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Design and Analysis of Reconfigurable Microstrip Antenna using for 5G Applications

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Abastrct-Conventional materials' year-round availability in sufficient quantity and quality is a major challenge for construction workers in this age of energy crises and resource depletion. The need for these supplies rises steadily as the demand for shelter and living space rises at an ever- increasing rate. Researchers throughout the world are refocusing their efforts to develop locally accessible, low-cost masonry units in response to the problem. To allow for the use of low- quality materials and low-skilled labor in the mass manufacturing of building blocks, the idea of green material and construction has been properly defined in the study. In this light, there is a rising interest in using earth, as a sustainable material, in contemporary architecture. The proper disposal of trash is one of the most pressing environmental issues in the United States today. There are now millions of cubic meters of discarded plastic in our nation. Suitable accommodation of the trash in some form (as fibres) is one approach to resolving these solid waste management and environmental challenges. Basic research can examine their potential use in the production of fiber-based blocks (plastic fiber–mud blocks). Furthermore, the literature study reveals that with very few exceptions, investigations on natural fibers have concentrated on cellulose based/vegetable fibers generated from sustainable plant resources.

Keywords- 5G, MIMO, Array, ECC.

I. INTRODUCTION

Compound reconfigurable antennas means several parameters of the same antenna to be simultaneously using separate control methods [1]. It is very difficult to change any of the antenna's parameters (pattern, resonant frequency and polarization) without affecting the others parameters; however, control on multiple parameters at a time adds in favor of the new antenna which is more useful and effective in a changing operating condition.

The resonance frequency, antenna pattern, and polarization of compound reconfigurable antennas can all be changed. Compound reconfiguration is a potential technique for minimizing the complexity of different communication system technologies. To achieve several reconfigurations in a same antenna configuration as earlier that do not obstruct one another during antenna service, careful fabrication techniques are required. [2,3].

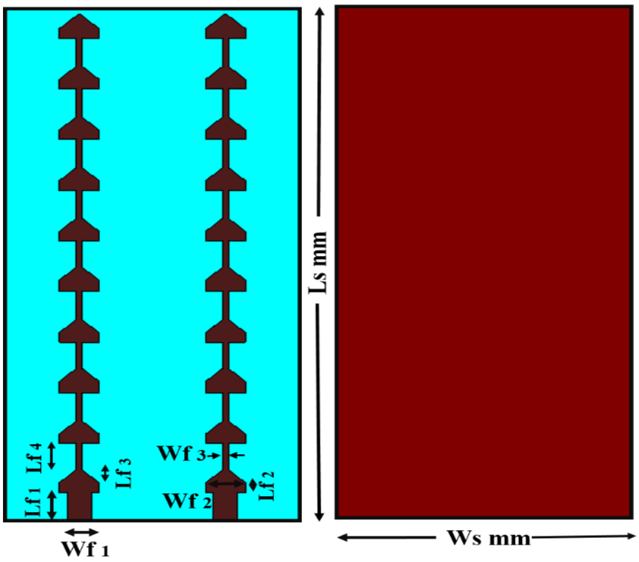
In order to reduce the total size and increased bandwidth, loop excited, Yagi-based MIMO antenna with 2-element is shown, where both sides of the substrate have half of the driven loop element [4]. For enhancing the isolation and wideband resonance, split ring resonator loading and the printed monopole, a ring-shaped ground is presented alongside the wideband planar MIMO antenna. 2.2 GHz to 6.28 GHz of wide impedance matching range is provided using the slotted ground [5]. For improving inter-element isolation, mushroom structured double layer walls are placed in between the elements of a cavity-backed MIMO slot antenna [6]. Instead of using a traditional ground plane, the single-layered artificial magnetic conductor having circular metallic unit cells reduces the couplings between dual-polarized elements of antenna in MIMO array and also yields a low profile [7]. Designing both the radio-frequency amplifier and the MIMO antenna separated on 50-Ω interfaces has been skipped; instead implementation of the co-design without the confinement of impedance has been done. This is done to achieve the enhanced performance of wideband matching in an active MIMO array [8].

In recent times, UWB transmission has received substantial recognition in academia and industry for its application in wireless communications. UWB is no longer considered a technology; instead, it is an available spectrum for unlicensed usage. The R&D efforts have validated that the UWB radio is an optimistic solution for the entire spectrum (high, moderate, and short-range) of wireless communications and ranging. Furthermore, comprehensive investigating, experimenting, and development is essential to build efficient and effective UWB communication systems. There is very little literature available on Genetic Algorithm for filters, usefulness to optimize band pass filters for different applications. Also, reconfigurable filters utilizing stubs on CPW have received little attention. This research work aims to design and develop an Ultrawideband Bandpass Filter for indoor and hand-held systems. Genetic algorithm was applied for all optimizations. The simulations were carried out on High Frequency Structure Simulator (HFSS) software..

