

Design of 5g Mimo Antenna with Enhanced Isolation

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Abstract: In this paper, MIMO 2-port, 2-element antenna for 5G applications is presented. This is monopole antenna structure consists of two-rectangular patch of same shapes. Each antenna has a feeding plate connect at the centre of the patch antenna for enhancing isolation the etching of rectangular slots on the ground plane in between the two patches along with thick and sheet of the substrate just below at the centre of the patch. Maximum isolation achieved among the ports is less than -30db. envelope correlation coefficient is below 0.10 in bands of interest. The minimum frequency range covered by the four ports of this antenna is from around 3.0 to 4.0 GHz, thus covering expected future 5G band (3300–3700 MHz).

Keywords: Maximum isolation achieved among the ports is less than -30db.

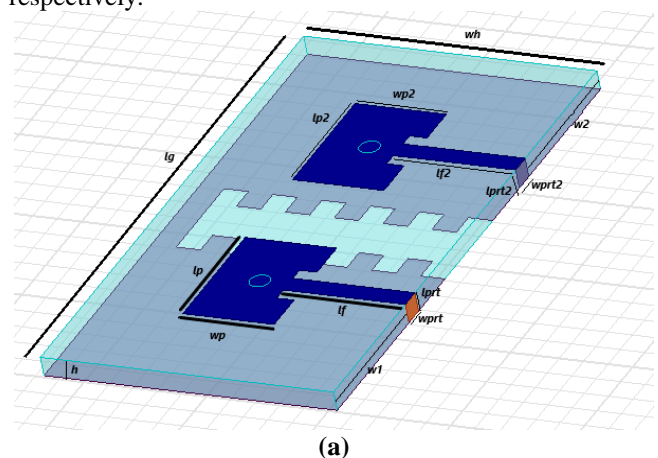
I. INTRODUCTION

With the relentless advancement occurring in remote correspondence frameworks, there's an ever-expanding requirement for top execution of versatile handheld applications which principally incorporate high information rates. 5G, resulting age media transmission standard is anticipated to have information paces of many megabits every second, for example up to 10 Gbps [1], [2]. Various Input Multiple-Output(MIMO)means that at least two receiving wires are utilized all the while for transmission additionally concerning gathering over a radio channel. MIMO innovation utilizes multipath to accomplish higher information rates all the while expanding unwavering quality and range without utilizing additional transmission capacity, along these lines improving unearthly efficiency to manage the need of high information rates for different administrations [3]. The procedure wont to deal with multipath blurring in no way from of-Sight (LOS) radio channels, called reception apparatus decent variety is utilized by various plans like spatial, example and polarization assorted varieties or a blend of those to get assorted variety increase, at least one of those assorted variety techniques are frequently actualized thinking about different factors which incorporate nature, impedances and accessible space [4], [5]. Small scale strip radio wires have gotten alluring for use in portable applications. This receiving wire has pulled in much intrigue due to its position of safety (i.e., smaller size), light weight, ease large scale manufacturing, and simplicity of establishment. Be that as it may, a significant restriction in its application is its thin data

transmission. The method that has been utilized widely for expanding transfer speed is stacked patches, in which a parasitic component is put vertically over the lower fix. [6-8]. Various 2 component receiving wire structures are found in writing utilizing fundamentally space assorted variety to accomplish assorted variety gain [11]–[13]. Be that as it may, a less consideration is given to the radio wires having at least two ports associated with a typical transmitting component for decent variety/MIMO applications utilizing polarization or potentially design assorted varieties. The explanation of this reality is the difficulty to disconnect the ports set near one another in the event of four-port MIMO reception apparatuses, there are chiefly 2D printed radio wires found in the writing with omnidirectional radiation designs having lower gain [14], [15].

II. DESIGN CONFIGURATION

In Micro Strip Patch antenna has three main parts namely Substrate, Patch, Ground Plane. The proposed monopole antenna fed by a 50ohm micro-strip line, which is printed on epoxy FR4 substrate of thickness 4 mm and permittivity of 4.4. the structure consists of 2 rectangular radiating patches, feed-lines and a ground plane with defective ground structure. The patches are connected to feed-lines; on the other side of the substrate a conducting ground plane is placed. The proposed antenna is connected to a 50-SMAconnector for signal transmission. The design configurations are as follows Lg, Wh length and width of the ground of 110mm and 60mm, Lp, Wp length and width of the patch whose parameters are 18.7mm and 26.1mm. Lf is length of the feeding plate which is 21. 4mm Lprt is length of the port Wprt is width of the port which are same for both the ports 4mm W1 is the distance of the port 1 is 29.9 W2 is the distance of the port 2 76.04 respectively.



