Problem 6:

1. Conventional beamforming processing (CBF).

A vertical array of 32 receivers are spaced 10 meters, and receive a signal (f = 20 Hz) from 30^o. The sound speed is 1500 m/s. Source Level is 0 dB. Noise Level is 0dB.

a) Plot the beampattern (eg without Source and Noise Level).

b) Plot the beamformer output using the CBF method. Normalize the maximum to zero dB.

2) Minimum variance distortionless response (MVDR)

The parameters are the same with above,

plot the beamformer output using the MVDR method, compare those two results.

Normalize the maximum to zero dB.

3) Experiment

a) Try moving the angle of an additional source with same the same source level closer, which method fails first?

b) Choose an angle 5 deg further apart than in 3a) and then increase the noise level until it fails.

4) More experiments

Pick your own experiments (2 cases) or choose form the following

a) Double array aperture
b) Double number of sensor
c) Vary source powers and noise powers.
d) Try a different sound speed for replica
e) Try \lambda/10, \lambda, and \lambda/2 spacing
f) Implement it as a matrix method y=Ax
g) Plot Gram matrix |A^HA|
h) Simulate noise as a random signal.
i) Try MUSIC instead of MVDR

Homework 7

A vertical array of ten receivers are spaced 10 meters apart at range 0 in the middle of water column. In a simple Pekeris waveguide, (from problem 4: f=300 Hz, c=1500m/s, cb=1800m/s, D=150m, attenuation 0.1dB/lambda).

Pick a source position in the water column and 1km< range <5km, for your data vector d (dimension 10). Data vector d should be obtained by wavenumber integration. Your goal is to localize a source using the conventional beamforming (CBF) and Minimum Variance distortionless processor (MVDR), in range and depth.

a) First focus is on generating the replica vectors for a 100 by 120 grid of potential source positions and save them in a mat file
b) Then read the mat file. Pick one of these grid points as a source position. Run CBF. Plot ambiguity surface.
c) Run MVDR with diagonal loading (or noise)