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ADAPTIVE BEAM FORMING MUSIC & MVDR LMS ALGORITHM OVER 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 predictable to have a major 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. We present brief function in account of LMS algorithm on smart antenna (SA) system in context of adaptive beam forming. The capability of smart adaptive antenna is 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. This is an overview of smart Antenna technology their benefits how they work and how they can be deployed to best advantage implementation that revolves around MVDR MUSIC algorithm into the MATLAB simulation of an adaptive array of a smart antenna base station system is to investigate its performance in the presence of multipath components and multiple users. A smart antenna system is capable of efficiently utilizing the radio spectrum and is a promise for an effective solution to the present wireless system problems while achieving reliable and strong high-speed high-data-rate transmission. Smart antenna technology presented significantly improved solution to reduce interference level and improve system capability. With this technology each users signal is transmitted and received by the base station only in the direction of that particular user.

***Keywords*: Smart/adaptive antenna beams forming LMS MUSIC OFDMA.**

1. INTRODUCTION

In recent years a substantial increase in development of broadband wireless access technologies for evolving wireless internet services and improved cellular system has been observed because of them there is traffic that demands on both the manufacturer and operators to provide sufficient capacity in the networks. This becomes major problems for service provider to solve since there exist certain negative factors in the radiation environment contributing to limit the capacity. The growing demand for mobile communications is constantly increasing the need for better coverage improved capacity and higher transmission quality rises. Therefore a more efficient use of the radio spectrum is required. Smart antenna systems are capable for efficiently utilizing the radio spectrum and are a promise for an effective solution to the present wireless systems problems while achieving reliable and robust high-speed high-data-rate transmission in fact Smart antenna systems comprise a number of critical areas such as individual antenna array design signal processing algorithms space-time processing wireless channel modeling and coding and network performance. A smart antenna can be view as a combination of “regular or conventional” antenna elements whose transmit or received signals are processed using “smart” algorithms. In reality antennas are not smart it is the digital signal processing along with the antenna which makes the system smart. 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 users only. Each beam becomes a channel therefore avoiding interference in a cell.

2. LITERATURE REVIEW

This section presents some of the related literatures on the same field. Md. Bakhar Vani R.M. and P.V. Hunagund[8]- 04 July 2010 Md. Bakhar1 Vani R.M. and P.V. Hunagund has given the overview of smart antenna and provided a basic model for determining the angle of arrival for incoming signals the appropriate antenna beam forming and the adaptive algorithms that are used for array processing[3]MUSIC (multiple signal Classification) a direction-of-arrival estimation (DOA) algorithm and LMS (Least Mean Square) an adaptive Beam forming algorithm for smart antenna systems. First one is for identifying the directions of the source signals incident on the sensor array and later is for directing the main beam towards the desired source signals and also

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generating deep nulls in the directions of interfering signals. E Mal-ardi and R Mshubair-Performance evaluation of the LMS adaptive beam forming algorithm used in smart antenna system August 092010[9].In this paper a performance evaluation of the LMS algorithm that is used as an adaptive beam forming technique in smart antennas. This evaluation is carried out with respect to the antenna array size in terms of the number of elements forming this array as well as their physical spacing. Also the signal environment parameter is analyzed in terms of the number of signals incident on the antenna array and their angular.Assimakis K. Leros and Vassilios C. Moussas 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. They reformulate the problem in state-space and employ a multi-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 performance is assessed by simulation in several operational scenarios. The results demonstrate that the algorithm is capable of tracking changes in the angles of arrival and of detecting variations in the number of sources present.

3. ADAPTIVE BEAMFORMING

Beam forming is a general signal processing technique used to control the directionality of the reception or transmission of a signal on a transducer array. Beam forming create the radiation pattern of the antenna array by adding the phases of the signals in the desired direction and by nulling the pattern in the unnecessary direction. The phases and amplitudes are adjusted to optimize the received signal. A Fixed weight beam-former is a smart antenna in which fixed weight is used to study the signal arriving from a specific direction. It optimizes the signal arriving from specific direction while attenuating signals from other directions thus it is called the spatial matched filter. 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.

3.1 MAXIMUM SIGNAL TO INTERFERENCE RATIO

One criterion which can be applied to enhancing the received signal and minimizing interfering signals is based upon maximizing SIR. The SIR is defined as the ratio of the desired signal power and undesired signal power. Let one desired signal arriving from angle θ_0 and N interferers arriving starting angles $\theta_1 \ldots \theta_N$. The signal and interferers are received by an array of M elements with M potential weights. All received signal at element m also includes additive Gaussian noise. Time is represented by the k^{th} time samples. Therefore the weighted array output can be given in the following form

$$\bar{x}(k) = \overline{a_0} s(k) + [\overline{a_1} \ \overline{a_2} \ldots\ldots\ldots \overline{a_N}\ ].\lfloor i_{1(k)\ldots i_{N(k)}} \rfloor + \bar{n}\,(k)$$

3.2 MINIMUM VARIANCEN DISTORTIONLESS RESPONSE METHOD

Minimum Variance solution is also called minimum variance distortion less response (MVDR) or minimum variance performance measure. The goal of MV method is to minimize the array output noise variance.

3.3 LEAST MEAN SQUAR ALGORIAM

LMS algorithm uses the estimates of the gradient vector from the available data LMS incorporates an iterative procedure that makes successive corrections to the weight vector in the direction of the negative of the gradient vector which eventually leads to the minimum mean square error. A Uniform Linear Array (ULA) with N isotropic elements which forms the integral part of the adaptive beam forming system The LMS algorithm initiate with some arbitrary value for the weight vector is seen to converge and stay stable for $0 < \mu < 1/\lambda$ max Where λ max is the largest Eigen value of the correlation matrix R the convergence of the algorithm is inversely proportional to the eigen value spread of the correlation matrix *R*. When the Eigen values of *R* are widespread convergence may be slow. The eigen value extend the correlation matrix is estimated by computing the ratio of the largest Eigen value to the smallest eigen value of the matrix. If μ is chosen to be very small the algorithm converges slowly. A large value of μ may lead to a faster convergence but may be less stable around the minimum value.

