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Asub-6 MIMO Antenna for Wireless Communication Systems B-Shaped

Abstract: - modern wireless communication systems' advancement is based on the simulation of the designed antenna and utilizing the B-shaped MIMO antenna in various applications. However, the use of MIMO in low-band and mutual-coupling wireless devices is challenging. To address this, we propose a B-shaped microstrip MIMO antenna for modern wireless connectivity, which we simulated by "CST Microwave Studio". Our outcomes showed the proposed antenna has a dual-band frequency response at 4.798 GHz, with geometry applied on an FR-4 substrate thru dimensions of 35 × 78 mm and a thickness to 0.5 mm. Through simulations, we have observed the reflection coefficient (S11) to be less than -10 dB across two frequency bands and it exhibits improved isolation between antenna elements, with a value of less than -35 dB.

Keywords: CST, B-shape antenna, Index Terms – MIMO Antenna, and dual-band Antenna.

I. INTRODUCTION

The technologies of MIMO (Multiple Input Multiple Output) can enhance the performances of wireless communication systems by exploiting rich multipath environments to improve channel capacity and reliability [1-3]. However, the low correlation and mutual coupling between signals at the antenna ports pose a problem for the operation of his MIMO in wireless devices, especially compact devices requiring minimal antenna spacing. To address this, several antenna designs for MIMO applications have been proposed [4-11]. For instance, [4] offered his simplified MIMO antenna design using a four-planar H-shaped antenna with good isolation and directed radiation patterns. In another study [5], Using a tri-band, E-shaped printed monopole antenna with a mutual coupling of -15 dB and a correlation coefficient of less than 0.002, he looked at its applications for MIMO. On the other hand, the separation between antenna elements is $\lambda/10$. In [6], a two-element planar inverted-F antenna array with a pitch of 20 mm was proposed. It has an isolation of 20 dB and operates at a frequency of 5.2 GHz. In addition, work [12] proposes a dual-bands antenna for MIMO geometry that incorporates a novel B-type printed monopole antenna. The impedance bandwidth of the designed antenna is 29.9% at 2.45 GHz and 33.8% at 5.8 GHz.

Nevertheless, the geometries of antennas proposed in the literature are either relatively large, work only in a single frequency band, or have poor isolation between their elements. Therefore, the development of novel, sophisticated, and compact MIMO antennas that can provide reasonable mutual coupling, exhibit excellent radiation patterns and maintain acceptable correlation coefficients in multiband operation has become a significant challenge. increase. For contemporary wireless applications, there is an increasing demand for low-cost, efficient structures that are also geometrically tiny [14].

The current present study introduces a novel type-B dual-band MIMO antenna designed and developed to operate at frequencies suitable for 5G sub-bands. CST Studio program is used to get the desired performance

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from his suggested MIMO antenna. This compact antenna is suitable for use in a variety of applications such as mobile communication systems and biomedical monitoring [13].

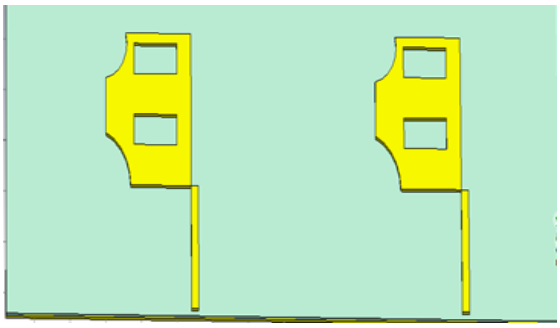
The remaining sections of this paper will be structured as follows: The second section will be providing an introduction to antenna structure, including full dimensions. Section III will provide and analyze the simulation's results, which include return loss and radiation pattern. Finally, Section IV will provide a conclusion summarizing the main ideas and findings of this work.

TABLE I THE PROPOSED ANTENNA'S DIMENSIONS

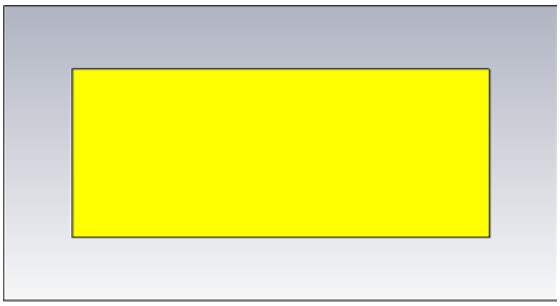
Term	Values (mm)
Wg	35
Lg	78
I1	24
I2	24
I3	17
H(thickness)	0.5
Circle	3.5 H(0.5)

II. HELPFUL HINTS

A. Figures and Tables



(a)



(b)

