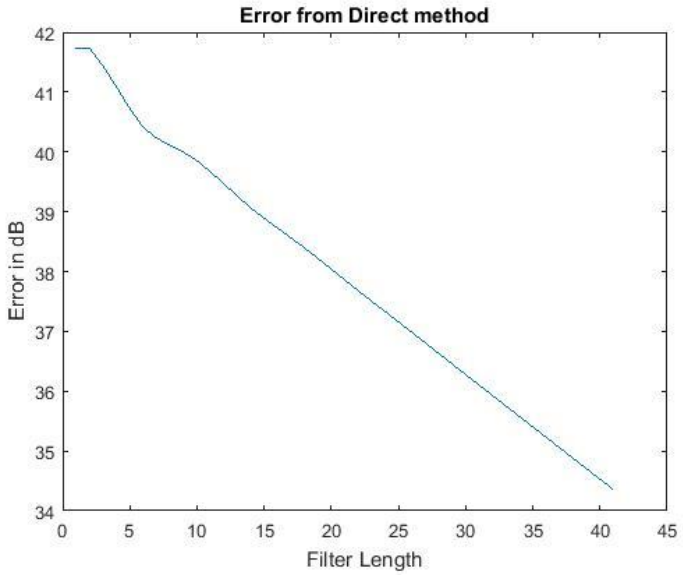
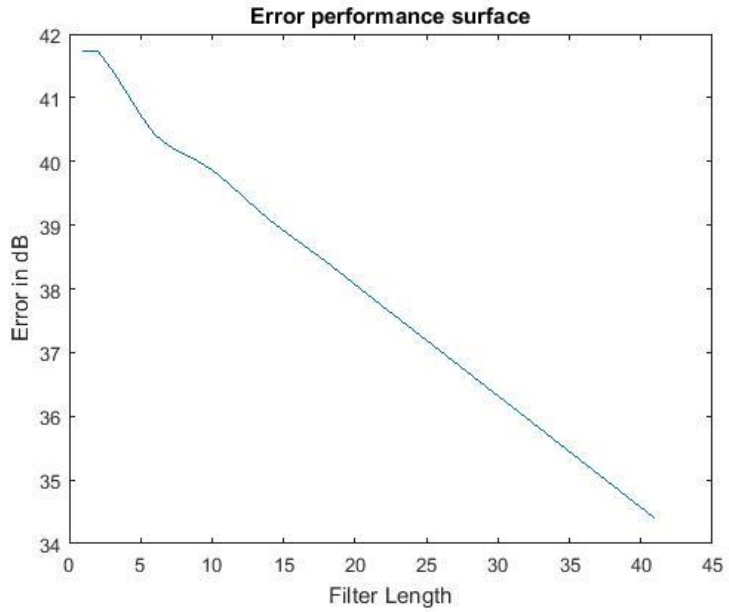
1a