Revised Manuscript Received on August 12, 2020.

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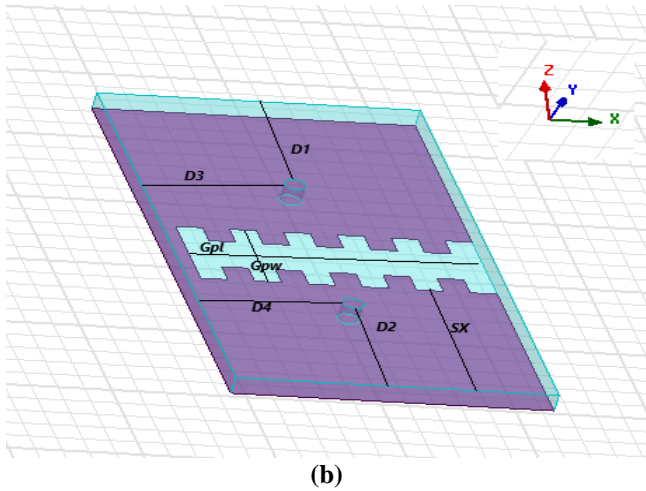


Figure.1 Design of 2 port antenna (a) 3-D view of model (b) Ground plane with substrate

The length and width of the ground plane are equal to that of the substrate where h is the height of the substrate which is 4mm the length of the feeding plates one and feeding plate are same. Also the width, length of the two ports are equal. The GDS method is used for enhancing isolation. The basic element of DGS is a resonant gap or slot in the ground metal, placed directly under a transmission line and aligned for efficient coupling to the line. Several resonant structures that may be used. Each one differs in occupied area, equivalent L-C ratio, coupling coefficient, higher-order responses, and other electrical parameters. A user will select the structure that works best for the particular application. The equivalent circuit for a DGS is a parallel-tuned circuit in series with the transmission line to which it is coupled The input and output impedances are that of the line section, while the equivalent values of L, C and R are determined by the dimensions of the DGS structure and its position relative to the transmission line.

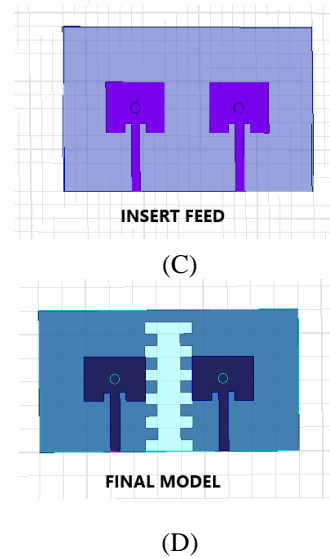
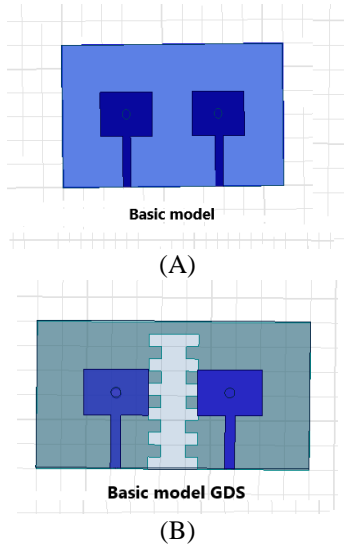


Figure 2: models with different parameters

For observing the change in the isolation enhancement. For all the different parameters the isolation is observed such as for the basic model, basic model with Ground defective structure, basic model with inserted feed and finally the final design.

III. RESULTS AND DISCUSSION

s-parameters

The simulated scattering parameters are plotted. As a comparison, the simulated performance with different patterns, the respective designs are given in Fig 2. such as the basic structure, basic structure with inserted feed and basic GDS were also plotted in Fig 3. From the figure, it can be seen that by adding the monopole elements the isolation in the operation band is greatly improved, in which S_{21} decreases from -33 dB to -50 db. Meanwhile, the operation band shifts a little to lower frequency and the bandwidth increases somewhat.

