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Research Paper

5g Cone-Shaped Mimo Antenna

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Abstract*: 5G will be a next-generation mobile wireless communication system. As wireless communication technology advances, MIMO is expected to play an important role in 5G. At 33 GHz, the return loss of the antenna is -14dB.The angle between the main lobe and the plane of an array is 90∘.*

Keywords: 5G,MIMO,Antenn Integration ,Rectangular Patch Antenna,Radio Frequency Performance(RF), antenna array

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I. INTRODUCTION

The advent of 5G technology has ushered in a new era of wireless communication. This has necessitated the development of innovative antenna designs to meet the high-speed and high-capacity requirements of 5G. One such design that has shown promise is the cone-shaped antenna with an embedded rectangular microstrip. This design offers the advantages of directional radiation patterns and compact size, making it an ideal candidate for 5G applications.

The cone-shaped antenna has a ground dimension of 9mm radius and an FR4 substrate of height of 0.5mm. It offers a unique advantage in terms of its radiation pattern, which can be utilized for Direction of Arrival (DOA) estimation, as discussed by Kim Kyungjung et al [8]. This feature of the cone-shaped antenna can significantly enhance the capacity and reliability of 5G communication systems.

Embedded within the cone-shaped antenna is a rectangular microstrip. This microstrip design provides a compact and efficient solution for high-frequency applications, as explored by researchers like Rabindra K. Mishra [11] and Ahmed Sayed [12]. The use of an FR4 substrate further enhances the performance of the microstrip, offering advantages in terms of dielectric and total attenuations. These factors are crucial for maintaining signal integrity in 5G applications.

The integration of Multiple Input Multiple Output (MIMO) technology with the cone-shaped antenna design can further enhance its performance, as discussed by Gong YaoHuan [1] and Gerard J. Foschini [3]. MIMO technology is a key component of 5G communication systems, and its integration with the cone-shaped antenna design can significantly enhance the system's capacity andreliability.

In conclusion, the cone-shaped antenna with an embedded rectangular microstrip, a ground dimension of 9mm radius, and an FR4 substrate of height 0.5mm presents a promising solution for 5G applications. It offers a unique combination of directional radiation, compact size, and high efficiency. Further research and development in this area will undoubtedly contribute to the ongoing evolution of 5G technology. The references provided offer a wealth of knowledge and insights into the intricacies of antenna design and the challenges and opportunities presented by 5G technology. These designs will play a crucial role in shaping the future of wireless communication as we move forward.

II. ANTENNA DESIGN

In the above the antenna was designed by using FR4 epoxy with a height of 0.5mm and it was not included in any of the antenna heights the design has 2 patches and 2 substrates and the patches that are used are the circular patches and the substrate that are used are the cone and the cylinder as shown in the below figure and the dimensions of the antennaare the ground of radius 9mm and the substrate of height 0.5 mm and the height of cone 10mm.

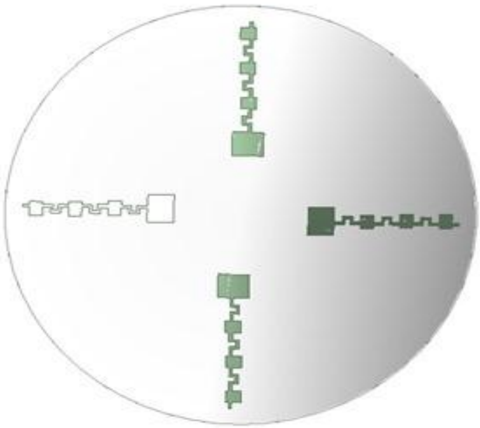

Figure 1: Front View Of Antenna

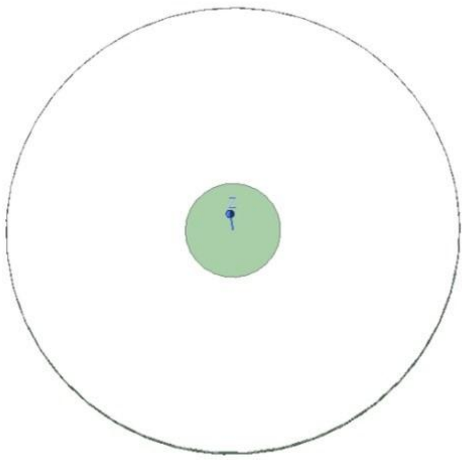

Figure 2: Back View Of Antenna

The above shown are the front view and the back view of the 5G Cone Shaped MIMO Antenna with a Rectangular patch.