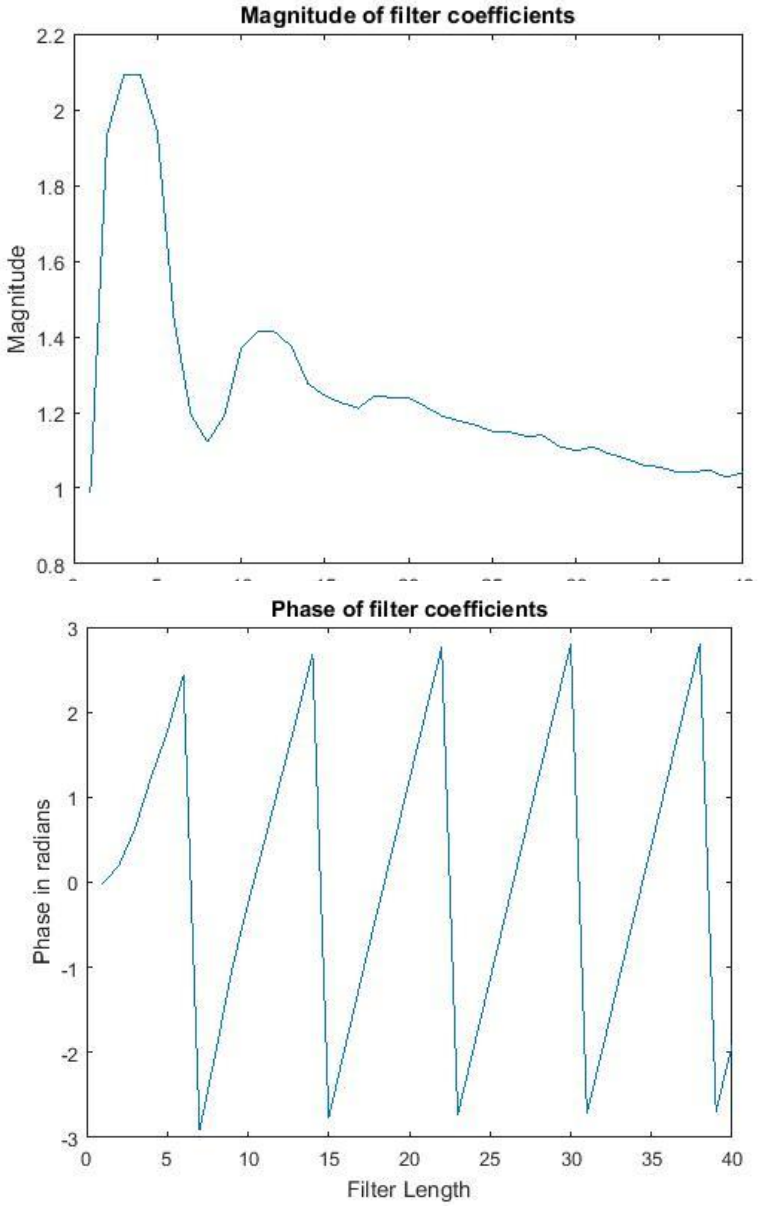
The mean square error using direct and analytical method was plotted as follows



