An Experimental Analysis of MVDR and MUSIC Algorithm

Vinod Kumar, Sanjeev Kumar Dhull

***Abstract*: This paper shows a experimental analysis of between MVDR algorithm (Minimum Variance Distortionless Response) and MUSIC (Multiple Signal classification) algorithm. These algorithms are used in direction findings for smart antenna. This paper shows the comparison between these algorithms based on the certain parameters like total no. of antennas, spacing between them, number of snapshot. At last, the Results obtained from MUSIC algorithm has been found better than MVDR algorithm.**

***Index Terms*: MUSIC, MVDR, Snapshot, Smart Antenna.**

I. INTRODUCTION

At present, high resolution direction of arrival estimation is an active area of research in the phased array signal processing. For signal point of view, Minimum Variance Distortion less response (MVDR) is based on the spectral estimation [1-3]. The MVDR method has low resolution and low accuracy. After that Sub space methods are evolved which are based upon the Eigen value decomposition. Spatial smoothing technique is also applied in MUSIC algorithm [4-9].

MVDR: The MVDR algorithm estimates the spectral spectrum of incoming narrowband signals by scanning a particular region of the broadside angles for a uniform linear array [3-4]. The algorithm calculates the direction of arrival for the specific number of signals by estimating peaks of the spectrum. The given figure estimates the two signals received with a rectangular lattice. The frequency is taken about 150 MHz. The signals directions are (-37, 0) and (17,20) degrees.

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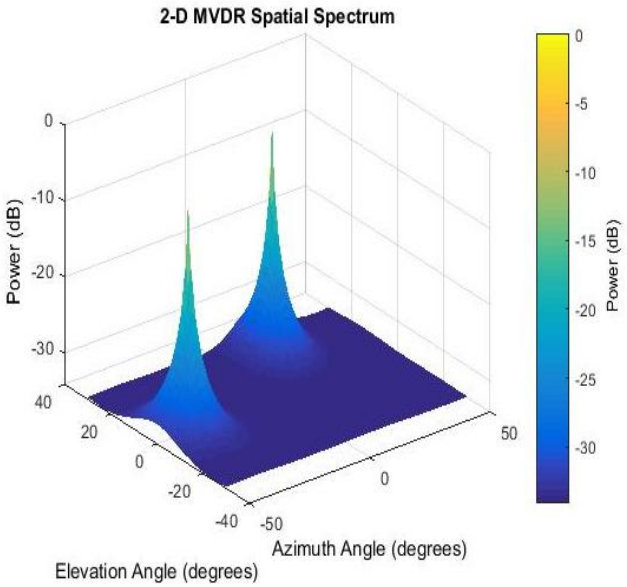

Figure 1: MVDR Spatial Spectrum corresponding to two signal

Model for MVDR: The model designed is worked for the narrowband signals

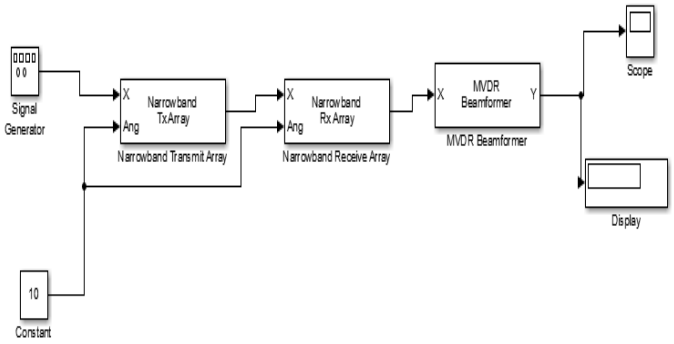

Figure 2: Model for MVDR

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II. MUSIC ALGORITHM

The music algorithm works out signal and analyse the noise and the signal subspace from the assessed eigenvectors of the signal correlation Matrix [5-8]. The Music algorithm deals separately with noise and signal subspace and find out the highest peaks of the corresponding signal directions. MUSIC algorithm estimates pseudo spectrum with in the received signals and find signal form co-relation matrix by using Eigen theory.

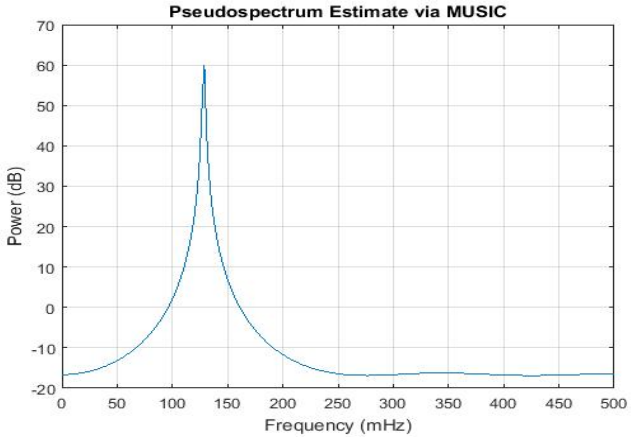

Figure 3: Pseudo Spectrum estimation using Music algorithm

MVDR Vs MUSIC

The given figure shows the comparison between MVDR and MUSIC estimator when the signals are coming from -60, -20,60 degrees. The MUSIC easily estimates the signal directions.