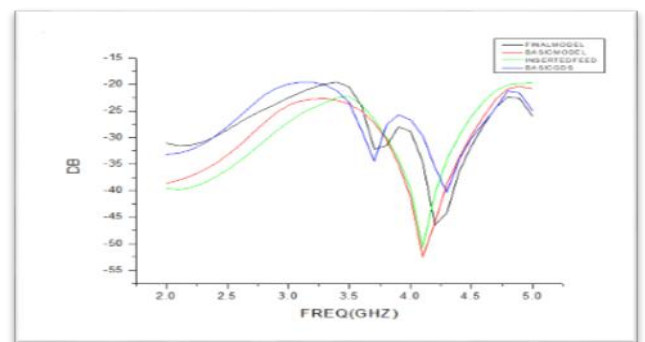


Figure 3 isolation results for different parameters Return loss

Scattering parameter which generally describes the electrical behavior of linear electrical system, this undergoes various steady state stimulation by electrical signal. S parameter describes the input and output relation between ports in an electrical system.

As it is known that the resonant frequency(fr) and the return loss can be calculated from the S11 curve of the patch antenna respectively. So the obtained resonating frequency is 3.5 GHz and return loss is -24 dB shown in the fig This shows that the antenna has very low return loss when it operates at 3.5 GHz frequency. That means a good amount of the signal will be transmitted by the antenna.

ECC

The correlation coefficient (ρ) is a measure that describes how the communication channels are isolated from each other. This metric deals with the radiation pattern of the antenna system. The square of the correlation coefficient is known as the ECC. The best way to calculate ECC is by using far field parameters. Some antennas may have a high correlation in one environment and a low correlation in another. A truly uncorrelated channel is highly unlikely for any real propagation condition. That's essentially equivalent to a cabled connection to the radio. Most often, however, ECC is just evaluated for a uniform isotropic field; something that never happens in the real world. Correlation below about 0.3-0.4 is usually considered "good enough" for MIMO antenna [9]. We can see that our ECC in fig 5. value is less than '0.02' for the most of the bandwidth (3.0-6.0) for our proposed antenna.

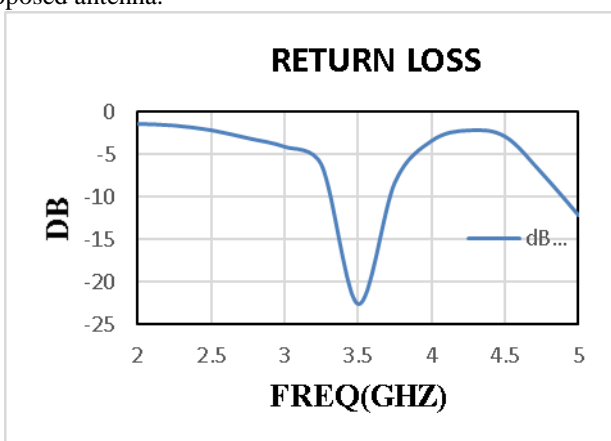


Figure 4 return loss

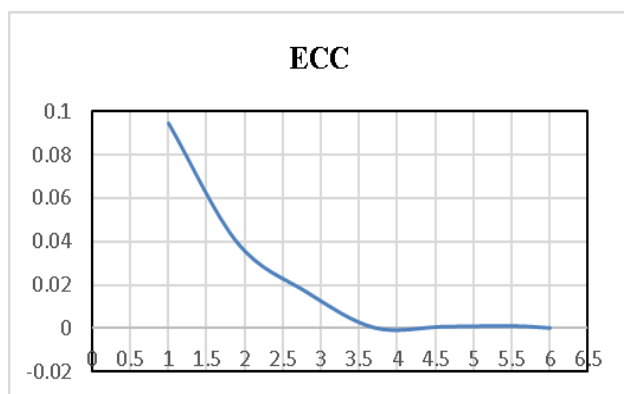


Figure 5 envelope correlation coefficient of proposed model

IV. RADIATION PATTERN

The measured 2D radiation patterns of two-port antenna is presented in Fig. 6, which clearly indicates that the pairs (1&3,2&4) have complimentary radiation patterns to prove

the presence of pattern diversity to obtain diversity gain. The two conditions of obtaining the diversity gain are met by this four-port two-element antenna as the correlation coefficient remains below 0.1 as obvious from the Fig. 5, which shows a graph of correlation coefficients as a function. of frequency between ports whereas mean effective gains of two ports have a ratio around 1 for frequencies from 3 GHz to 4 GHz [19], [20].