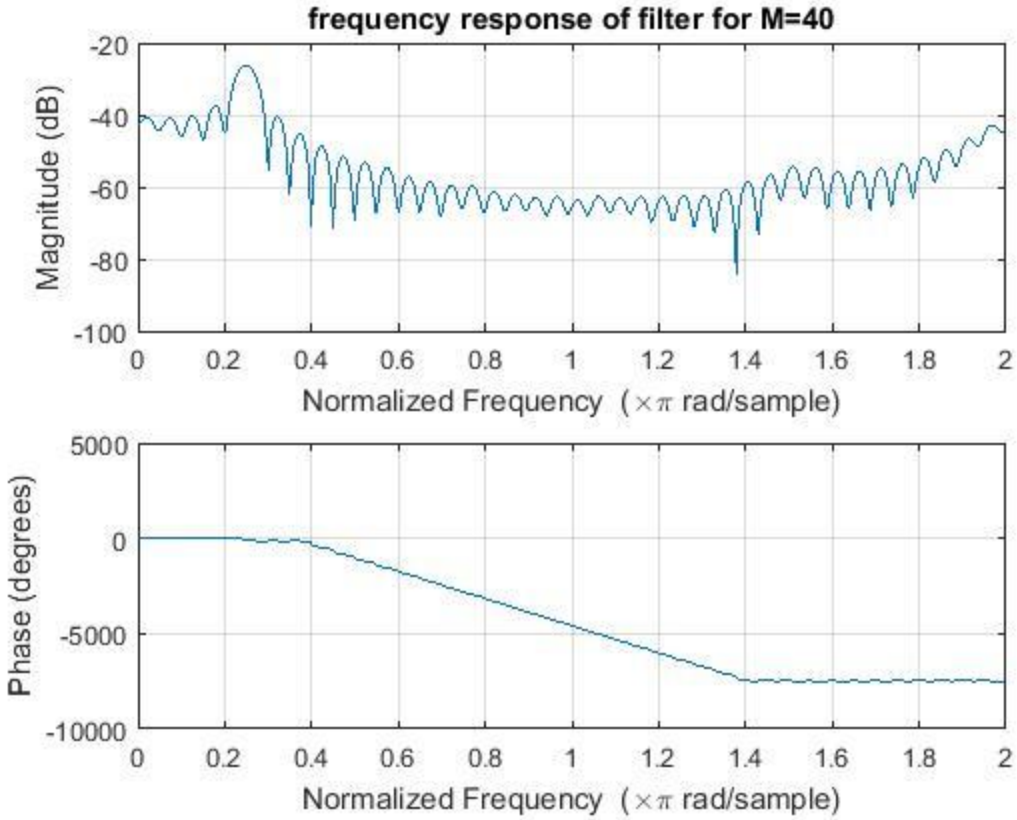


The error is decreasing with the increase in filter length thus moving towards minimum MSE.

The magnitude and phase response of the filter is plotted as follows:

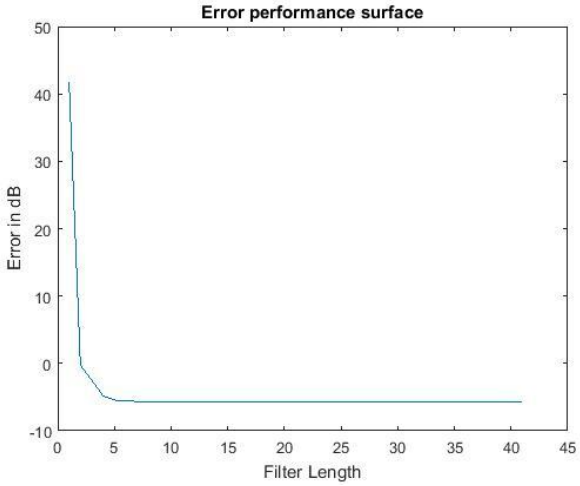


The frequency response of the filter is plotted as follows

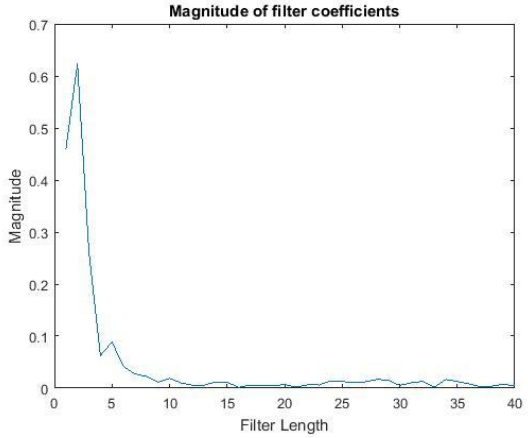


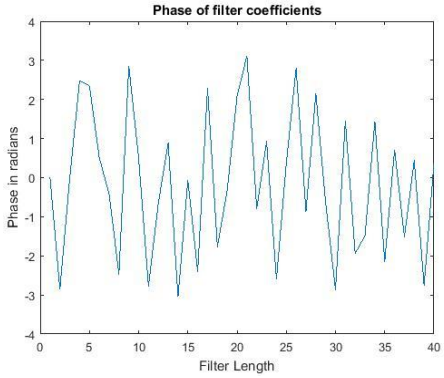
d) If we assume it to be MA model , we can see that the MSE is continuosuly decreasing with increasing filter length going towards MMSE so the length of the MA model should be more than 40.

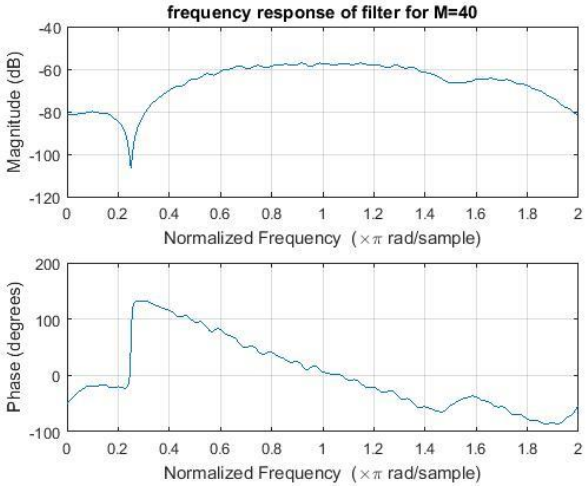
2a If we repeat 1 by chaning x(n) and d(n) we get