The below figures show the step-wise construction of the antenna.

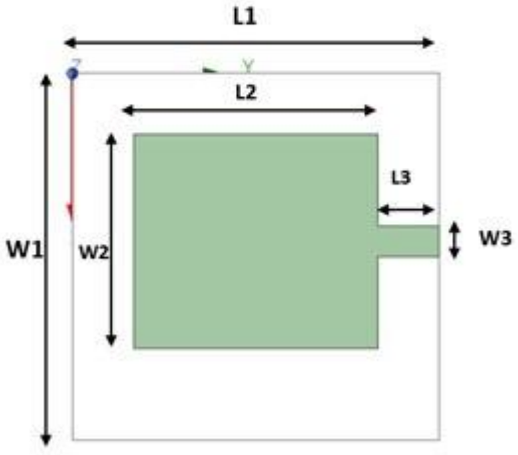

Figure 3: First Patch Of Antenna

Figure 3shows the first patch of the antenna that is designed to the rectangular patch that is embedded in the antenna and the parameters of the antenna are given below.

S. No	Parameters	Values (mm)
1	L1	6
2	L2	3.5
3	W1	6
4	W2	4
5	W3	0.5

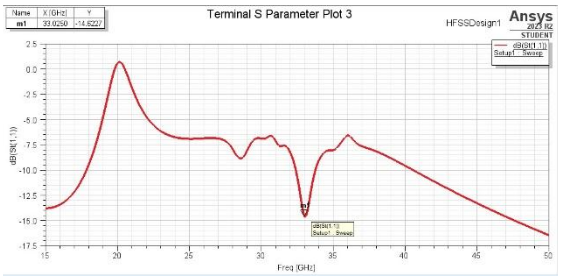

Figure 4: S Parameter Plot

The above given is the S Parameter plot of the rectangular patch of the antenna and the graph shows that the 31.5 GHz at -22dB

As shown in the design the microstrip antenna resembles the frequency of 31.5GHz which comes under the upcoming range of the 5G antennas. To improve the return loss and the frequency of the antenna we are going to design a patch for the MIMO antennas. The given below is the full patch of the antenna.

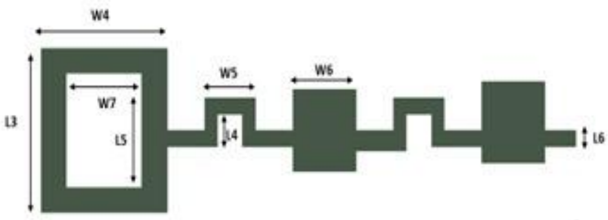

Figure 5: Full Patch Of Antenna

Figure 5 shows the rectangular patch antenna that is to be embedded in the cone antenna and the dimensions of the antenna are shown below

S. No	Parameters	Values(mm)
1	L3	4
2	L4	1
3	L5	3
4	L6 `	0.5
5	W4	4
6	W5	1.8
7	W6	2
8	W7	3.5

The S Parameter graph of the rectangular patch antenna that is shown in Figure (3) is shown below as both are compared with the S parameter of Figure (4).

Figure 6: Patch Antenna embedded In Cone

Figure 6 shows the rectangular patch antenna that is embedded in the cone and the parameters that are involved are shown below

S.No	Parameters	Values(mm)
1	H1	10
2	H2	0.5

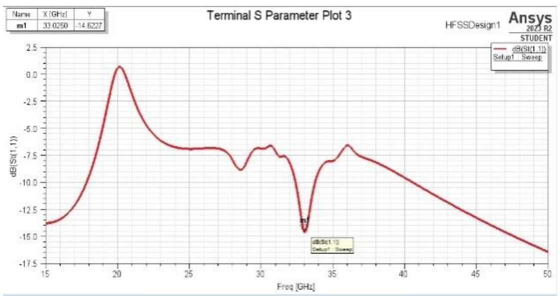

Figure: S Parameter

The above graph shows the S parameter values of the antenna in which the rectangular patch is embedded in the cone. It shows the antenna working at 33GHz frequency at -14dB

The next step of the cone-shaped antenna is to convert it into a working MIMO antenna which we know stands for multiple input and multiple output antenna.

