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Design and Analysis of Microstrip Patch Antenna Array with DGS for 5G mobile and mm wave Application

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ABSTRACT: The 5th generation mobile communication provides various advance application with high quality of services. The research is continuing going on 5G network communications applications. The expectation from 5G antenna is to meet the higher speed, low latency and large bandwidth. An antenna array is a set of multiple connected antennas which work together as a single antenna, to transmit or receive radio waves. Microstrip Patch Antenna (MPA) is array design is also very emerging research area for 5th generation communication application. This paper proposed design and analysis of microstrip patch antenna array with DGS for 5G mobile and mm wave application. The CST microwave studio software is used to antenna design and simulation.

KEYWORDS: Microstrip, mm wave, C band, Antenna, CST, FR4, VSWR, Return loss.

I. INTRODUCTION

The advancement of remote correspondence advances, it has gotten progressively alluring for present day specialized gadgets to coordinate different correspondence guidelines, for example, 2G/3G/4G/5G. Hence, radio wires with broadband execution are popular for multi-standard inclusion. Array receiving wires are generally utilized in remote correspondence frameworks. To accomplish broadband activity, different plans of array reception apparatuses have been accounted for, for example, altering the state of the array arms, improving taking care of strategies, stacking parasitic radiators, and utilizing magnetolectric reciprocal structures.[1]

Moreover, radiation execution is additionally required for some remote correspondence applications, for example, indoor sign inclusion, remote passages, and small scale base stations. In view of the multi-mode PFDA, a straightforward and powerful structure to accomplish radiation execution is created by setting two of the proposed PFDA's consecutive. The subsequent reception apparatus displays great radiation designs in the even plane with level increase variety of fewer than 1.27 dB. The introduced conservative broadband radio wire is a decent contender for indoor sign inclusion.

Three resounding modes are gotten by utilizing a changed planar collapsed array and its coupled taking care of structure. Consolidating the shorting pins and parasitic patches, numerous resounding modes in the receiving wire are controlled, moved, and afterward joined to build the impedance data transmission. Utilizing this idea, a model of a multimode collapsed array is planned, manufactured, and estimated [1]. Common coupling between two array receiving wires with various measurements put at self-assertive equal positions is broke down utilizing synchronous indispensable conditions with definite parts and limited hole feeds[2]. A tale plan technique for a wideband double enraptured reception apparatus is introduced by utilizing shorted dipoles, incorporated baluns, and crossed feed lines. Reenactment and proportionate circuit investigation of the receiving wire are given. To approve the plan technique, a receiving wire model is planned, upgraded, manufactured, and estimated [3]. An epic ultra-wide-band firmly coupled array reflect array (TCDR) radio wire is introduced in this work. This reflects array receiving wire comprises of a wideband feed and a wideband reflecting surface. The feed is a log-occasional array cluster reception apparatus. The



reflecting surface comprises of 26×11 unit cells. Every cell is made out of a firmly coupled array and a defer line. The base separation between nearby cells is 8 mm, which is around 1/10 frequency at the most minimal working recurrence. By joining the benefits of reflect array reception apparatuses and those of firmly coupled exhibit radio wires, the proposed TCDR recieving wire accomplishes ultra wide transfer speed with decreased unpredictability and creation cost[4].

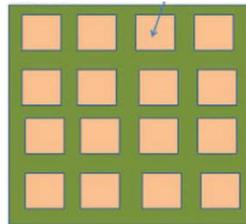


Figure 1: Array Antenna

Microstrip array radio wire is exceptionally well known in light of the fact that the data transmission of smaller scale strip array receiving wire is high when contrasted with the miniaturized scale strip fix reception apparatus. Small scale strip array reception apparatus will be the principle focal point of this work.