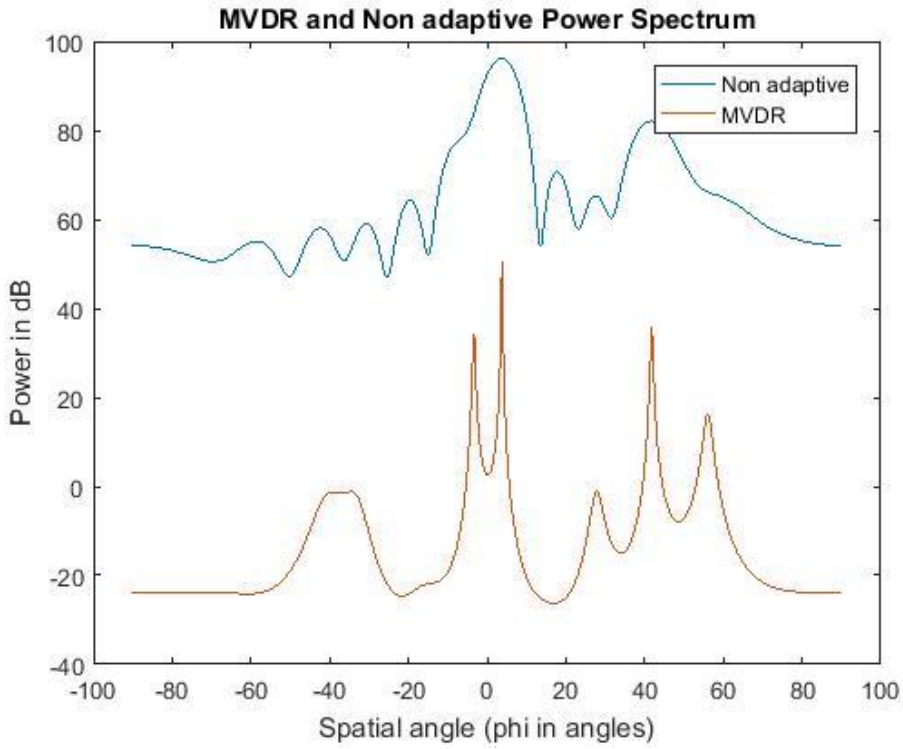
As error reaches 0dB for filter length of 1, the unknown system is MA model of length 1.