Figure 1. illustrates two antennae with a B-shaped design in both front and back views

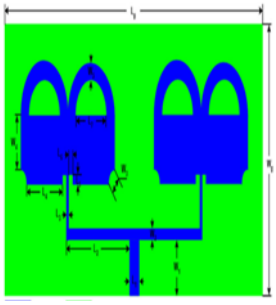
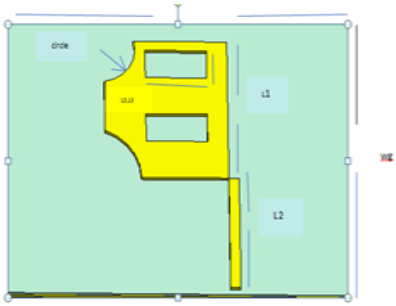


Figure 2. (A) show [14] The reference inspired by the form of research, which is B shape



(B) shows the patch antenna set up in a B form.

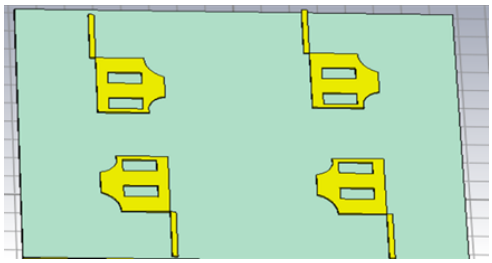
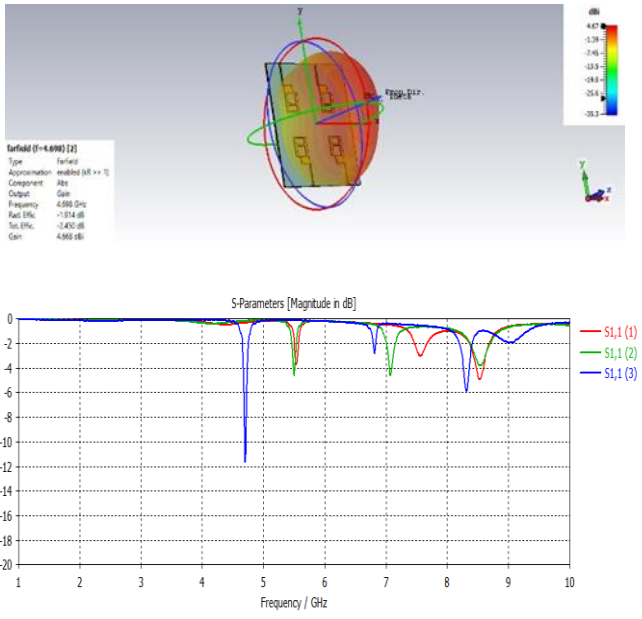


Figure 3. The four-element MIMO B-shape antenna.



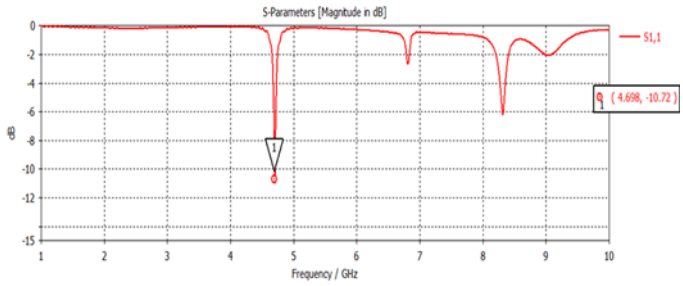


Figure.4 shows the suggested two elements and the MIMO antenna S11 reflection coefficient.

Figures 5 and 6 depict the B-shaped MIMO antenna's 2D-radiation patterns in different frequencies of 4.798 GHz, respectively, while Figure 7 shows the 3D radiation patterns in frequencies of 4.798 GHz. The outcomes of the study demonstrated that the proposed antenna displayed near-omnidirectional properties with only minor nulls**.**

