

**Problem Set 6**

Spring 2009

**Issued:** Friday, April 17, 2009

**Due:** Wednesday, April 22, 2009

---

Assigned reading

4/15/09 — Sections 6.6-6.10 in *Optimum Array Processing*

4/22/09 — Sections 7.1-7.3 in *Optimum Array Processing*

---

Please include a **hard-copy** of any Matlab code you develop. This week you'll need to develop code to compute optimum beamformer weights and the associated array gains.

**Problem 6.6.2** in *Optimum Array Processing*

**Problem 6.7.2** in *Optimum Array Processing*

Do part a only.

**ECE-754 Problem 6-1**

In this problem, you'll design Matlab code to recreate some of the performance plots I showed in class on Wednesday night. The scenario I considered is as follows:

- 20 element linear array with  $\lambda/2$  spacing
  - The arriving signal consists of
    - A source with SNR = 10 dB. The source is at  $u_s = 0.03$ .
    - An interferer at  $u_I = 0.25$  with INR = 30 dB
    - Spatially white noise (the source and interference levels are determined with respect to whatever white noise level you pick using the SNR and INR numbers)
- (a) Generate the beampattern plots for the conventional, MVDR, and MPDR beamformers assuming that the array is steered to broadside  $u = 0$  and that the ideal statistics are known.
- (b) Generate 100 snapshots of data for this case. You may use the code `mksnaps.m` posted on the course website or write your own.
- (c) Process the 100 snapshots of data using conventional, MVDR, and MPDR beamformers. Your processed results should include plots of the output power versus scan direction. You should consider 2 sets of scan angle spacings:
- $\Delta u_z = \frac{1}{N}$  where  $N$  = number of array elements
  - $\Delta u_z = \frac{0.25}{N}$  where  $N$  = number of array elements
- (d) Using the analytical results for the mismatch analysis (presented in Section 6.6 of the text and discussed on 3/25/09), you should be able to predict the beamformer output SNR for the source. Do your analytical predictions agree with your processed data? You may need to generate additional snapshots to get a good estimate of the average power at the output of the appropriate beam.
- (e) Vary the SNR and INR levels, and the source location  $u_s$ . Discuss what you've learned.

*If you have time you may want to experiment with adding diagonal loading to your MVDR and MPDR beamformers.*