II. METHODOLOGY

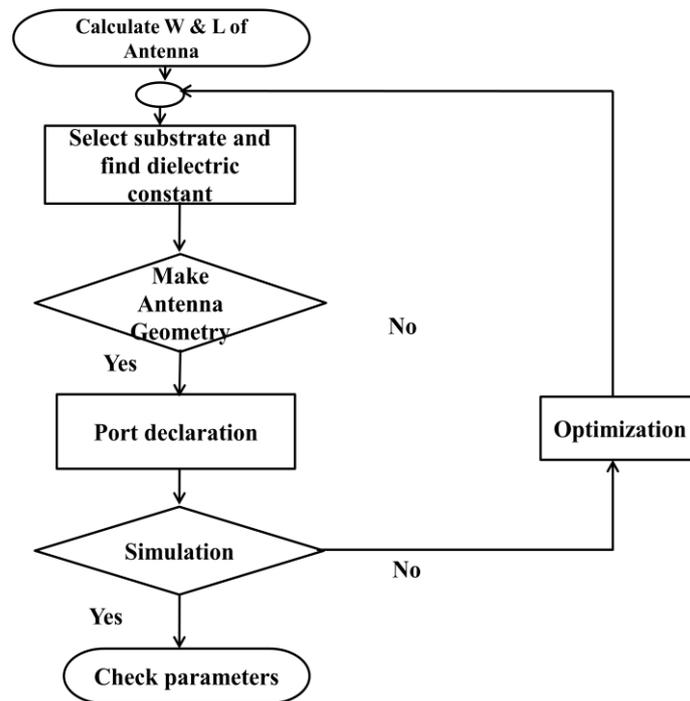


Figure 2: Flow Chart

The flow chart work as following steps-

1. First find application and define requirement.
2. Next steps is finding out major specification of antenna
 - a. Resonating Frequency of antenna (according to application define in initial step of CST).

3. Choose a suitable substrate, it may depend upon various factor like availability of material, integration of antenna with other circuit components on board. Dielectric constant and height of substrate are important for microstrip antenna parameter calculation.
4. Calculate Microstrip antenna dimension. Most of the time antenna used in wireless communication is not simple antenna, these are customized structure.
5. Calculate antenna width and length using standard formula.
6. Antenna height (Its define in substrate material already for microstrip antenna its usually 1.5mm-1.6 mm). It can be selected using CST
7. Draw antenna geometry and define materials.
8. Define feed-point and radiation boundary
9. Run simulation and check performance parameters values.

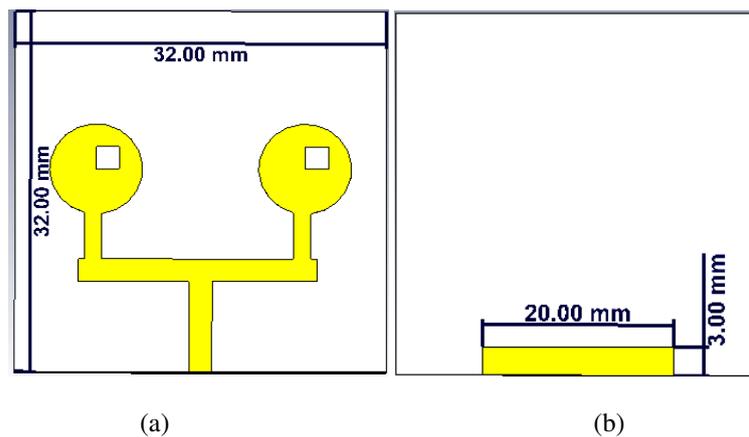


Figure 3: (a) Top view (b) Defected Ground Structure

Figure 3 is indicating proposed microstrip array antenna of plan. The top and ground layer is made by lossy copper material and substrate is made by Rogers RO4350B material which having 3.36 dielectric steady worth.

III. SIMULATION RESULTS

The geometry of the proposed structure of microstrip array for C-band applications is appeared in figure 3. The general size of the structure is 32mm × 32mm × 1.64mm (L × W × H) and imprinted on RO4350B material which having 3.36 and a loss digression of 0.024. Table 1 records the element of the proposed antenna. The antenna is taken care of by 50-Ω and 0.5W coaxial link or straightforward. The antenna utilizes the microstrip array structure with one opening for C-Band applications.

