to the isotropic noise correlation matrix (e.g., set $\sigma_i^2 = 0$). How do the two patterns compare? Compute the signal to interference plus noise ratio (SINR) for the two beamformers.
3. Implement subspace projection and add the resulting pattern to the plot. Compute the SINR.