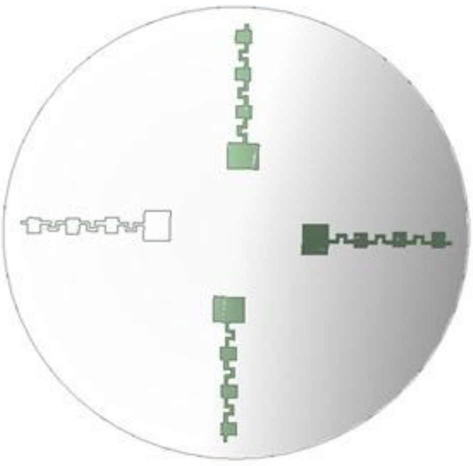

Figure 7: Patches Placed on Cone

Figure 7 shows the patches are placed at 90^0 with each other and the lumped port porting is given to every antenna.

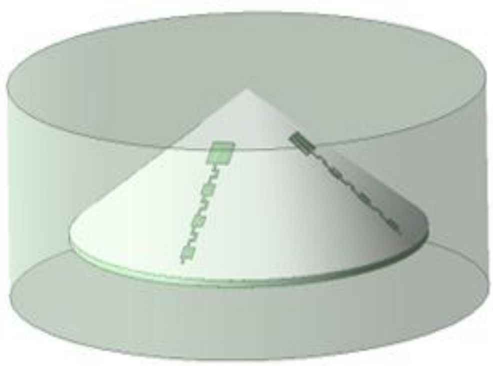

Figure 8: Antenna in Radiation Box.

Figure 8 shows the radiation box and the antenna that is placed. It shows the complete antenna that is placed in the radiation box.

III. RESULT & ANALYSIS

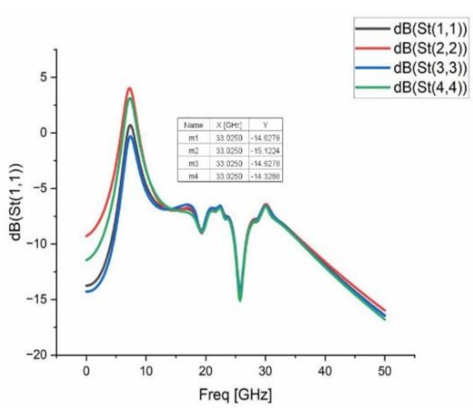

Figure 9: S Parameter Values

The above graph shows the S Parameter values as all the values of the antennas lie at 33Ghz frequency.

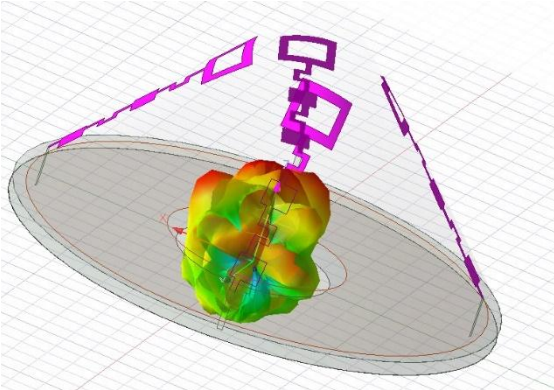

Figure 10: Pattern Maxima on Antenna

Figure 10 Shows the Pattern Maxima of the Antenna.

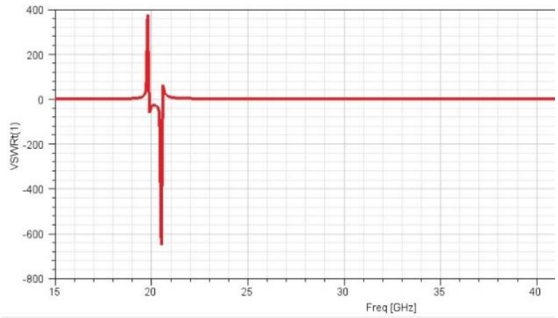

Figure 11: VSWR Plot

Figure 11 shows the VSWR parameter of the antenna

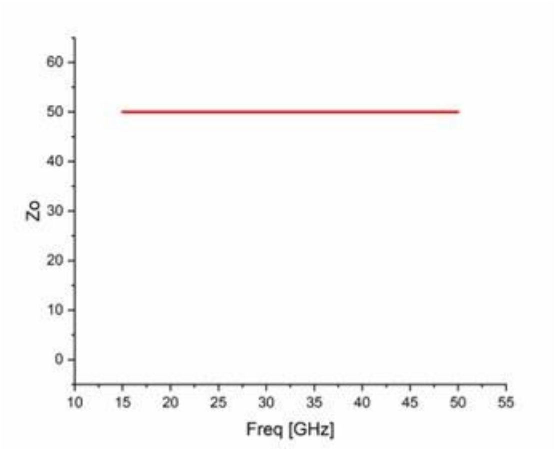

Figure 12: Zo Plot

Figure 12shows the Zo plot of the antenna.

