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Microstrip patch antenna designed for 5G implementations

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Abstract
Over the past few decades, there has been a significant surge in the development of wireless communication technologies, leading to a remarkable increase in the utilization of wireless communication. Within the realm of telecommunications, the Microstrip Patch Antenna emerges as a pivotal type of radio antenna, particularly valued for its capacity to be mounted in a discreet, low-profile manner. Microstrip array antennas are used in MIMO (multiple input multiple output) for 5G application. As we are use higher frequency it provides more bandwidth to use and it is also called 5G range Frequency.

The purpose of this paper is developing, designing of the Microstrip Patch antenna for 5G applications. The dimensions of the antenna, inclusive of the ground plane, are 10.3mm x 8.3mm x 0.5mm.The antenna, crafted from Rogers RT/duroid 5880 substrate as its dielectric material. The substrate possesses a dielectric constant of 2.2 and maintains a thickness of 0.5 mm. The microstrip patch antenna exhibits resonance at both 28 GHz and 50 GHz frequencies. The high frequency structure simulator is employed to simulate the antenna. The antenna provides a gain of 2.59 dB.

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1. Introduction

The rapid expansion of present wireless communication technology is propelled by the growing numbers of internet users. We have encountered a progression from 1G to 2G, 3G, and most recently, 4G LTE technologies. One of the prevailing challenges impacting contemporary wireless communication is the scarcity of viable frequency resources. To address this issue, research endeavors have commenced in 5G wireless communication, particularly focusing on the millimeter frequency band spanning from 20 GHz to 300 GHz. The frequency range predominantly employed for 5G research typically falls within the spectrum of 24 GHz to 60 GHz [1]. This technology has found widespread adoption across various sectors, particularly in conjunction with the Internet of Things (IoT). A primary objective of 5G is to facilitate the seamless connection of millions of devices. Future applications of 5G technology include deployment in smart cities, enhanced transportation systems, and advancements in robotics.

The rapid miniaturization of mobile devices has led to the demand for smaller antennas capable of fitting within these devices without compromising functionality [2]. Consequently, microstrip patch antennas have gained prominence since the 20th century. Comprising a thin metal foil affixed to a substrate, microstrip patch antennas typically include a ground plane beneath the substrate [3]. This microstrip patch antenna offers seamless integration onto the surface of a PCB, making it highly suitable for utilization in mobile devices. Primarily deployed within microwave and millimeter frequency bands, these antennas serve various applications effectively.

2. Antenna Design

The antenna's overall dimensions include a ground length of 10.3 mm and a ground width of 8.3 mm. The physical parameters were meticulously optimized as detailed in Table 1.

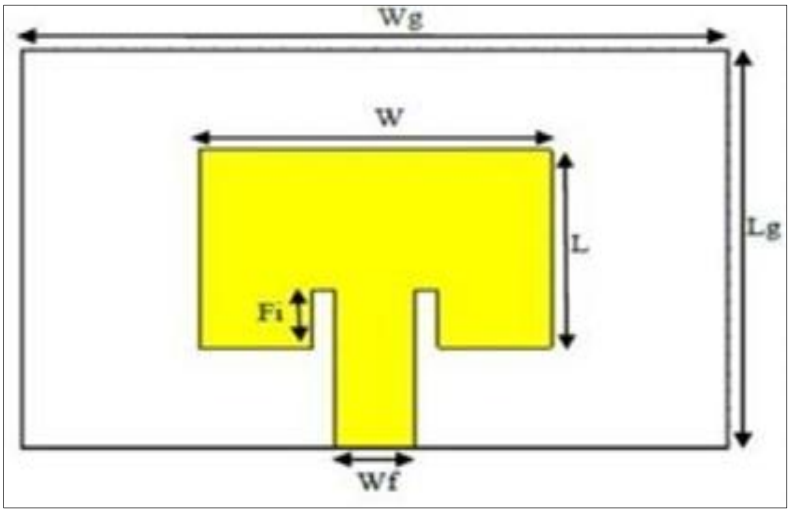

Fig 1: Geometry of the proposed Mcrostrip patch antenna

Table 1: Optimised Dimension of the Proposed Antenna

Parameter	Dimension (mm)
Ground Plane Length, Lg.	10.3
Ground Plane width, Wg.	8.3
Length of patch, L.	3.3
Length of width, W.	4.2
Height of substrate, h.	0.5
Width of feedline, Wf.	1.23
Feedline insertion, Fi.	1.23
Ground Thickness, t.	0.033

