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Mutual Coupling Reduction Using 8x8 MIMO Antenna for MM Wave Applications

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ABSTRACT- A 8x8 multiple input multiple output antenna is developed for the applications of MM wave. this proposed model has 8 ports on the single structure of antenna system. The proposed design gives a triple bands k-band (14.6 at-22dB), ku-band(19.6 at -28dB) and ka-band(27.6 at -27dB) which this ka-band wii be act as mm wave band for the applications of MM wave. The proposed antenna having the dimensions of 64mm x 32mm x 1.6 mm having thickness 1.6mm and the Fr4 substrate has been used for designing. The proposed antenna is designed, measured and tested

KEYWORDS- MIMO Antenna, MM Wave, Multi-Band antennas, 5G, Mobile Communication

I. INTRODUCTION

Multi-Input Multi-Output(MIMO) Antennas have received higher attention in present research due to its capacity to operate multiple level antennas at the same time. Even so ,to develop dense MIMO antenna using a tiny volume but with very large isolation is a huge challenge .To acquire MIMO operation for Milli - Meter Wave communication ,multi-antenna model can take benfit of specimen and decomposition for obtaining authentic transmission with low mutual coupling. From some designs [1] they provide a bandwidthof2.1GHz of large gain of 9.24 dB with single directional radiation principle and each element having mutual coupling lower than 20dB.In [5][2] By using 4 port MIMO antenna it resulted with high bandwidth ranging from 24.55GHz to 26.5GHz and 25.1–37.5GHz respectively .Although ,having a low bandwidth[5] it exhibited production metric such as the pearson product-moment correlation coefficient(ECC),diversity gain(DG),channel capacity loss(CCL).The work demonstrated a wide band of 4 element MIMO antenna is operated in mm-wave band. Due to electromagnetic based reflector this antenna showed less mutual coupling I.e.,20db[3].The antenna obtained bandwidth varied from 25 to 45GHz, a handful of attempts have been done to compress mutual coupling between MIMO antennas though it contains tinier antenna frequency which allowed multi-level elements to fitting medium space[4][5][6]. Since now the technologies of 4g has been implemented the technologies which was provided by modern era was not satisfying the conditions exposed by 4g technologies [12]. This is the leading challenge to increase the data rate and bandwidth [6,7] . To overcome this issue multi input and multi output data transmission of data are essential for further development. so, the multi input and multi output is offering the best approach to enhance the performance. The mutual coupling mainly depends on three components: coupling between feeding lines, coupling due to spatial feeds, feeding lines. We can reduce these mutual coupling accordingly by their own methods. Correas-Serrano et al and Sun [2][3] represent the 8x8 compact MIMO antenna for 5g operations in smart phones in 3400-3600 MHz band and 4800-5000MHzband is represented. As the frequency band plays an important role for modeling any communication systems, the telecom industries are doing tremendous work in performing 5g communications network. Thus the antennas plays primary constituent for the successful communication networks. it was identified that most among the countries are following 26-28 GHz bands for communication with 5g[6].The wide band antennas show less desirable than multi band MIMO antennas to merge unnecessary interference for an used bands .As the elements increase in the system the mutual coupling also increases .

II. DESIGN

The geometrical representation of mutual coupling reduction using 8x8 MIMO antenna for mm wave applications is specified in fig.1 fig.2. The outcome dimensions of the design are 64mm x 32mm x 1.6 mm. The mentioned antenna

substrate and reflector are manufactured by flame retarded 4 (fr4) by taking thickness of 1.6 mm

The antenna element array or 8x8 elements MIMO antennas are largely limited and area of potential of the report to be exposed. The elements of the antenna are fed by a 60 Ω micro-strip feed-line that is connected to 60 Ω SMA connector with ground edge.

