Monopole Reconfigurable Antennas for MIMO Systems

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ABSTRACT

Now various antennas are used in the multiple input multiple output (MIMO) communication system which improves capacity and adds diversity. Microwave is at the core of the wireless communication system, which uses different types of antennas. In recent years, the limitations of broadcast antenna technology on the quality, capacity, and coverage of wireless systems have prompted an evolution in the fundamental design and role of the antenna in a wireless communication system. There are many types of antennas depending upon the performance, shapes, sizes, volumes and costs. The antennas can be divided in many ways as monopole , dipole , microstrip etc . In this we are going to demonstrate performance benefit given by pattern reconfiguration using monopole antenna. These antennas have ability to dynamically reconfigure their radiation pattern and this feature is not available in static or fixed antennas. This antenna contains one feed element and six passive elements. The arbitrary direction of this antenna can be selected by changing the input voltage to the different passive elements. These antennas can be designed using two steps: first step is performance measured using simulation and second is design and evaluating the Monopole antenna. For simulation we are going to use Ansoft HFSS software. The performance can tested using the VNA. In this we demonstrate the performance benefit of monopole reconfigurable antenna by radiation pattern, VSWR and Return loss at a fixed frequency. This antenna gives better performance as -10dB RL with 2.01 VSWR at 2.33GHz frequency. Due to use of monopole elements the design becomes simple and cheaper.

Keywords- Multiple Input Multiple Output (MIMO), Vector Network Analyzer (VNA), Voltage Standing wave Ratio (VSWR)

I) INTRODUCTION

The evolution of wireless communication systems and networks in recent years has been accelerating at an extraordinary pace and become an essential part of modern life style requirements. With the development of wireless communication technology, a new concept of a pattern reconfigurable antenna is introduced. This antenna changes the radiation pattern at a fixed operating frequency. The pattern reconfigurable antenna adds diversity in system and also improve performance of the communication system[1]. This antenna is mostly used in MIMO (Multiple input Multiple output) systems because it improves channel capacity. In this paper, Monopole antenna is used to implement reconfigurable antenna system. The ways to reconfigure the antenna are frequency, pattern, radiation configurations. But, among them pattern configuration is better to improve system performance and reliable. Under this work it is proposed to use antenna simulation software, High Frequency Structure Simulator (HFSS) and simulated antennas are fabricated to study antenna parameters using Vector Network Analyzer (VNA) and Antenna Measurement System (AMS) for the design of Monopole reconfigurable antenna. In this process the antenna parameters like resonant frequencies, S-parameters, radiation pattern, impedance matching, gain etc., will also be analyzed.

II. METHODOLOGY

1. SIMULATION DESIGN

In this we are using AN-SOFT software for simulation results. The **AN-SOFT** is a comprehensive software tool for the modeling and simulation of antenna systems and general radiating structures. It can be used to describe the geometry of the antenna, to get insight into the behavior of a particular antenna, to predict antenna performance, to tune for performance, to try several possibilities before building the real model and to choose construction materials . The program is based on an improved version of the so-called Method of Moments (MoM) for wire structures.

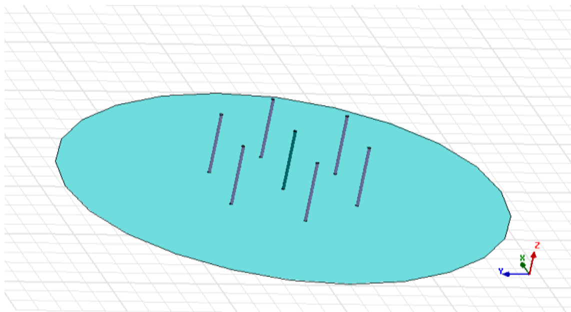


Fig1. Monopole antenna by Simulation Result.

The modeling of the structure can be performed by means of the AN-SOF specific 3D CAD interface. Electromagnetic fields, currents, voltages, input impedances, consumed and radiated powers, gain, directivity, and several more parameters can be computed in a frequency sweep and plotted graphically.

The following Graphical representation shows the radiation pattern of this Pattern reconfigurable MIMO antenna.

Fig2. Radiation Pattern of Monopole antenna by Driven element.

