Multiple Element Antennas using Mimo

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***Abstract:** MIMO usage the multiple elements for transmitting and receiving the signals, and it will able to increase the performance of the channels. The significant performance of MIMO antennas is using number of antennas at each end of the antennas.Recent days, in mobile communication facing the issues of integrating the numbers of uncorrelated individual antenna elements. The Multiple Element antennas (MEA) is improving the system performance by varying the parameters like gain diversity, correlation and capacity. The gain diversity describes the signal combination methods, correlation explains the statistical characteristics, and the capacity indicates the performance of the communication. Usage of these parameters designs the MEA antennas.*

I. INTRODUCTION

The MEA's are utilized to increase the communication channel performance by organizing the diversity of the antennas and MIMO techniques.

An MEA is the array antenna, which are identical, general spaced elements [1]. The array is having a scalar array factor. The array factor is that multiplies the element pattern any synthesis [2]-[4].

MEAs are general than arrays. An MEA can include identical or various types of the elements, e.g., [5], so the classical array factor may not be related. The MEA elements can be unevenly spaced and inversely orientated to minimize mutual coupling for maximizing diversity performance, while also seeking a minimal size. In maximum cases, the elements need to be arranged to assign the shape and volume requirements of the platform. MEAs are essential for MIMO systems, so the MEA communications performances are improves.

1.1 MEAs for MIMO and diversity systems

MIMO techniques is illustrate the tremendous attention as a dominant solution for improving the data throughput and for improving the reliability in wireless communications, without additional transmit power and bandwidth.

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MIMO usage MEAs at both the transmitter and receiver to utilize spatial channels for increasing data rates. Data are transmitted over each antenna elements, and the transmits the power is separated among the transmit channels, either evenly or weighted, based on the knowledge of the channels. The data throughput of a MIMO system increases with the number of antennas.

The capacity bandwidth efficiency C, denotes the MIMO channel capacity over the used bandwidth.

The capacity of parallel channels was preserved by Gallagher in the 1960s and is now in current information theory texts, e.g., [6]. The capacity limit for MIMO channels is given by the sum of the Shannon capacities of the water-filled eigen- channels. A pragmatic approach is to split the transmit power equally between the transmit antennas, and this offers a capacity close to the Shannon limit. For a system with n_T transmit and n_R receive antennas, C is

$$C = 〚log〛\_2 [1 + SNR/n\_T \ HH^H] \quad \text{(Bits/Hz)} \quad (1)$$

Where I is the $n_R \times n_R$ identity matrix, H is a $n_R \times n_T$ channel matrix, the operation $()^H$ is the Hermitian conjugate transpose, andSNR is the average signal-to-noise- ratio at the output of each receiving antenna element

1.2 MIMO implementation

The latest 3GPP is a Long Term Evolution (LTE) which has set high datathroughput performance necessities, such as a downlink crowning data rate of at least 100Mbps and an uplink rate of at minimum 50Mbps. Furthermore, the LTE Advanced, submitted for 4G systems in the fall of 2009 and expected to be finalized in 2011, has set the peak data rate up to 1Gbps for low mobility cases and 100Mbps for high mobility cases. To achieve the high data rate requirements, MIMO joining with other techniques, such as orthogonal frequency-division multiple access (OFDMA) MIMO, is required in the LTE standards.

1.3 Difficulties in MIMOimplementation

Presently MIMO implementation is frontingseveral problems, including the following:

1) For techniques that use channel state information (CSI), there is much channel usage required which bites into the capacity.

2) Integrating a number of antenna elements in the limited size of mobile devices.

3) Lack of figures of merit and standard measurement procedures to evaluate the performance of MIMO antennas.

II. LITERATURE REVIEW

In the past decade, the MIMO antenna designs are attracting massive attention despite the difficulty of MIMO implementation. In the second part of this paper, currently available MIMO antenna evaluation techniques in the literature are outlined.

The usually used parameters to measure MEA performance are potted to prepare for the discussion on figures of merit for MEA evaluation.

2.1 Review on MIMO antenna design in literature

Recently MIMO antenna design focuses on antenna elements design, geometric arrangement of the elements for compact antenna size, and methods to reduce mutual coupling. The goal is to obtain de-correlated signals from various antenna elements with great distributed gains for maximizing SNRs.

The basic antenna element types (i.e. dipole, loop, slot and patch) have been utilized in designs reported in the literature. Dipoles (or their monopole counterparts) – both wire and printed, and the patch, have been the very popular elements owing to their simplicity of manufacture and because their performance characteristics. There are numerous papers on various MEA designs with dipoles and patches, for example, [6]-[10]. On the contrary, loops and slots are seldom used in MIMO antenna design. Relatively few papers are available here, such as [11]-[12] for the loop and [13]-[16] for the slot.

MIMO antenna design has been concentrating on the techniques to reduce antenna size and fit multiple antennas into a space-limited device. Currently, the mm-wave Industrial, Scientific and Medical (ISM) bands (e.g., 24, 60, and >100 GHz) is increasing attention to MIMO research because of the small physical sizes of the antennas. The drawbacks of these antennas, including low efficiency are being addressed by current research.

The concept of "multi-feed diversity antennas" is also representation attention. Here, one antenna structure has multiple feeds at different locations. The feeds excite orthogonal modes, and in turn, their patterns are orthogonal. Pattern diversity is achieved with a single antenna structure.

The objective of MIMO is to the capacity, reliability, etc. In MIMO, antenna diversity can be implemented at the receiver or the transmitter, or both. Diversity patterns are derived by using: spacing the antenna elements apart (spatial diversity); orthogonal polarizations (polarization diversity); patterns with different directional coverage (angle diversity). Using any of these, or a combination of them can be referred to as pattern diversity. Another method to the problem of reducing correlation is by directly considering the radiating structure rather than the resulting embedded element patterns, and the concept of "feed point isolation" is presented. It is typically realized by disconnecting or extending the path of electric current flow between the feeds of each two MEA elements. The MEA with its elements sharing a groundplane, inserting slots between the feeds in the groundplane will extend the currents paths, and thereby reduce the coupling.