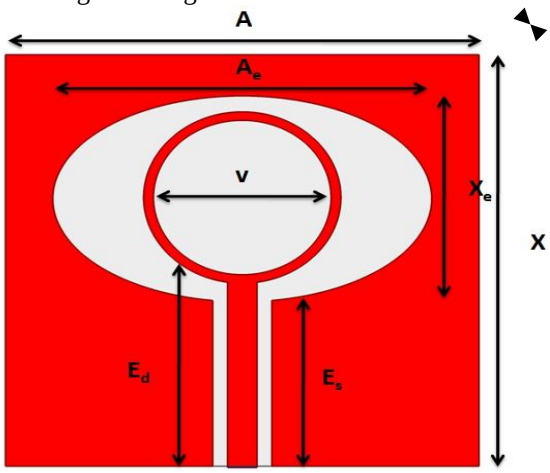

Figure 1: Dimensions of singular antenna

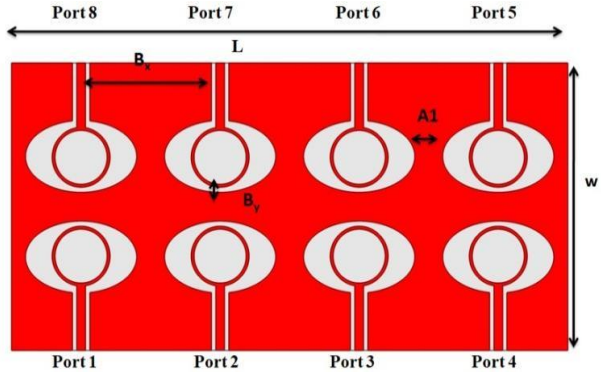

Figure 2: Front view and dimensions of proposed antenna

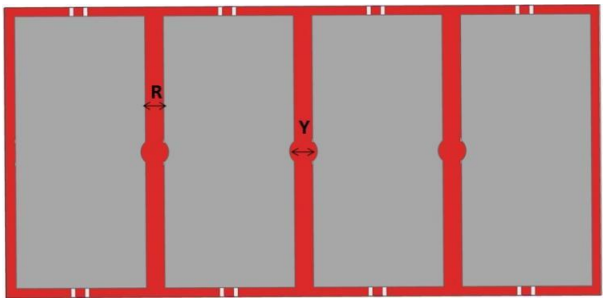

Figure 3: Back view of proposed 8 port MIMO antenna

Table 1: Proposed antenna dimensions

Parameters	A	X	V	Ed	Es	Xe	L
Dimensions(mm)	16	16	6	7.5	6.5	8	16
Parameters	Ae	Bx	By	A1	R	Y	W
Dimensions(mm)	12.8	14	3.2	3.2	2	3	16

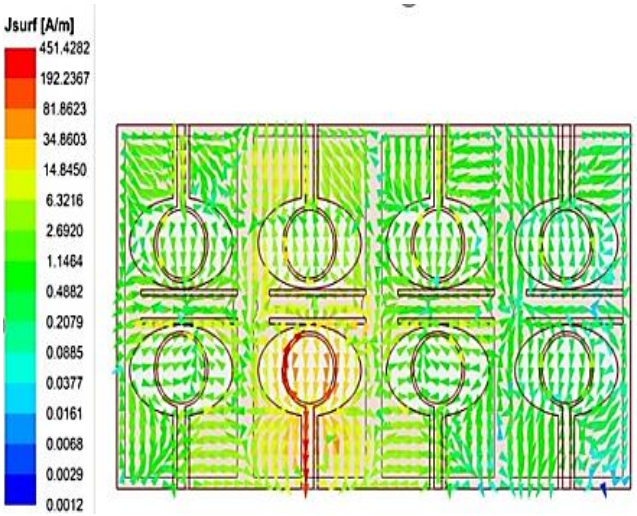

Figure 4: Current distributions of port 2 concentrated at centred

From fig. 4 the current distributions of port 2 are mainly concentrated at centred on the feed line and there will be some concentration on the central ring of port 2.