3. Results & Discussion

The return loss [7] measured at 28 GHz is 21 dB, while at 50 GHz, it reaches 31 dB. The figure illustrates the return loss plot for reference.

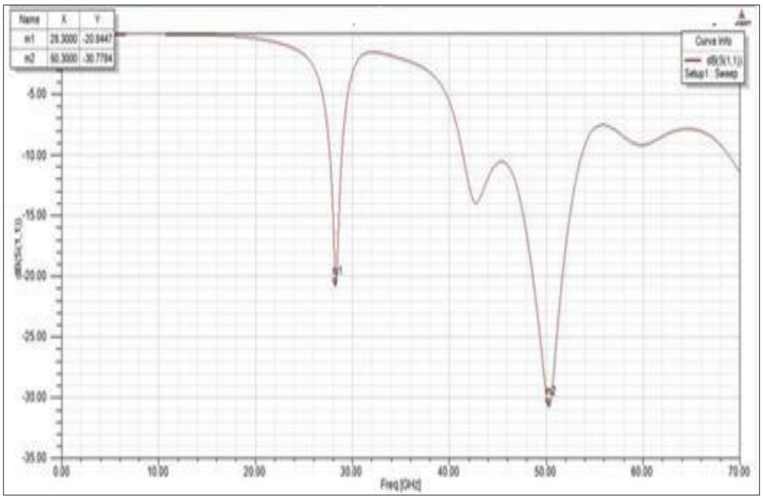

Fig 2: Return loss of single patch antenna

Gain

The 3D plot depicts the antenna's gain, which measures at 2.59 dB. The figure illustrates the gain of the patch antenna for further clarification.

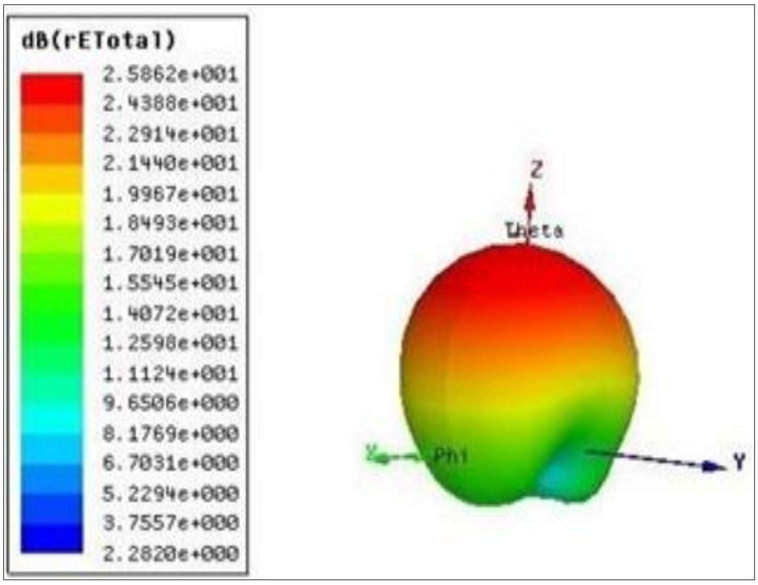

Fig 3: Gain

Conclusion

In this paper, the development of a microstrip patch antenna tailored for forthcoming 5G communication systems is outlined. The antenna exhibits resonance at both 28 GHz and GHz, showcasing return losses of 21 dB and 31 dB, respectively. The antenna is particularly well-suited for compact devices facing spatial limitations, offering seamless integration capabilities.

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