Implementation of Beamforming Algorithm and Analysis of Radiation Pattern of Smart Antenna

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Abstract - The adoption beam formation of smart antenna techniques is increase the interference moderation future of wireless systems. It is estimated to have a significant impact on the efficient use of the spectrum, the minimization of the cost of build new wireless networks the optimization of service quality and realization of diaphanous operation across multi technology wireless networks. This paper presents the brief functioning account of LMS algorithm on smart antenna (SA) system in context of adaptive beam forming. The capabilities of smart / adaptive antenna are easily employable to Cognitive Radio and OFDMA system. Further Implementation that resolves around the LMS adaptive algorithm chosen for its reckoning restraint and high constancy into the MATLAB simulation of an adaptive array of a smart antenna base station system, is look into its performance in the presence of multipath components and multiple users.

Keywords - Smart/adaptive antenna beams forming LMS MUSIC OFDMA.

I. INTRODUCTION

Since Radio Frequency (RF) spectrum is limited and its efficient use is only possible by employing smart/adaptive antenna array system to exploit mobile systems capabilities for data and voice communication. Smart refers to the signal processing ability that forms vital part of the adaptive antenna system which controls the antenna pattern by updating a set of antenna weights. Smart antenna support by signal processing capability directs narrow beam towards desired users but at the same time introduces null towards interferers thus optimizing the service quality and capacity.

Consider a smart antenna system with (*Ne)* elements equally spaced (*d*) and user's signal arrives from desired angle 0 as s. Adaptive beamforming scheme i.e. LMS is used to control weights adaptively to optimize signal to noise ratio (SNR) of the desired signal in look direction Φ. In reality antennas are not smart; it is the digital signal processing, along with the antenna which makes the system smart. When smart antenna is deploy in mobile communication using either time division multiple access (TDMA) or code division multiple access (CDMA) environment exploiting time slot or assigning different codes to different users respectively it radiates beam towards desired user only. Each beam becomes a channel thus avoid interference in a cell. If a single antenna is used for CDMA system then this system supports a maximum of 31 Users. When an array of five elements is employed instead of single antenna then capacity of CDMA system can be increased more than four times it can be further improved if array of more elements are used.

II. LITERATURE REVIEW

The problem in state-space, and employ a Assimakis K. Leros and Vassilios C. Moussas- Performance Analysis of an Adaptive Algorithm for DOA Estimation LAENG International Journal of Computer Science, 38:3 IJCS_38_3_17.24 August 2011[6]. Assimakis K. Leros and Vassilios C. Moussas presents an adaptive approach to the problem of estimating the direction of arrival angles of narrowband signals emitted from multiple sources. We reformulatemulti-model partitioning algorithm combined with extended Kalman filters for combined identification of the number of sources and estimation of the angles of arrival. The proposed algorithm's performance is assessed by simulation in several operational scenarios. The results presented demonstrate that the algorithm is capable of tracking changes in the angles of arrival and of detecting variations in the number of sources present Suchita W. Varade K. D. Kulat-Robust Algorithms for DOA Estimation and Adaptive Beamforming for Smart Antenna Application Second International Conference on Emerging Trends in Engineering and Technology ICETET-2009 [7]

In this performance of adaptive beamforming algorithm has been studied for two different DOA estimation algorithms namely MUSIC & MVDR estimates the number of incident signals on the array and their directions of arrival. It also gives the direction of arrival desired signal the Minimum Variance Distortion less Response (MVDR) is a very well

known algorithm to obtain the optimum weight vector which maximizes the output signal to noise and interference ratio (SNIR) of multiple antennas.

Reeta Gaokar and Dr. Alice Cheeran -Performance Analysis of Beamforming Algorithms IJECT Vol. 2 Issue 1 March 2011.[5] .In this paper three beamforming techniques Null steering Minimum variance distortionless response (MVDR) and Minimum mean square error (MMSE) are presented simulation has been carried out for all three algorithms Simulation result shows that beamforming reduces the interference power significantly thereby increasing output signal to interference-noise ratio (SINR). This paper includes simulation results and performance analysis of these beamforming techniques depending on the application one of the methods is selected for deployment of beamforming antenna.

III. 3. DIRECTION OF ARRIVAL

A was programed that simulates the DOA algorithm. Thefunction receives the reception time of two elements (antennas) and the distance between them from the main program. The algorithm used in this simulation based on time delay algorithm mentioned insection which locate User Position based on the difference in Signal arriving time between two array elements. The algorithm calculates DOA using equation and the returns the angle of the user (DOA).function named DOA. The first one performs the direction of arrival (DOA) estimation and determines the number of incoming signals. The second part performs the DOA classification. It is find that which signals originate from the user and which ones from the interferers.