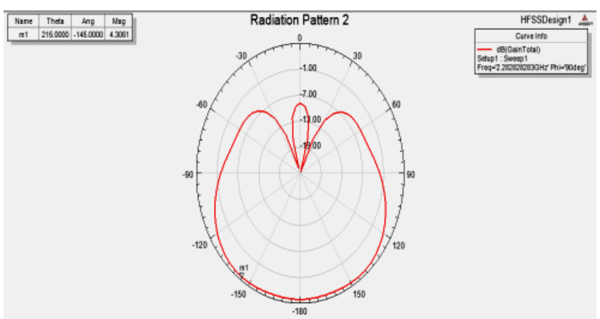
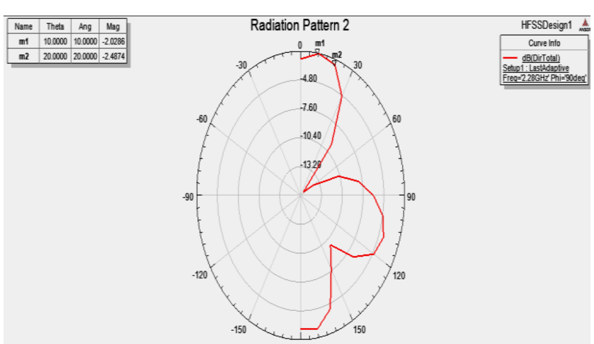


Fig3. Radiation pattern of Monopole antenna by parasite element.



2.HARDWARE IMPLIMENTATION

This design consists of one driven monopole in the center, surrounded by a ring of six uniformly λ spaced parasitic monopoles which is used to provide reasonable beam steering flexibility .This antenna has many degrees of freedom in the design. To simplify the design procedure and to achieve omni-directional beam scanning, identical structural parameters are used for all the monopoles. The proposed antenna is shown in below Figure, with the driven element colored in centre. By using CAD tools such as Ansoft HFSS, the length of each monopole H, is determined to be $0.238\lambda_0$, where λ_0 is the free-space wavelength of the test frequency 2.28 GHz.The radius of monopole is R = 0.01 λ_0.The ground plane is circular in shape with a radius R_{sub} = 0.75 λ_0 The parasitic monopoles are spaced from the driven element is calculated as D = 0.25 λ_0.

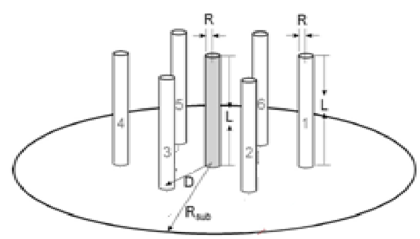


Fig4. Considered design of Monopole antenna.

Fig5. The fabricated Monopole antenna with VNA.

By configuring different adjacent passive elements on the this antenna as directors or as reflectors, it is able to generate a directive pattern in a selected direction. By Shifting the configuration circularly by one element each time allows to generate six patterns with the beam angles 90 degrees apart in azimuth. To observe the multi-antenna measurements, a pair of

ESPAR antennas is fabricated on one single 1.5 mm ground. Their driven elements are spaced half a wavelength apart. The two antennas are oriented to maximize pattern flexibility of each antenna as well as make their radiation characteristics as similar to each other as possible.

III. EXPERIMENTAL RESULTS

The following graphical representation shows the experimental results of monopole antenna are measured in terms of VSWR, Return loss, radiation pattern and also smith chart.

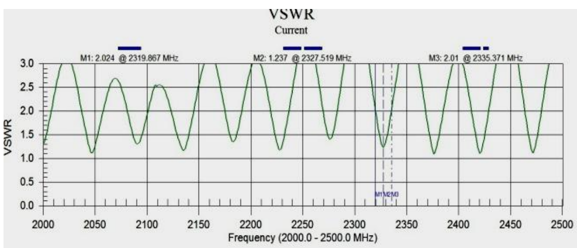


Fig 6. Measured VSWR on VNA.

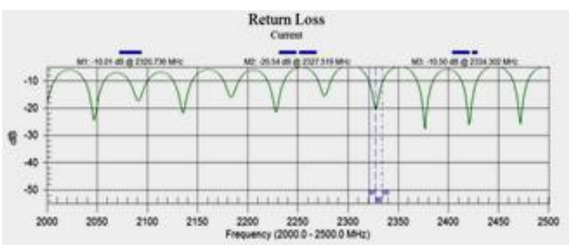


Fig7. Measured Return loss on VNA.

Measured points	Frequency	Return loss	VSWR
M1	2.3207GHz	-10.01dB	2.024
M2	2.3275GHz	-20.54dB	1.237
M3	2.3343GHz	-10.50dB	2.010

Table 1. Measured Output on VNA.

IV. DISCUSSION

In this we have studied pattern-reconfigurable antennas on MIMO systems, the monopole antenna is investigated using seven elements of monopole antenna type also analysis has been done through both simulated and physically measured results. The majority of the increase in performance over the monopoles comes from the higher antenna gains. While this antennas were considered here, this study can be generalized to any pattern reconfigurable antennas that has the ability to fully control the beam angle of its radiation patterns and makes them the better omni-directional antennas in MIMO system related applications. In this we have design and evaluate the Monopole reconfigurable antenna also measured the experimental performance with respect to return loss, VSWR and radiation pattern at a constant frequency. As this antenna improves the performance with simple and cheap design it becomes promising option for MIMO applications.

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