II. PROPOSED 5G MIMO-ARRAY ANTENNA DESIGN

Nowadays, the main demand in the PCB industry is size reduction, ease of fabrication, and low cost. Filters are regarded as a key component in reducing the total size of the RF front design. There are numerous techniques in the literature for obtaining wideband or UWB, such as open-circuited stubs, short circuit stubs, MMR, etc.

In this chapter, we developed a parallel-coupled line filter with folded lines to reduce the overall dimension of the filter. Such a filter creates one band in the UWB band. Though, our goal is to have a wide band and notch band with good in-band and out-of-band performance, as well as a simple fabrication process due to smaller size. As a result, we convert our filter into a CPW structure. Many benefits of CPW technology include lower radiation loss, less dispersion, and smoother integration with ICs. There is no need for a via hole, it is not impacted by substrate thickness, and the dispersion effect is minimal. In the CPW structure, a folded line is placed on the upper surface of the substrate and subsequently changed into a CPW, which offers good band performance while decreasing the reflection coefficient. After simulation, the bandwidth increased from 3.3GHz to 10.1GHz, which is very close to the FCC limit. It also provides excellent in-band and out-of-band performance. For all simulations, the HFSS tool is used.



(a) (b)

Fig.1. Schematic views: (a) Front and (b) back of the proposed 5G MIMO-array.

Table 1 Dimensions of proposed antenna.

Parameter	Dimension (in mm)
Ws	25
Ls	51.5
Wf1	3
Lf1	3.875
Wf2	4.3
Lf2	1.939
Wf3	1.5
Lf3	2.27
Lf4	3.6

III. RESULTS AND DISCUSSION

Return Loss & VSWR

This structure can be fabricated on a substrate with a high dielectric constant which is about 8 or 10. The disadvantage of CPW is it needs a higher dielectric constant. A higher dielectric constant lead to a higher dimension of the circuit and increased cost, but at the same time, it reduces the size of the filter. To mitigate this disadvantage, made use of FR4, which is easily available in the market at a lower price. Using this technique, the size of this filter was reduced substantially from the literature and by 23% from our filter in a cost-effective manner.

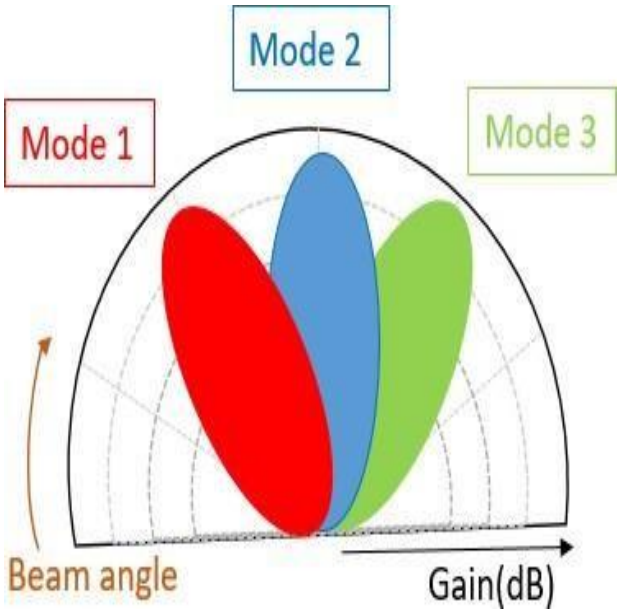


Fig. 2. S-parameters for the proposed 5G MIMO-array.

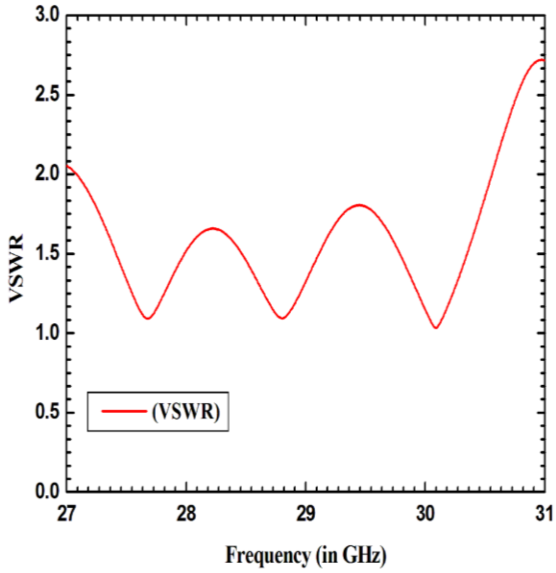


Fig.3. VSWR for the proposed 5G MIMO-array.