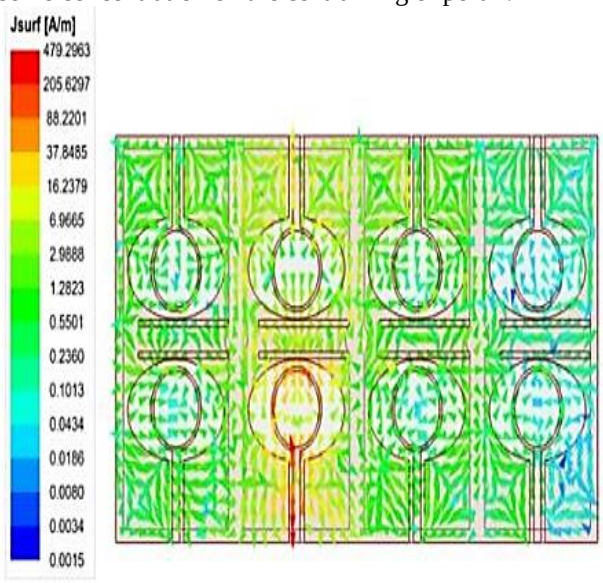

Figure 5: Current distributions of port 2 are slightly concentrated on the side of left feed line

From figure 5 the current distributions of port 2 are slightly concentrated on the side of left feed line and there is little amount of concentration on the left side of the central ring for the purpose of high band width.

III. RESULTS AND DISCUSSIONS

A. Performance of Antenna

In the below figure 6, represents the graph between frquency and reflection coefficient(dB).it explains about the overall results obtained in the graphs of S11.In the above figure it has been observed that three bands for the given

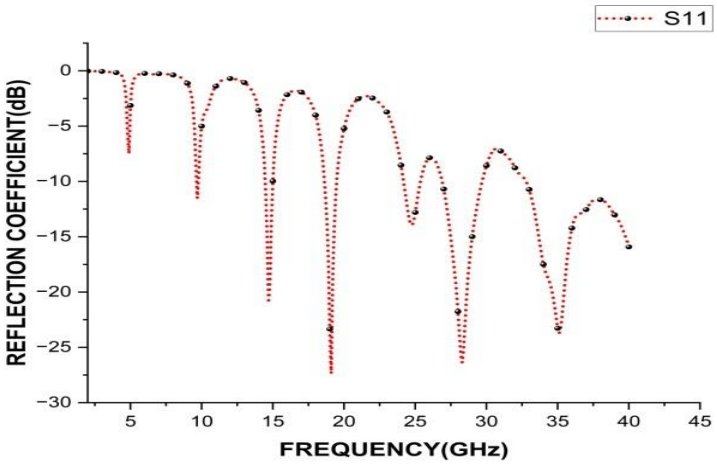

Figure 6: Reflection Coefficient Vs. Frequency

model that is k band havig 14.6GHz which is less than -22dB, ku band having frequency of 19.6 at -28dB, ku band having frequency of 27.7 at -27 dB this band is considered as MM wave frequency range for the given antenna.

