Soft Hand Over for High Capacity Beam Pattern using MIMO

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Abstract— A downlink soft handover scheme is proposed for cell edge users in 4G-LTE systems. To avoid capacity loss in cell edge areas the proposed handover scheme uses multi-cell MIMO cooperated by multiple base stations. Capacity of the 4G LTE is very high than the 3G LTE and also 4G is more faster because the main beam traverse towards the mobile user .4G LTE Variable step size has low mean square error which almost equal to nullify. In the proposed scheme, different multi-cell MIMO transmissions are adaptively exploited based on the spatial correlation of a downlink channel and path loss of adjacent cells by comparing link level capacity. MIMO is computed by using a method called singular value decomposition. SISO is used in the old LTE systems its capacity is less. Radiation pattern for 4G LTE is very high.

Key word: spatial correlation, cooperative, Multiple input multiple outputs

I. INTRODUCTION

Adaptive antennas have been used for decades in areas such as radars, satellite communications, remote sensing, and direction finding etc. For instance, radar and secure communications systems take advantage of the ability of these antennas to adapt to the operating environment to combat jamming. Satellite communications systems have used multiple beam and spot beam antennas for years to tailor their coverage to specific geographic locations. Each of these applications is associated with its own unique set of challenges such as, the channel in which the system operates, the propagation environment, sources of interference, and noise or jamming. In addition, the end goal for which the adaptive antenna is used affects the selection of the type of array, size, adaptive algorithms, and integration with other system components.

A. *Adaptive Antenna*

Adaptive antenna is one which adapts itself to pick a user signal in any direction without user intervention. Basically, it accomplishes through a two-phase process:

- Direction Detection Estimation (DDE) estimation using a suitable algorithm and sensor data.
- Beam forming which forms a beam in the direction estimated by the DDE algorithms.

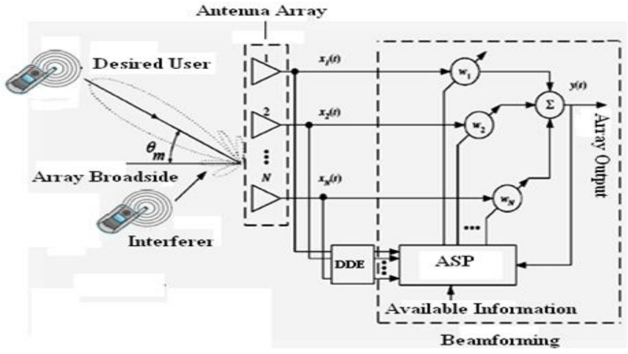

Fig. 1.1: Adaptive Antenna Block

In engineering applications, where an incoming wave is detected and/or measured by an array, the associated signals at different points in space can be processed to extract various types of information including Directions of plane waves falling on antenna array by using Detection Estimation (DDE) methods.

II. METHODOLOGY

The previous 3G algorithm has Less radiation pattern and which produces the main beam not exactly at desired angle with side lobes. The number elements increases the magnitude become closure to zero so it produces the radiation towards all the directions.4G LTE has the very efficient and very fast which form the main beam towards the desired angle with less number side lobes so we are going for the 4G LTE algorithm.

III. BEAM FORMING METHODS

A. *Digital Beam Forming:*

The digital beam forming method cannot be called electronic steering since no effort is made to directly shift the phase of the antenna element currents. Rather, the phase shifting is computationally performed on the digitized signal. If the parameters of operation are changed or the detection criteria are modified, the beam forming can be changed by simply changing an algorithm rather than by replacing hardware.

B. *Adaptive Beam Forming:*

Adaptive beam forming is generally the more useful and effective beam forming solution because the digital beam former merely consists of an algorithm which dynamically optimizes the array pattern according to the changing electromagnetic environment.

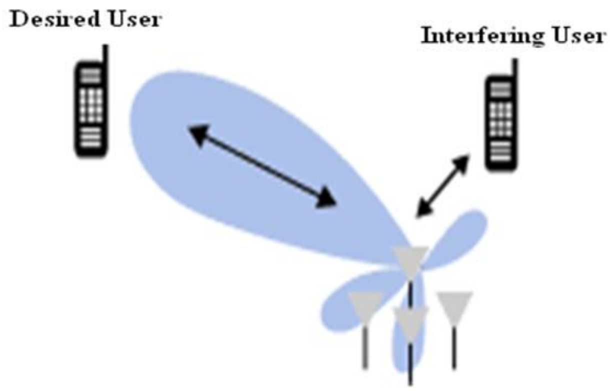

Fig. 2: shows Adaptive Beam Forming

IV. 3G LTE BEAM FORMING

1) Compute the Lx1 steering vector for desired direction θ_0 .