The ECC is the important parameter in MIMO antenna to understand the diversity behavior of the proposed design. The simulated ECC result shows in Fig.4 which is less than 18^{-3} in whole frequency band. The ECC can be calculated using S-parameter and formula mention below in eq. 1.

$$\rho_{nm} = \frac{|S_{nn}^{*}S_{nm} + S_{mn}^{*}S_{mm}|^2}{(1-(|S_{nn}|^2+|S_{mn}|^2))(1-(|S_{mm}|^2+|S_{nm}|^2))} \quad \text{............1}$$

Where m, n are the antenna elements and N is the number of antennas.

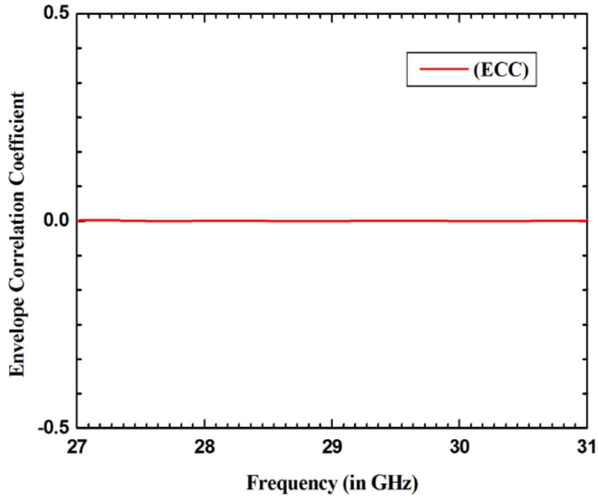


Fig. 4. ECC for the proposed 5G MIMO-array.

Antenna Gain

The next important parameter of reconfigurable antenna is pattern reconfiguration. Pattern reconfigurable antenna is able of changing radiation pattern according to the necessity. The shape or beam pattern of a varying or tilting radiation pattern can be used to illustrate its application. Pattern reconfiguration is understood by adapting adjustable structures, and switching components. Pattern reconfigurable antennas are generally used for beam direction and null monitoring for interference reduction during operation. By directing maximum radiation and maintaining a stable system with mobile devices, antenna gain can be optimized in the intended direction. and are shown in Fig.5.

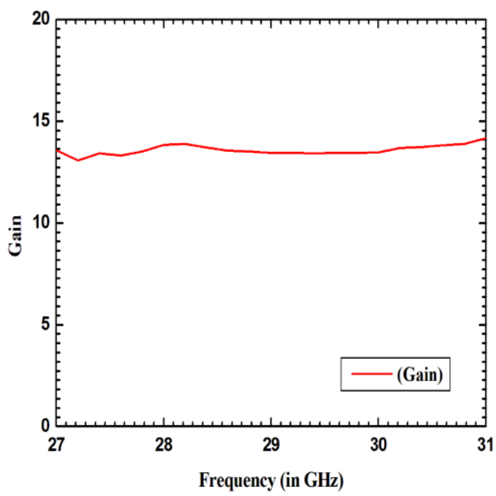


Fig. 5. Gain for the proposed 5G MIMO-array.

Antenna Efficiency

Figure 6 shows the total efficiencies of the proposed MIMO-array antenna and the simulated radiation. Results show that over the entire bandwidth, the radiation efficiency is better than 99% & total efficiency is better than 90%.

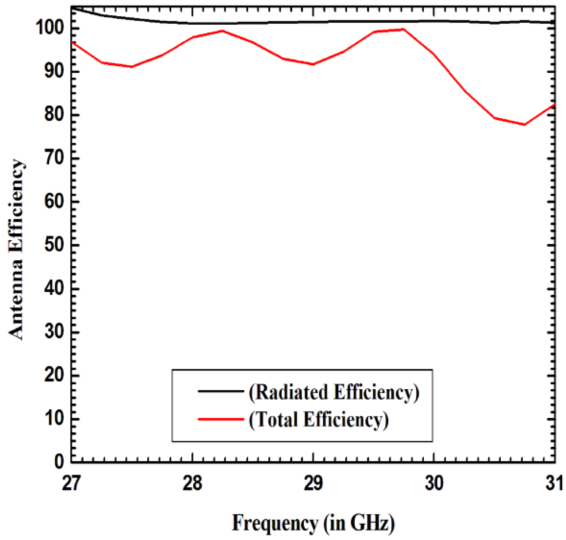


Fig. 6. Efficiencies for the proposed MIMO-array.