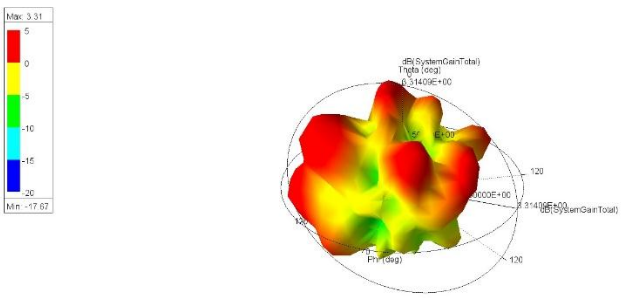

Figure 13: Gain Plot

Figure 13 shows the Gain plot of the antenna.

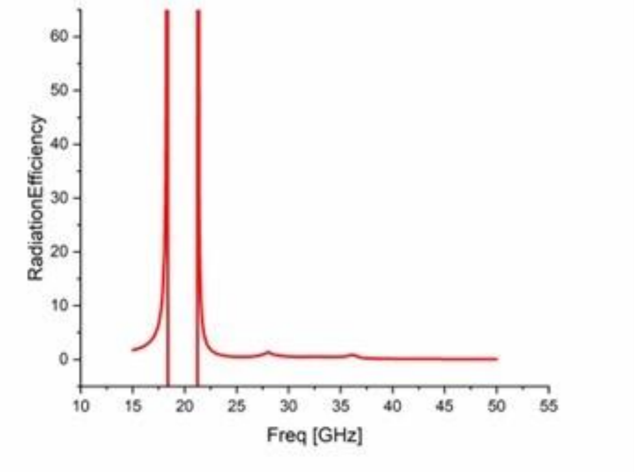

Figure 14: Radiation Efficiency
Figure 14 shows the radiation efficiency

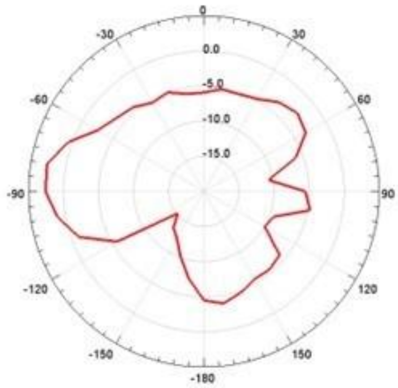

Figure 15: H-Plane Pattern
Figure 15 shows the H-Plane pattern

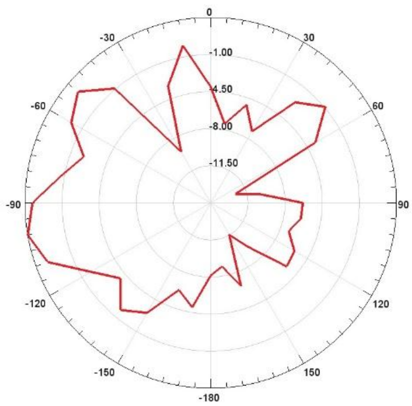

Figure 16: E-Plane Pattern
Figure 16 shows the E-Plane Pattern of the antenna.

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IV. CONCLUSION

This paper presents the design of a 4-element series-fed microstrip standing wave antenna array for Ka-band (33 GHz) applications. The main lobe direction of the array is controlled by changing the distance between the elements. The current distribution of the elements is adjusted by using the Taylor synthesis method to lower the first sidelobe level. A MIMO conformal antenna at 33 GHz is also designed, which has a bandwidth of more than 10%, a gain of more than 10 dB, and a first sidelobe level of −22 dB The main lobe angle of the conformal antenna is 90 degrees concerning the carrier axis. The experimental results validate the simulation results and satisfy the system requirements for the antenna performance. To consider the system cost, space limitation, and antenna coupling, four 8-element series-fed microstrip standing wave antenna arrays are designed and placed uniformly on the conformal carrier. The antenna coupling is less than −20 dB.

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