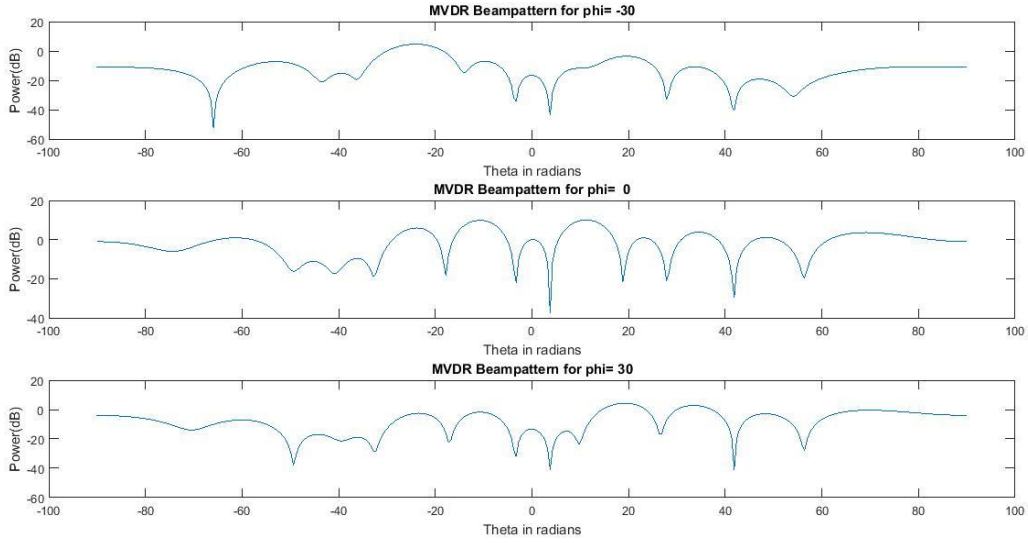


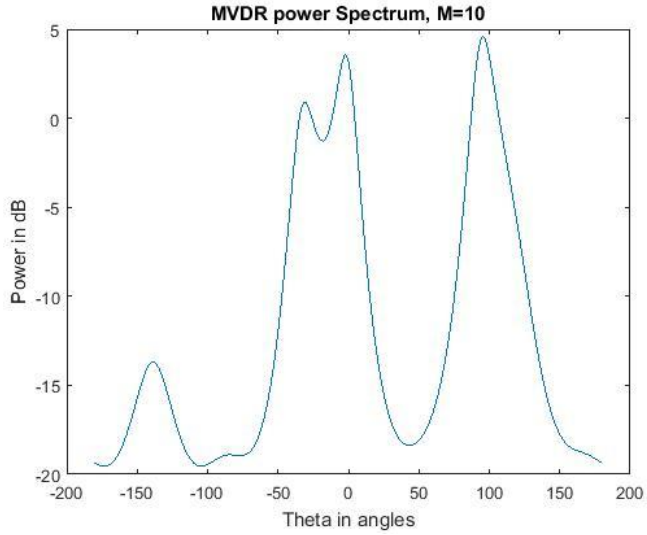


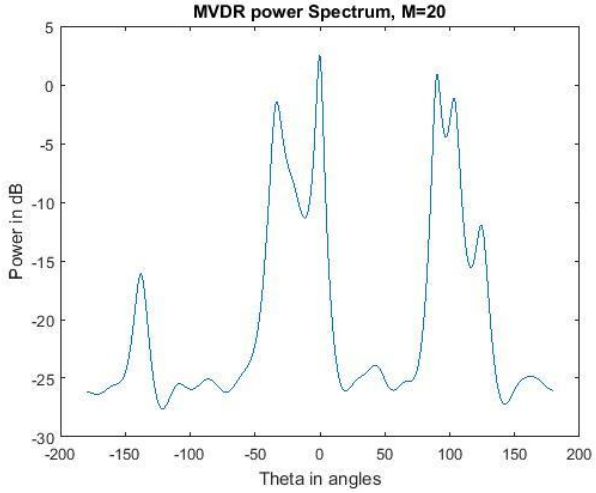


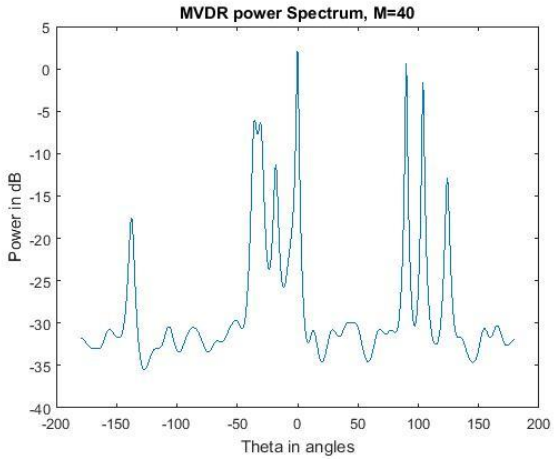
3a) There are 8 visible signals in the nonadaptive beam pattern and there are 7 signals visible in mvdr beampattern. MVDR is better in making distinction between closely spaced signals thannon adaptive one.