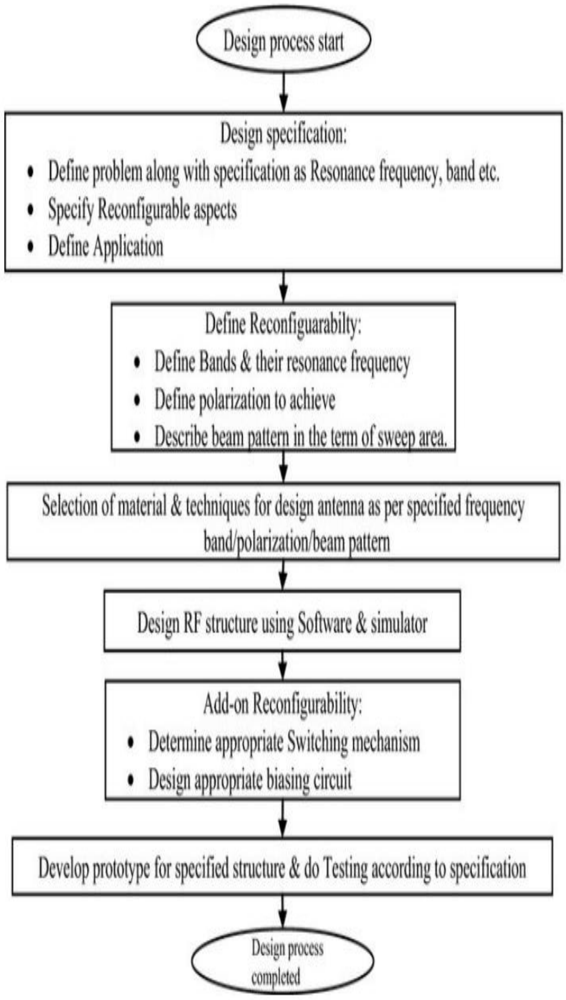


Fig.7 Proposed Plan of work

Table 2 compares the proposed MIMO-array antenna with the previous papers. Results show that in comparison with the existing references, the proposed MIMO has a high radiation efficiency, very high gain, large bandwidth, and low size.

Reconfigurable antennas can be used in a number of situations because they aremore beneficial than rigid antennas.One reconfigurable antenna component can accomplish theroleofseveralstaticantennas for reception diversity i.e., for portable and lightweight deviceslike as mobile phones, smart phones, laptops, domestic appliances. Conventional arrays static antenna elements can be replaced with reconfigurable elements, which can overcome theconstraints of modern approaches and provide greater flexibility interm so fregulationand analysis.The application of reconfigurable antenna principles to current and future wireless systems is cost-effective, low-complexity,space-efficient, and low power-consumption

Table 2: Comparison with available references.

Ref. No.	Frequency Band/ Bands (GHz)	No. of elements	Size (mm^2)	Gain (dBi)	Efficiency (%)
[13]	27-29	5	100 x 100	7	-
[14]	22.66-29.11	9	20 x 20	9.9	60
[15]	26-29.5	5	20 x 20	8.3	60
[16]	27.49-29.42	11	24.61 x 56.18	10.33	78.58
Proposed	27.446-30.518	11	24 x 50.5	14	90

IV. CONCLUSION

This paper has designed 5G MIMO antenna for two inputs and two outputs. The proposed design contains 11 arbitrary shaped patch elements arranged in tapered array for each port this process helped to achieve a reduced size of the filter, design a CPW technique that is useful to connect any passive element on the top surface only and eliminate a need for shorting in a cost-effective manner. From the results shown in the paper achieved bandwidth 3.072 GHz from 27.446 GHz to 30.518 GHz. For the entire bandwidth, proposed antenna achieved gain higher than 13dBi, radiated efficiency is better than 99%, total efficiency is better than 90%, TARC is calculated for different excitation angles (0^0, 30^0, 60^0, 90^0, 180^0, 270^0, 300^0), CCL is better than 0.3 bit/s/Hz. 4. The multi-purpose antenna design makes the system very cost-effective, compact in size, weight, and low power consumption, which enhances the operating system's stability and working life.

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