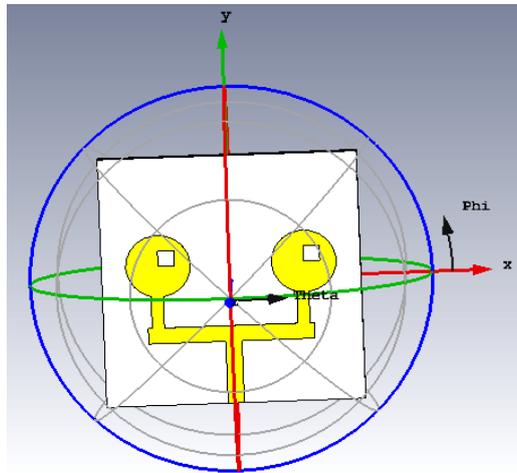


Figure 4: Simulation and fields of proposed antenna

CST microwave studio used to recreate the proposed plan. Figure 4 is demonstrating reenacted electric and attractive field in round organize framework.

Table 1: Design parameters for proposed Antenna

Sr No.	Parameter	Value
1	Lower Frequency(f_L)	4 GHz
2	Higher Frequency(f_H)	12 GHz
3	Dielectric constant(ϵ_r)	Rogers RO4350B
4	Ground (LxW)	3 mm X 20 mm
5	Ground height	0.035mm
6	Substrate(LxW)	32mm X 32mm
7	Substrate Height(h)	1.57 mm
8	Line Impedance	50 Ω
9	Tangent Loss	0.06
10	Input watt	0.5W

Case –I: Anenna design with Rogers RO4350B for lower band of 5G

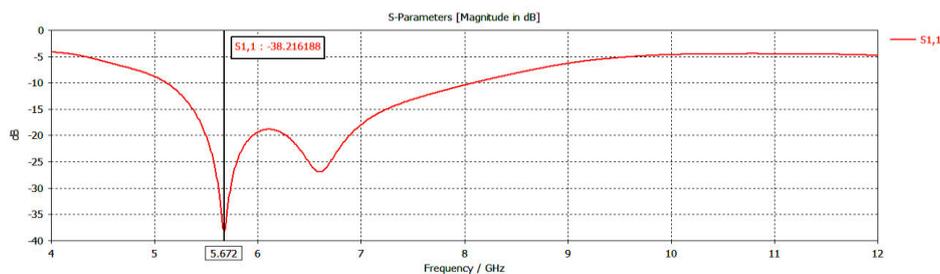


Figure 5: Return loss

The value of return loss is 5.672GHz with resonant frequency is -38.21dB.

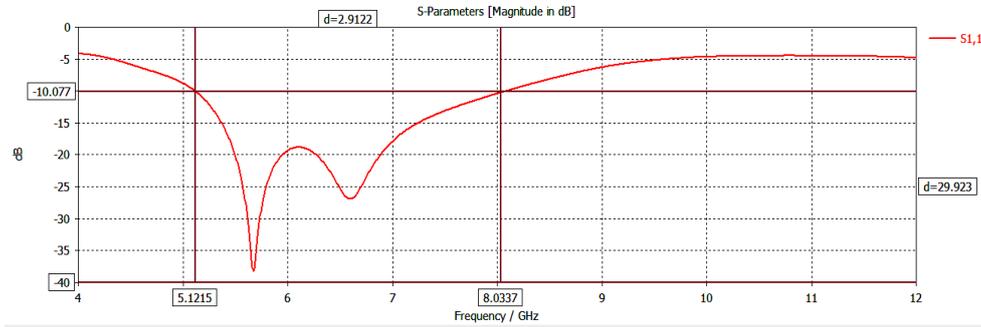


Figure 6: Bandwidth

The bandwidth of proposed antenna is 2912MHz, (8.037GHz-5.121GHz).