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$$a(\theta) = \begin{bmatrix} 1 \\ e^{i2\pi d\sin\theta} \\ \vdots \\ \vdots \\ e^{i2\pi d(L-1)\sin\theta} \end{bmatrix}$$

Compute the LxM array manifold vector corresponding to M interference source directions $\theta_1, \theta_2, \ldots\ldots\ldots, \theta_M$

$$A = \begin{bmatrix} 1 & 1 & \ldots\ldots & 1 \\ e^{i2\pi d\sin\theta_1} & e^{i2\pi d\sin\theta_2} & \ldots\ldots & e^{i2\pi d\sin\theta_{M-1}} \\ \vdots & \vdots & \vdots & \vdots \\ e^{i2\pi d(L-1)\sin\theta_1} & e^{i2\pi d(L-1)\sin\theta_2} & \ldots\ldots & e^{i2\pi d(L-1)\sin\theta_{(M-1)}} \end{bmatrix}$$

2) Obtain signal samples 'S' by sampling continuous time signal of baseband frequency.(for simulation cosine wave samples are considered)
3) Compute Lx1 cross-correlation matrix r_{xs} by using $r_{xs} = E[XS^H]$
4) Compute LxL covariance matrix R_{xx} by using $R_{xx} = E[X\ X^H]$
5) The inverse of covariance matrix R_{xx} is found.
6) The weight vector is computed by using equation $w(n) = R_{xx}^{-1}\, r_{xs}$
7) The array factor is computed by using equation

$$AF = \sum_{i=1}^{L} w^H(i)\, e^{j2\pi d\sin(\theta)} \qquad -90^0 \le \theta + 0.001 \le +90^0$$

The value of θ in equation varies between $-90^0 \le \theta + 0.001 \le +90^0$ and $w^H(i)$ is hermitian transpose weight update vector $w(n)$. Array factor versus angles are plotted.

V. 4G LTE BEAM FORMING

1) Compute the Lx1 steering vector for desired direction θ_0.
2) Compute the LxM array manifold vector corresponding to M interference source directions $\theta_1, \theta_2, \ldots\ldots\ldots, \theta_M$.
3) Obtain signal samples 'S' by sampling continuous time signal of baseband frequency. (For simulation sine wave samples is considered).
4) Compute the autocorrelation matrix R_{xx}.
5) Compute the step size by using equation (3.19)
6) Compute the following for all signal samples $0 \le n \le N_s$. Where, N_s is the total number of signal samples.
7) The array factor is computed by using equation (3.12)
   Array factor versus angles are plotted.
8) desired mobile user. This main Beam forms has description of design and implementation and parameter are shown as follows:

Enter the desired angle=45
Enter the Number of interference angle=2
Enter the 1st Interference angle=10
Enter the 2nd Interference angle=15

$$e(n) = s(n) - y(n)$$

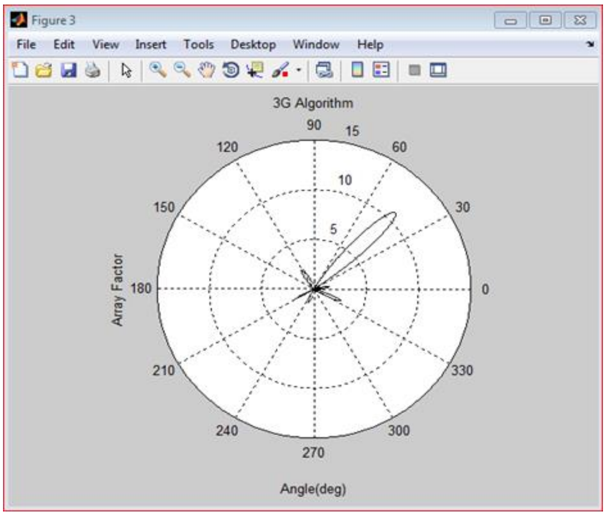

Fig. 3: Polar plot for 3G LTE

Figure 3.shows the main beam towards the desired angle 45 degree but it has more number of side lobes.Even for the interference angle it shows high beams.

A. *Beam Forming:*

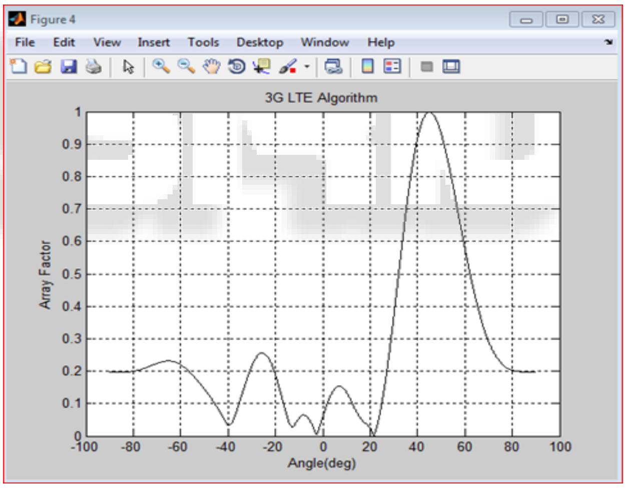

Fig. 4: Beam form plot

VI. 4G LTE VARIABLE BEAM FORMING

4G LTE Variable step size is designed by following parameters

- Number of array elements=8
- Enter the Desired angle=30
- Enter the number of Jammers=3
- Enter the 1 Jamming direction=10
- Enter the 2 Jamming direction=45
- Enter the 3 Jamming direction=60