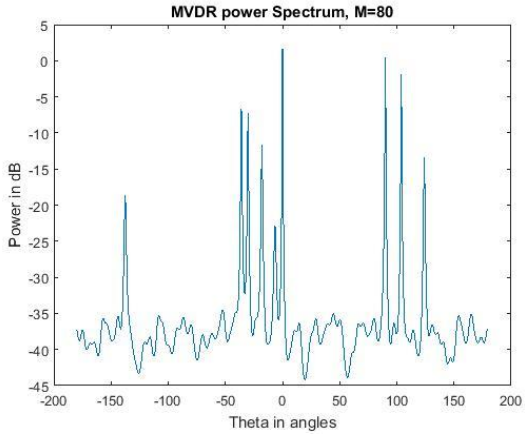

MVDR and Non adaptive Power Spectrum
Non adaptive
MVDR
Power in dB
Spatial angle (phi in angles)


MVDR Beampattern for phi= -30
MVDR Beampattern for phi= 0
MVDR Beampattern for phi= 30
Power(dB)
Theta in radians

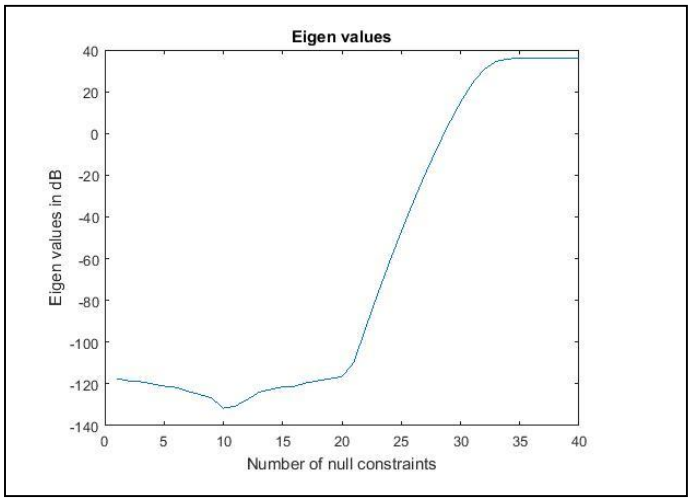


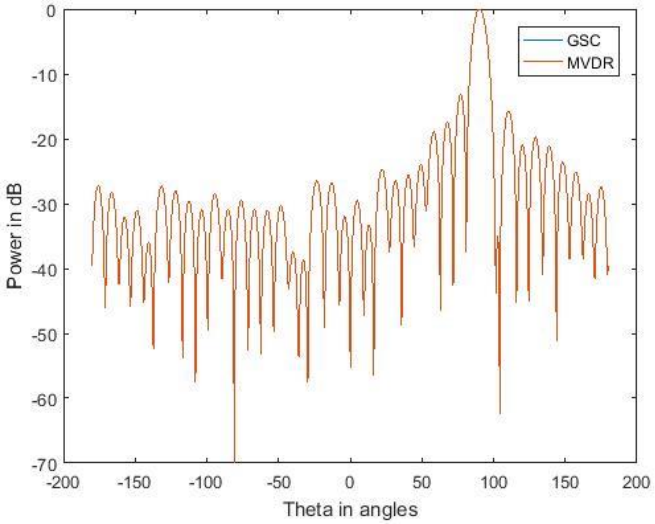


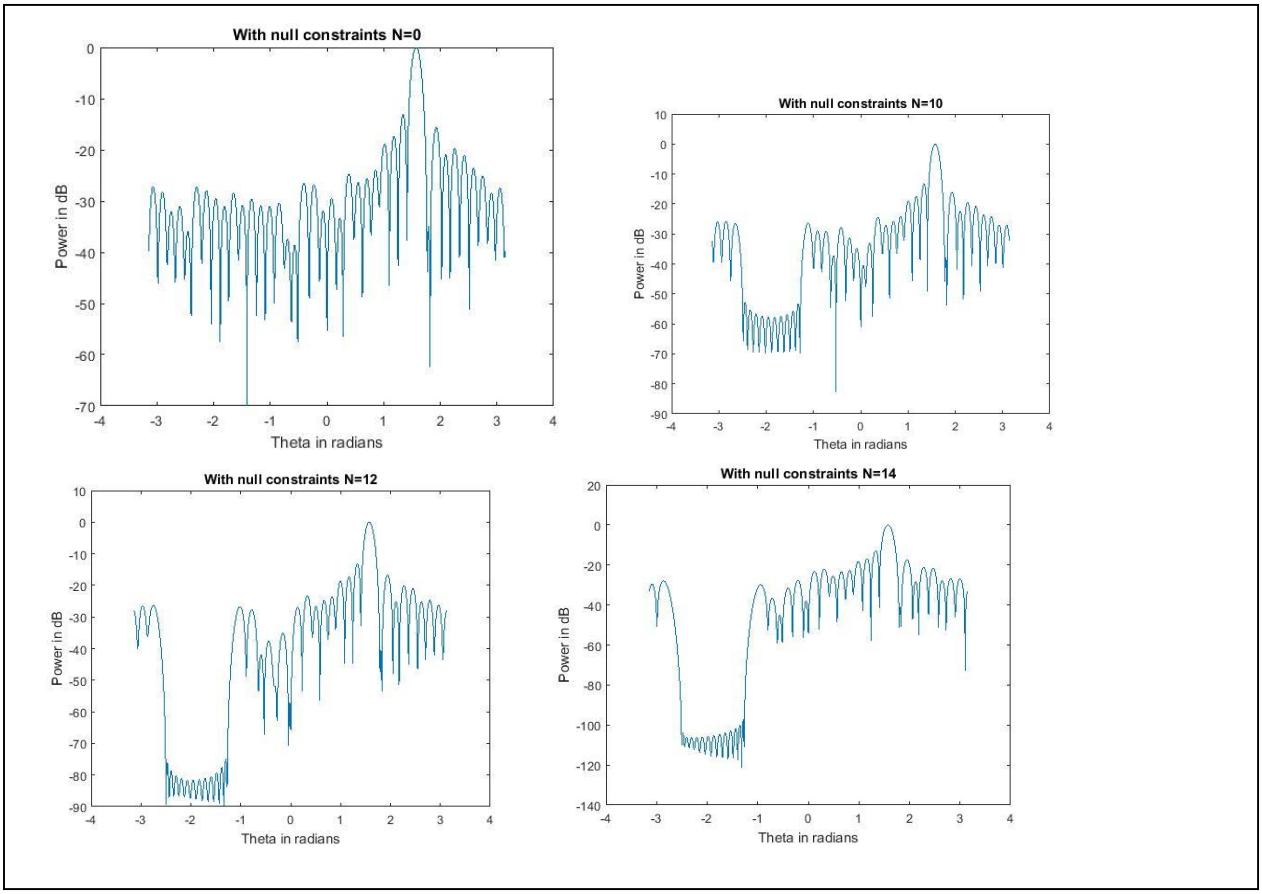


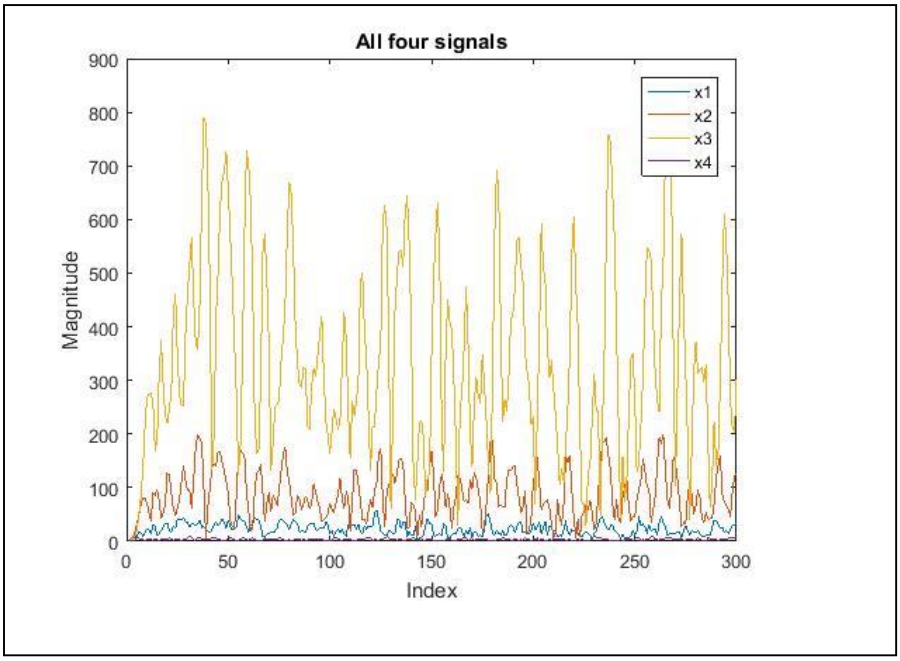


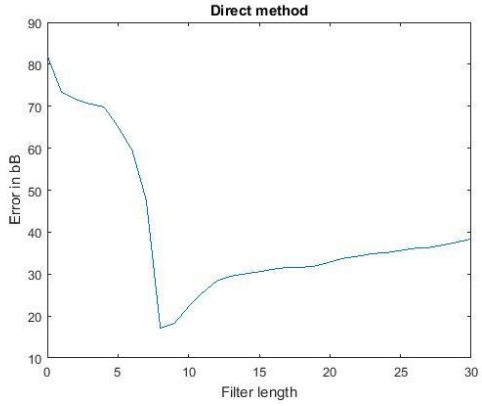