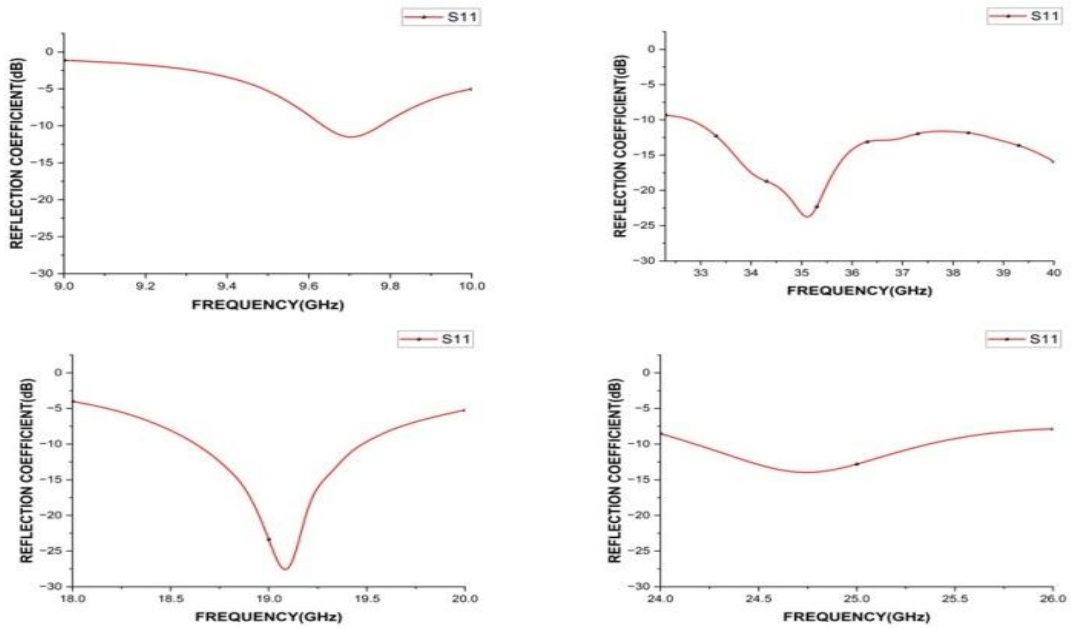

Figure 7: Reflection Coefficient Vs. Frequency results at different frequencies

The above figure represents the individual S11 frequencies which relates between frequency and reflection coefficient as same as fig.5 it just gives the brief individual overview of bands which works at overall bands x band, ku band, k band, ka bands. Here ka band is considered as mm wave range for our particular proposed antenna.

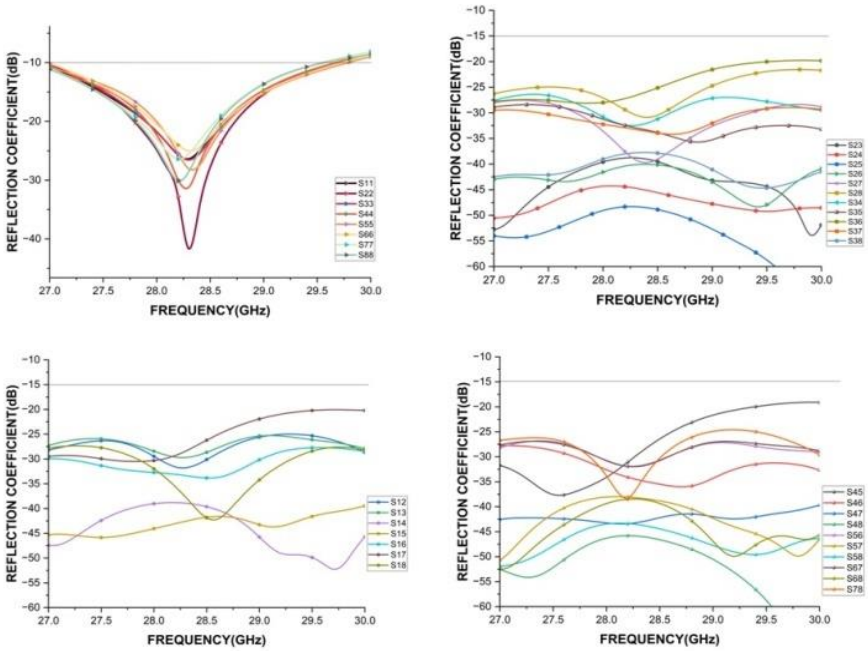

Figure 8: MIMO antenna s-parameters

The above figures represent the characterizations of all elements of array antenna. All the ports works simultaneously at each and every point.