Third part consists beam forming algorithm It forms an antenna pattern with a main beam steered in the direction of the user while minimizing the influence of the interfering signals and the noise

3.1. ADAPTIVE BEAMFORMING

The adaptive algorithm used in the signal processing has a profound effect on the performance of a Smart Antenna system. Although the smart antenna system is sometimes called the ―Space Division Multiple Access it is not the antenna that is smart. The function of an antenna is to convert electrical signals into electromagnetic waves or vice versa but nothing else. The adaptive algorithm is the one that gives a smart antenna system its intelligence without an adaptive algorithm the original signals can no longer be extracted. In the fixed weight beam forming approach the arrival angles does not change with time so the optimum weight would not need to be adjusted. However if desired arrival angles change with time it is necessary to devise an optimization scheme that operates on-the-fly so as to keep recalculating the optimum array weight that's done by using adaptive beam forming algorithm.

3.2 LEAST MEAN SQUARES ALGORITHM

This algorithm was first developed by Widrow and Hoff in 1960. The design of this algorithm was stimulated by the Wiener-Hopf equation. By modifying the set of Wiener-Hopf equations with the stochastic gradient approach a simple adaptive algorithm that can be updated recursively we developed. This algorithm was later on known as the least-mean-square (LMS) algorithm. The algorithm contains three steps in each recursion: the computation of the Processed signal with the current set of weights the generation of the error between the processed signal and the desired signal and the adjustment of the weights with the new error information by the gradient method. This algorithm like the preceding one requires a reference signal and it computes the weight vector using the equation.

$$w(n+1) = w(n) + \mu x(n)[d*(n) - x^{H}(n)w(n)$$

3.3 MAXIMUM SIGNAL TO INTERFERENCE RATIO

MUSIC algorithm is a high resolution Multiples Signal Classification technique based on exploiting the Eigen structure of the input covariance matrix. It is provide information about the number of signals DOA of each signal Strengths and cross correlations between incident signals noise power etc. Consider an N-element linear array that detects M signals impinging on it whose directions of arrival need to be known.

3.4. MINIMUM VARIANCEN DISTORTIONLESS RESPONSE METHOD

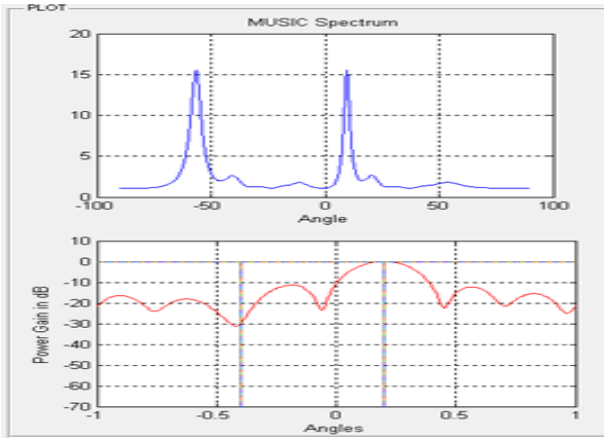
The peaks in the MVDR angular spectrum occur whenever the steering vector is orthogonal to the noise subspace. This technique minimizes the involvement of the undesired interferences by minimizing the output power while maintaining the gain along the look direction to be constant.

INPUT PARAMETERS

Name of input parameters	Values
Angle of signal	10,20,30
Power of incoming signal	1,2,3
No of snapshot	200
SNR	60
No of Array	8,7
Iteration of LMS algorithm	200
No of desired signal	1

IV. RESULT

In this figure we display the simulation result of smart antenna using direction of arrival (DOA) estimation and MUSIC algorithm for same angle and different power with SNR=60 and N=8 elements.)



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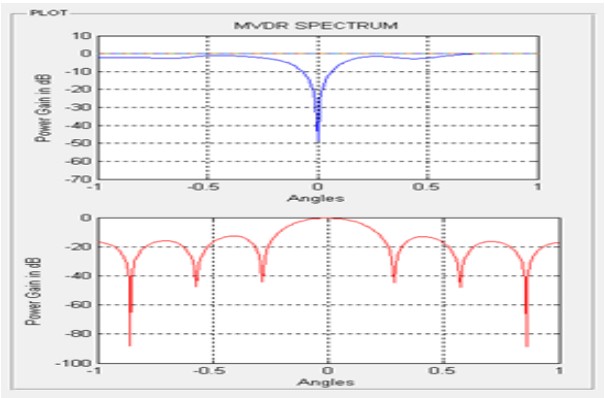

V. CONCLUSION

The LMS algorithm is most commonly used adaptive algorithm because of its simplicity and a sensible performance. Since it is an iterative algorithm it can be used in a extremely time-varying signal environment. It has a stable and robust performance in opposition to different signal conditions. It may not have a really fast convergence speed when we are compare to other complex algorithms like the Recursive Least Square (RLS). It converges with slow speeds when the environment yields a correlation matrix R possessing a large Eigen spread. Generally traffic conditions are not static the user and interferer locations and the signal environment are varying with time in which case the weights will not have enough time to converge when adapted at an identical rate.

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