With the increase in filter lengths MVDR is able to isolate more closely spacedd frequency components or signals ie spatial resolution becomes better.

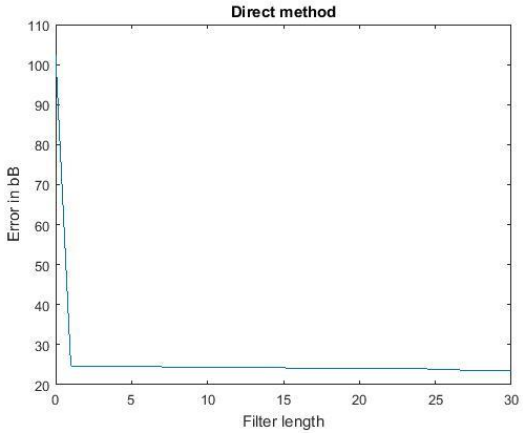

Eigen values
Eigen values in dB
Number of null constraints
40
20
0
-20
-40
-60
-80
-100
-120
-140
0
5
10
15
20
25
30
35
40

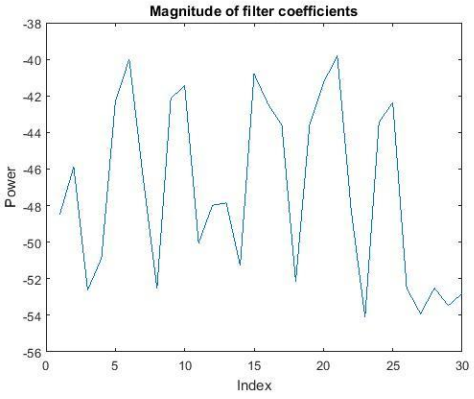

GSC
MVDR
Power in dB
Theta in angles
0
-10
-20
-30
-40
-50
-60
-70
-200
-150
-100
-50
0
50
100
150
200

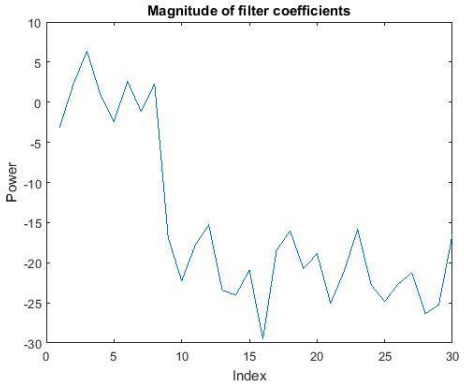

With null constraints N=0
Power in dB
Theta in radians
With null constraints N=10
Power in dB
Theta in radians
With null constraints N=12
Power in dB
Theta in radians
With null constraints N=14
Power in dB
Theta in radians


All four signals
Magnitude
Index
x1
x2
x3
x4
0
100
200
300
400
500
600
700
800
900
0
50
100
150
200
250
300


Direct method
Error in bB
Filter length


Direct method
Error in bB
Filter length


Magnitude of filter coefficients
Power
Index


Magnitude of filter coefficients
Power
Index