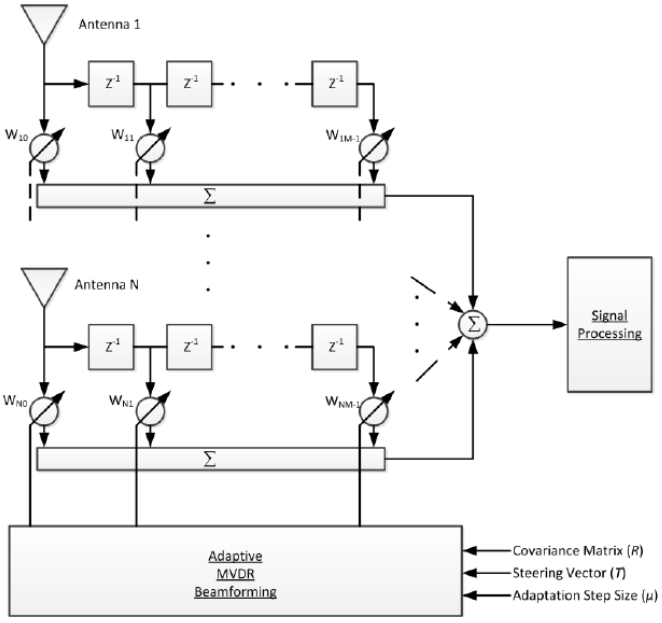

Figure 4: MVDR Algorithm

The figure above giving demonstration of basic working of MVDR algorithm. Further the comparison of MVDR and MUSIC algorithm is illustrated via graphs in Figure 4 and Figure 5 below.

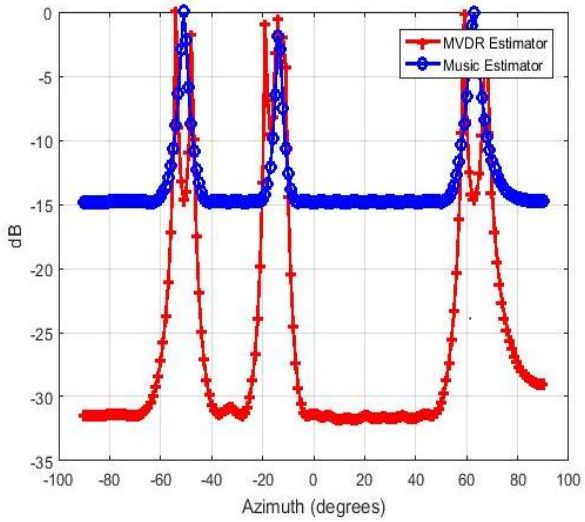

Figure 4: Comparison of MVDR and MUSIC Algorithm

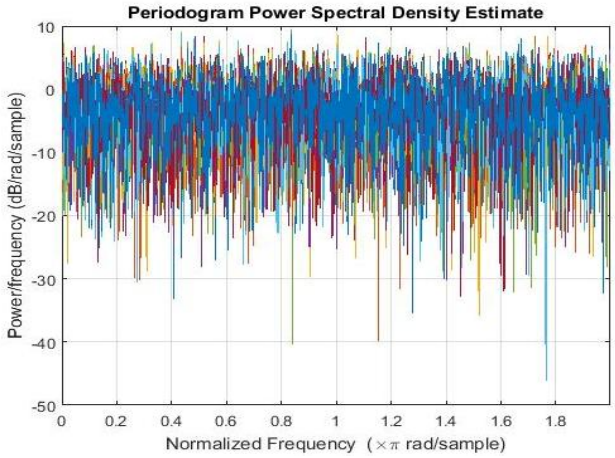

Figure 5: Power spectral density estimation using Music algorithm

III. ESPRIT ALGORITHM

The model for estimation of signal parameter using rotational invariant technique is shown in the given figure 5. The signal of direction 20 degree is transmitted through the narrowband transmitter and received by a narrowband receiver. After that ESPRIT algorithm is applied to estimate the signal direction which is 20 degree estimated.

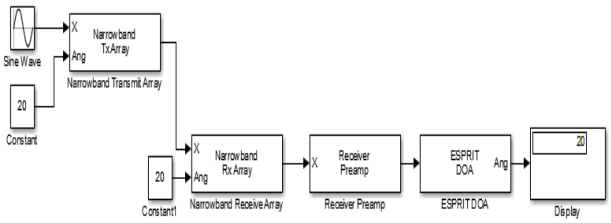

Figure 6: Model of ESPRIT Algorithm

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IV. CONCLUSION

The MVDR algorithm has better resolution than beams can. MUSIC algorithm easily distinguish two signals which are very close to each other. When the total number of antenna and the number of snapshots are more, the Music algorithm shows better results. The optimum spacing between the adjacent elements are 0.5. MUSIC algorithm shows better results as compared to MVDR.

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