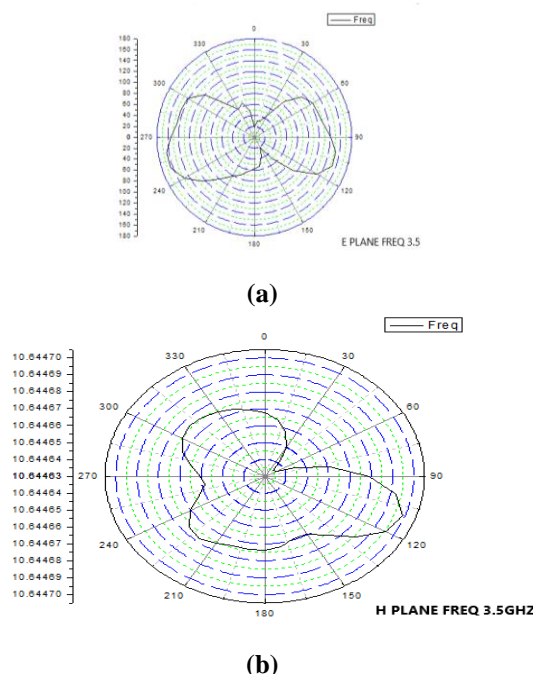


Figure 6 The simulated and measured radiation patterns of the proposed MIMO antenna in (b) the x-y (H-plane) and (a) y-z (E-plane) planes at 3.5GHz

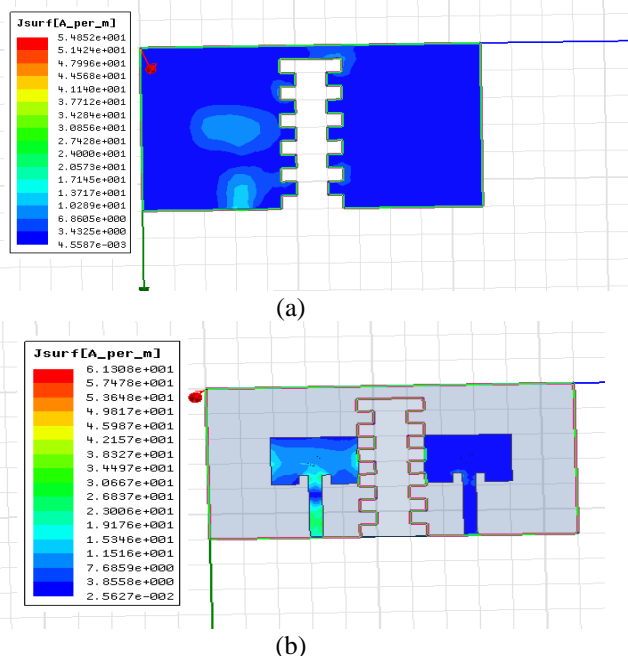


Figure 7 Current distribution of ground plane when both ports are active(a) and the current distribution when one port is active(b)

V. CONCLUSIONS

In this project rectangular antenna has been designed for using at 3.5 GHz for 5G application. The antenna has a physical size of 60 X110 mm. It has a return loss of -28dB at 3.5 GHz. Antenna gain is 5.01 db. The antenna has a very high efficiency of 96.67% with a stable Omni directional pattern at the respective frequency was also obtained. These outcomes make the proposed antenna a good candidate for UWB applications

FUTURE SCOPE

Modification of shape of antenna increase Isolation of Antenna like arranging the antenna in orthogonal manner. Changes in the Ground to achieve more and higher Bandwidth with better Return loss and Isolation. The MIMO systems are capable of increasing the channel capacity and reliability of wireless channels without increasing the system bandwidth and transmitter power. The advanced wireless technologies like WLAN and WiMAX have adopted the MIMO technology in their wireless systems and already the MIMO technology is being used in 3G and 4G mobile communications. Recently in India, the 3G service provider Reliance has started using the MIMO technology, providing the data rate at a speed of 28 Mbps. The recent researchers of MIMO technology have mainly focused on signal processing, channel modeling and coding aspects rather than the antenna design issues.

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