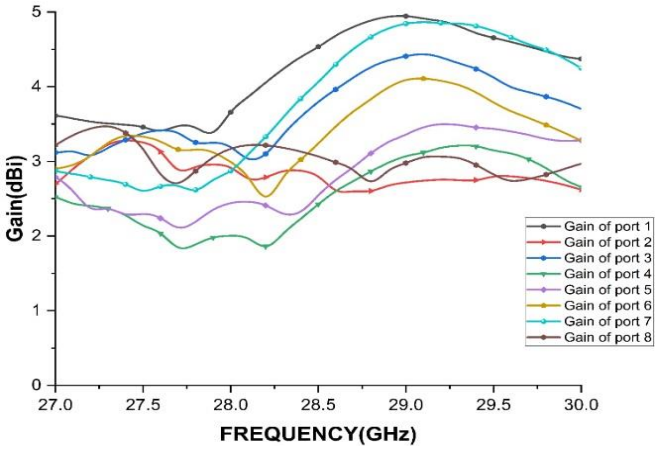

Figure 9: Gain plots of proposed antenna

B. Surface Current Distributions

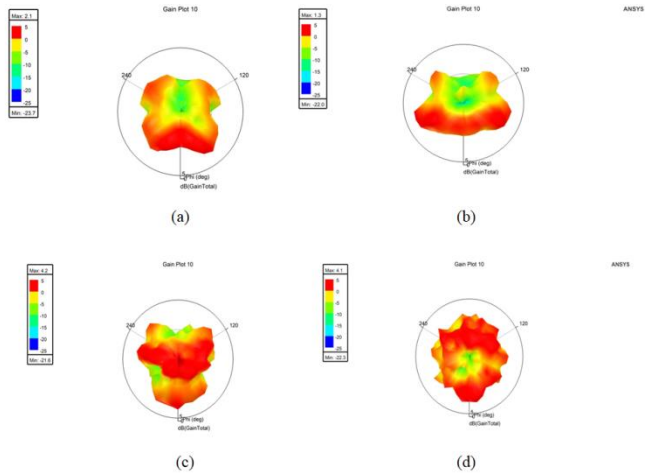

Figure 10: Surface current distributions

For this taken four iterations for it has been taken that surface current distribution varying the length of feed line and the ground.

C. Radiation Patterns

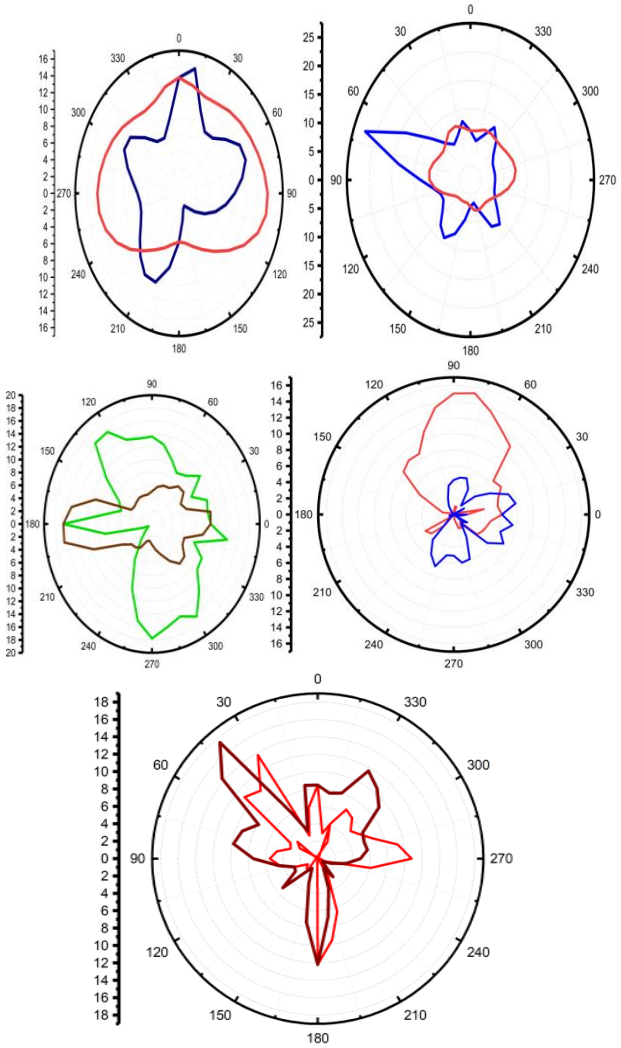

Figure 11: Radiation patterns of different iterations.

For the proposed model, the antenna is carried out through four iterations. It has observed that we got a good radiation patterns for the propsed model at 0 degrees and 90 degrees respectively.

IV. CONCLUSION

In this paper, a 8-element MIMO antenna is designed and developed for the applications of MM wave. The proposed antenna operates at three frequency bands k-band(14.6GHz), ku-band(19.2GHz),ku-band(27.7GHz) which ku bnad will be act as mm wave band. The surface current disturbutions are observed. A omni directional radiation patterns has been observed. This antenna is a good candidate for the applications of MM wave.The proposed antenna is used for the satellite communications, radar systems, WLAN applications

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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