Adaptive and Array Signal Processing/Processamento de Sinais Adaptativo

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Tutorial Questions/Lista de Exercícios - 8

1. Consider a beamforming problem in which a uniform linear array (ULA) is used and an MVDR beamforming algorithm is employed.



The signal model is given by

$$x\left[i\right]=s\_{d}\left[i\right]a\left(θ\_{d}\right)+\sum\_{k=1,k\ne d}^{K}s\_{k}\left[i\right]a\left(θ\_{k}\right)+n\left[i\right]$$

where$ x\left[i\right]$ is an N x 1 received vector, $s\_{d}\left[i\right]$ is the desired signal and$ a\left(θ\_{d}\right)$ is the steering vector of the desired signal, $s\_{k}\left[i\right]$ are the interfering signals that are generated by real Gaussian random variables and$ a\left(θ\_{k}\right)$ are the steering vectors for the k=1,2, ...,K signals impinging on the array. The noise vector $n[i]$ represents the measurement noise which is modelled as a complex Gaussian random variable with zero mean and variance $σ^{2}$. The system employs an MVDR to suppress the interference as shown in the Matlab programme on the website of the course.

Write Matlab recursions to study and simulate the following:

a) Model mismatch errors in the steering vector of the desired signal using complex Gaussian random variables with a variance $σ\_{e}^{2}=0.1σ^{2}$ and design a robust MVDR beamformer with diagonal loading. Show SINR x snapshots, SINR x SNR and beampattern plots.

b) Develop LMS and RLS versions of the MVDR beamformer and compare them using SINR x snapshots, SINR x SNR and beampattern plots.