The results are obtained using a MATLAB simulator tool which is licensable software. The simulation results are shown below

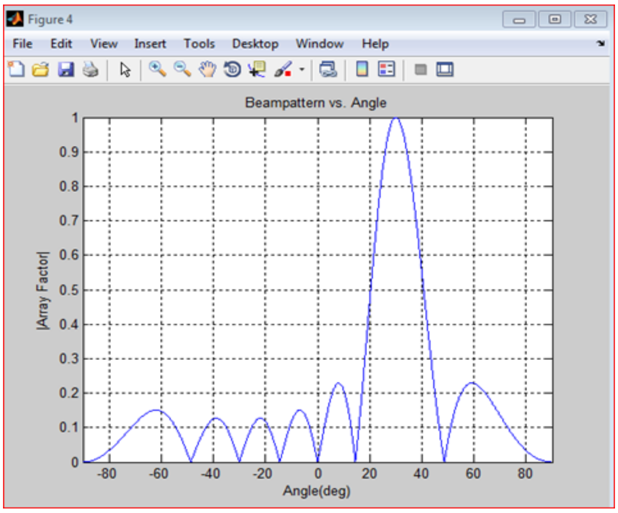

Fig. 5: Beam form of 4G LTE VSS

A. Polar Plot:

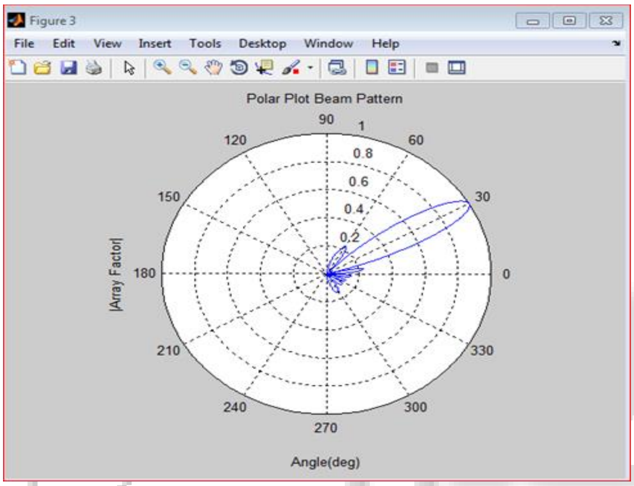

Fig. 6: Polar plot of 4G LTE VSS

B. 4G LTE Mean Square Error:

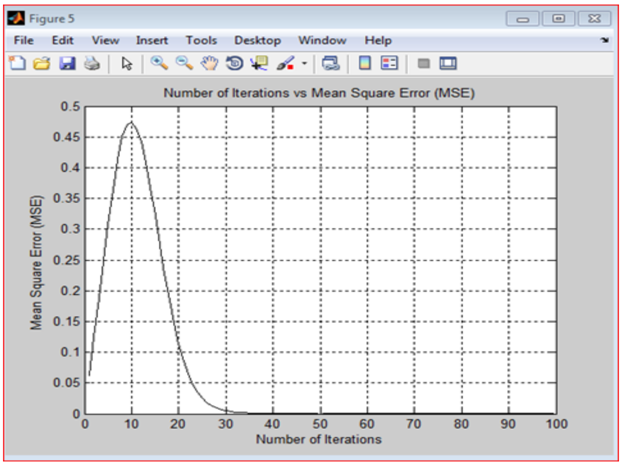

Fig. 7: Mean square error

The 4G LTE has main beam towards the desired user .Which has minimal number of side lobes .Mean square error is nearly equal to zero.

VII. CONCLUSION

In this project, a low cost cooperative 4G algorithm proposed to find out the beam pattern towards the desired user and which has minimal number of side lobes. Even though the number of interference increases it forms the main beam to words the desired mobile user.4G LTE improved amount of beam forming, radiation pattern narrow and Mean square error becomes zero at some iterations than the 4G LTE fixed step size. For the we have more number of antenna elements and multiple jammers 4G LTE variable step size forming the best with respect to radiation and also Mean square error.

VIII. ACKNOWLEDGMENT

I would like to articulate my profound gratitude and indebtedness to my project guide Mrs.Jyothi H (Assistance Prof. Dept. of ECE, SJBIT).Who is always being a constant motivation and guiding factor throughout the project time in and out as well.It has been a great pleasure for me to get a opportunity to work under them.

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