2.2 MIMO antenna evaluation techniques

In the existence of mutual coupling, the impedance and radiation behavior at each element of an MEA will be impacted by the other elements and their terminations. The performance of each MEA element can still be described with the parameters defined for single element antennas and arrays in [1], including input impedance, polarization, radiation pattern, etc. However, the element must be considered with the presence of other elements, i.e., we mustconsider the embedded element. MEA parameters such as the correlation matrix and diversity gain are now used to measure the performance of MIMO antennas in multipath scenarios [12].

2.2.1Scattering parameter matrix and impedance matrix:

Mutual coupling is the communication between two antennas. The quantity of coupled energy depends on the physical proximity and polarization of the antennas. The coupling can be observed as a current flowing on one element which is induced by the fields from the excitation of another element. If observed from the antenna port, this extra current cause's impedance alternation, viz., the mutual impedance combined with the self-impedance defines the input impedance. Therefore, mutual coupling relates to the antenna compactness and affects the communications performance, e.g., [54]-[57]. It is important in MIMO design to have a good understanding of mutual coupling and its effects.

The scattering parameter matrix (S) contains reflection coefficients (Sii) and transmission coefficients (Sij) measured at the ports of an MEA [58]. Sii is the ratio of reflected voltage to incident voltage at the port of the i^{th} element when all the other ports are terminated and matched so there are no reflections, and in this sense, it gauges how well this element is matched to its port impedance. Sij is the ratio of the voltage transferred from the jth element port to the ith element port to the incident voltage at the jth element port. Sij is a measure of mutualcoupling between the antenna elements.

The impedance matrix (Z) includes the self and mutual impedances of an MEA.

III.MEA EFFICIENCY AND IMPACT ON DIVERSITY AND CAPACITY

The impact of MEA efficiency on the gain diversity and the information theoretical capacity is also expressed and established using the measurements of example MEAs. With these designs, an equivalent number of idealized (lossless, uncorrelated, uncoupled, equal power) branches can be found for an MEA, and this defines the diversity order and the capacity order of the MEA. With this metric, the performance of different MEAs can be compared.

3.1 Embedded element efficiencies of MEA

For single element antennas, the radiation efficiency is expressed in terms of the transmission. It is well-established and features in Standards. The receive efficiency is identical to the transmit radiation efficiency for reciprocal antennas. From a simplified circuit model, the radiation efficiency is normally written as $ή_{rad}$ = Rrad / (Rrad +$R_Ω$), where Rrad is the radiation resistance and $R_Ω$is the ohmic resistance of the element.

The transmit efficiency of an embedded element for the i^{th} element is

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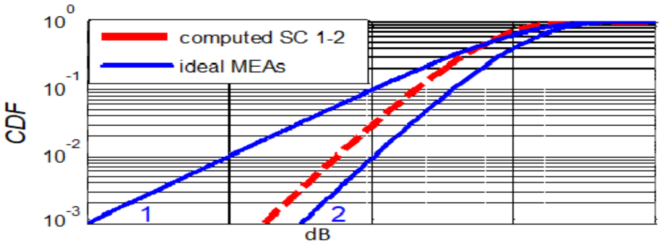
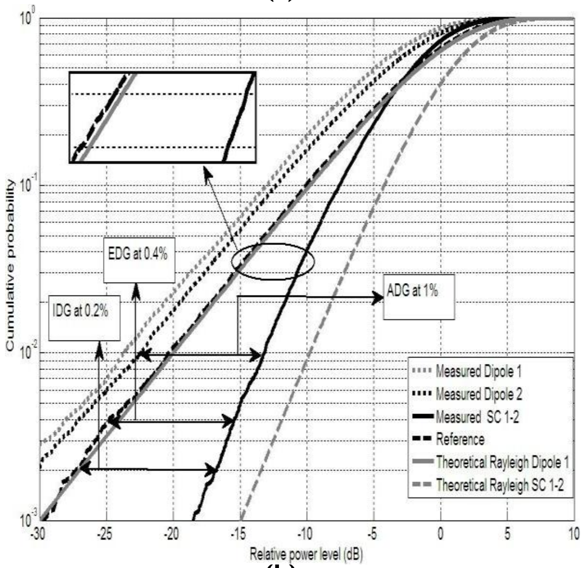
$$n_{Tx,i} = \sum_{i=1}^{n} P_{rad} \Big/ P_{yx}$$

III. RESULTS AND ANALYSIS:

The Fig 1 (a) shows the solid curve are the CDF of MEA. It was having 1-2 section of antenna from left to right.
The fig (b) shows the dashed curve line, which is the computed CDF of the two element half wavelength dipole MEA.



(a)



(b)

Figure 1: CDF vs SNR for 2-element dipole MEA

IV. CONCLUSION

The improved the MIMO Communication by developing the efficiency of a Multiple Element antennas with their diversity. The MEA element efficiency is determined by the transmitter and receiver, then reciprocity principle can be interpreted for Multiple Element antennas. The total efficiency of an element is also determined. The MEA efficiency is a communicated by the diagonal matrix of the elements.
This diagonal matrix form the MEA efficiency is helps to solve the MEA's entire efficiency of the communications levels in the form of gain diversity and Capacity in propagation. The MEA's have an element symmetric structure then the elements efficiency are same.
The order of diversity and order of capacity an MEA's are expressed as an equivalent number of elements, like lossless, gain are equal, an given the probability is around 0.5%.

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