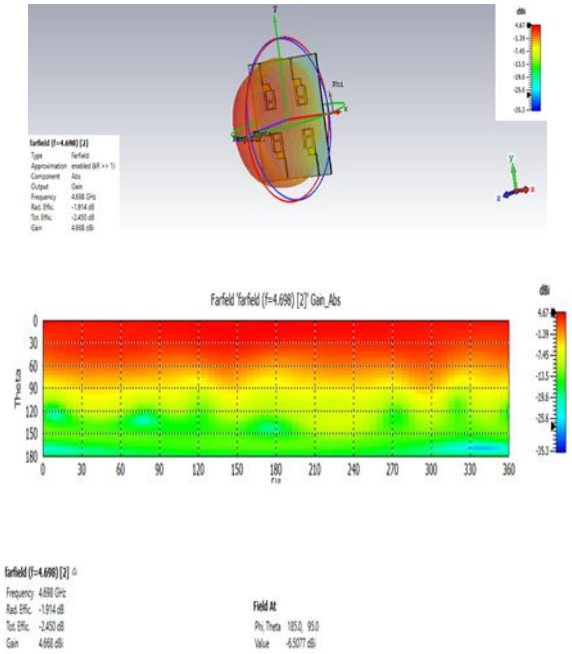
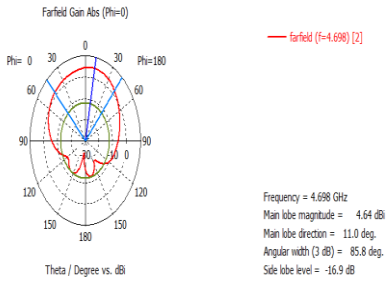


Figure 6. Various perspectives were utilized to simulate the 2D patterns radiation for utilizing the proposed MIMO antenna at 4.798 GHz, with support from far-field



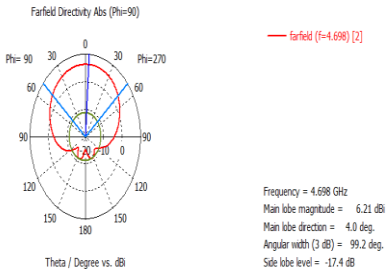


Figure 7 shows the suggested MIMO's simulated 2D radiation pattern at **4.798**

III. Method and Antenna Design

Although an antenna cannot amplify the power of a signal, its shape can be used to concentrate the available power into a smaller area, allowing for transmission and reception over greater distances than an omnidirectional antenna.

The operating frequency of the transmitter, the power radiated, and the general direction of the receiving device all influence the size, type, and shape of an antenna. This paper proposes and designs a B-shaped patch antenna for wireless communication systems.

A substrate made of FR-4 (lossy) with a thickness of 0.5 mm and a dielectric constant of 4.1 separates the antenna's ground and patch sections. To create a 4-element MIMO antenna, the B-shaped antenna are replicated four times. The proposed B-shaped single antenna appears in Figure-1, and the detailed structured, including dimension parameters, is depicted in Figure-2.

Additionally, Figure-3 shows the MIMO antenna, and Table 1 lists all proposed antenna dimensions. Here, the shape of the letter “B” was used as a shape, because the goal of design in communication is small in size, and at the same time it achieves work within the required and targeted frequencies, and here it is less than 6G. However, The resulting frequencies are not required to be higher than 6GHz.

IV. Results

Sub-6GHz refers to the frequency range below 6GHz within the radio spectrum and is commonly utilized for wireless services including 4G, LTE, 5G, and Wi-Fi. One notable advantage of Sub-6GHz lies in its capacity to accommodate higher data volumes compared to signals operating within the 2.4 GHz range. This is attributed to the availability of sufficient bandwidth for data transmission within the sub-6 spectrum. Furthermore, Sub-6GHz experiences lower susceptibility to interference in comparison to the 2.4 GHz band due to the lesser congestion in the sub-6 spectrum. With fewer devices employing Sub-6GHz, the potential for interference is reduced accordingly.

Except at the beginning of a phrase, use "(1)," not "Eq. (1)" or "equation (1)": "Equation (1) is..."

V. Outcomes of the Antenna Design and Evaluation

In this study, using CST MWS software, the performance of a proposed B-shaped single and MIMO antenna was tested. The reflection coefficient (S11) and isolation between the antenna elements (S21) were analyzed at the frequency ranges of 2-10 GHz, as demonstrated in Figs. 4 and 5. The results indicated that the proposed antenna had dual-band characteristics with resonant frequencies of 2.8 GHz (returns loss of -28 dB) and 6.122 GHz (return loss below -15 dB). Additionally, the B-shaped MIMO antenna showed remarkable isolation performance, with S21 below -35 dB at the frequencies of interest.

VI. Discussion

In this research, a comparison was made between the design from previous research[14], and the dimensions were modified to obtain results in another field, which is the range of Sub-6, to obtain more range within 5G applications.

VII. Conclusions

In the current paper, the 4-element B-shaped MIMO antennas are proposed for mobile and 5G-applications for less than 6, and Antennas that gives a signal of less than 6 are used within the 5G band for their applications. This antenna has proven good isolation between MIMO. The proposed antenna has been simulated by CST MWS and the outcomes illustrate that the designed antenna exhibits dual-band performance with resonant frequencies of 4.68 GHz. The reflection coefficient and isolation are all within acceptable values. The simulated radiation-pattern showed that the antennas have practically omnidirectional features, which is better in these applications.

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