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

4. RESULT

As a result the performance of cellular systems will be enhanced. We display the simulation result of smart

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antenna using direction of arrival (DOA) estimation and different adaptive beam forming (MUSIC/MVDR)

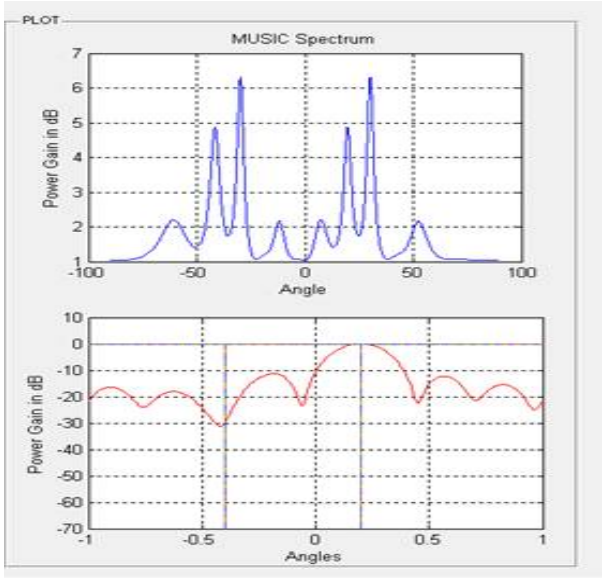

Fig.1. Simulation result of smart antenna using direction of arrival (DOA) estimation and MUSIC algorithm for different angle and different power with SNR = 60 and N = 8 elements.

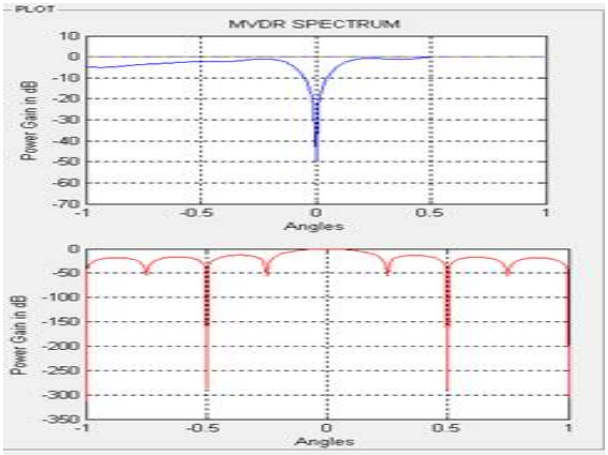

Fig.2. Simulation result of smart antenna using direction of arrival (DOA) estimation and MVDR algorithm for different angle with SNR=60 and N = 8elements.

4.1 COMPARISON OF MUSIC AND MVDR LMS

This graph presents the results of direction of arrival estimation using MVDR, MUSIC. These methods have greater resolution and accuracy and hence these are investigated much in detail. The simulation results of ALL methods show that their performance improves with more elements in the array with large snapshots of signals and greater angular separation between the signals. With appropriate adaptive algorithms such as MUSIC, MVDR the beam forming can be obtained. However graph shows that there are more errors in DOA estimation by using music compared to the MVDR algorithm. Clearly MVDR is more stable and accurate and provides high resolution.

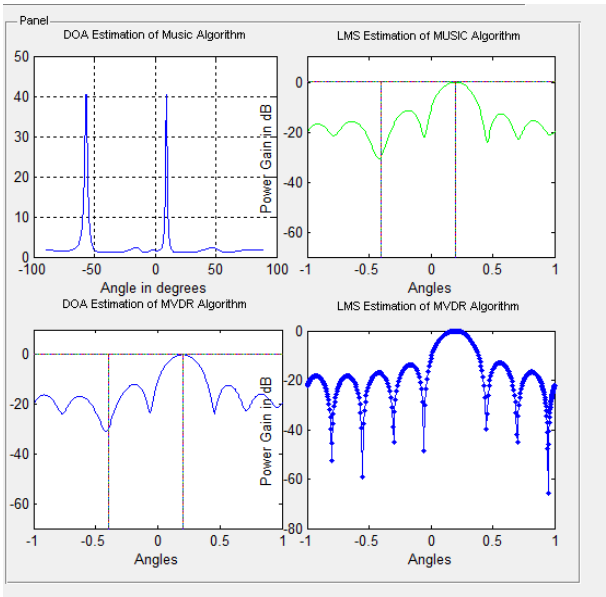

Fig.3. Results of direction of arrival estimation using MVDR, MUSIC.

5. CONCLUSION

The Smart Antenna systems are the antennas with intelligence and the radiation pattern can be varied without being mechanically changed. With appropriate algorithm such as MUSIC MVDR the beam forming can be obtained. The systems use a DSP processor the signals can be processed digitally and the performance with a high data rate transmission and good reduction of mutual signal interference. The narrow beams get rid of interference allowing many users to be connected with in the same cell at the same time using the same frequencies and can adapt the frequency allocation to where the most users are located. With adaptive beam forming spectral efficiency of the cell could be multiplied at least ten times. Smart antennas effectively reduce the power consumption which in turn avoids RF pollution minimize health hazard and save scarce resource (diesel & foreign exchange). Indeed it has been argued that performance requirement of a future cellular communication system cannot be made without the use of smart antennas.

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