Case –II: Antenna design with Rogers RO4350B for upper band of 5G

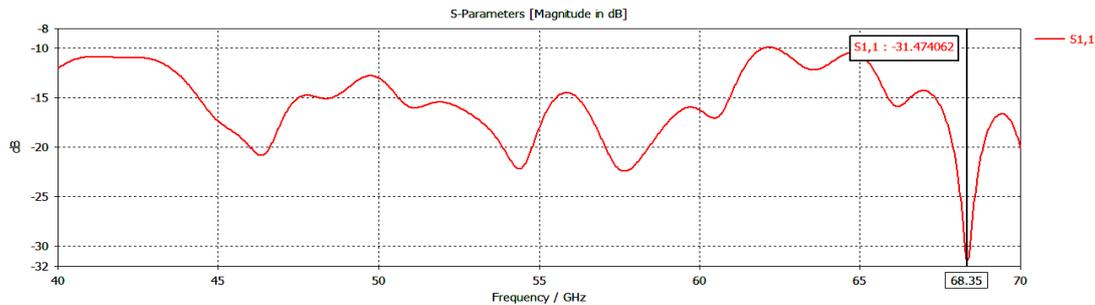


Figure 7: Return loss

The obtained value of S11 or return loss is -31.47dB at 68.35GHz resonant frequency, where antenna efficiency is higher.

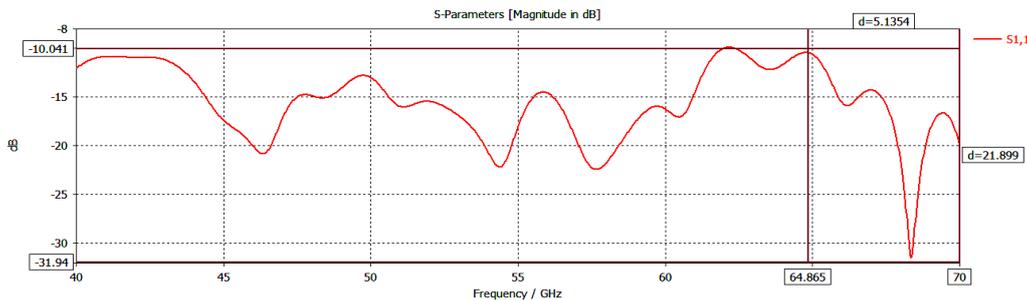


Figure 8: Bandwidth

The bandwidth of proposed antenna is 21.877GHz (61.877 GHz – 40 GHz). Therefore total bandwidth is 27.042GHz (5.165GHz + 21.877GHz).

Table 2: Result Comparison of proposed and previous work

Sr No	Parameters	Previous Work	Proposed Work	
1	Substrate Material	Rogers RO4350B	Rogers RO4350B	Rogers RO4350B
2	Return loss or S11	-34.5 dB	-38.21 dB, -27 dB	-31.47 dB
3	Bandwidth	3.8 GHz	2.912GHz	27.042GHz
4	VSWR	NA	1.024, 1.212	1.054
5	Resonant Frequency	59.5GHz	5.6 GHz, 6.6 GHz	68.35 GHz
6	No of Band	1	2	Multi
7	Application	5G upper band	5G Lower band	5G upper band

Table 2 is showing comparison between previous design and proposed design. It is clear from this table and results the proposed antenna array design have significant good and improved result than previous results.

IV. CONCLUSION

The proposed design of double band characteristics on a RO4350B Substrate microstrip patch antenna array for 5G lower band i.e. C-band mobile wireless communication and 5G upper band mm wave communication application. Different parameters like VSWR values are 1.024 and 1.212 for the respective frequencies 5.6 GHz, 6.6 GHz for the proposed C-band antenna. The overall bandwidth achieved is 2.912GHz. 5G upper frequency range (40GHz to 70 GHz) optimized the -31.47 dB return loss at 68.35 GHz resonant frequency. The overall bandwidth is 27.042GHz with 1.054.

REFERENCES

1. B. Tütüncü, "Microstrip Antenna for 5G Communication: Design and Performance Analysis," 2020 International Congress on Human-Computer Interaction, Optimization and Robotic Applications (HORA), 2020, pp. 1-4, doi: 10.1109/HORA49412.2020.9152855.
2. M. Patriotis, F. N. Ayoub, C. G. Christodoulou and S. Jayaweera, "A K/Ka Band Frequency Reconfigurable Transmit/Receive Antenna Array," 2019 13th European Conference on Antennas and Propagation (EuCAP), Krakow, Poland, 2019, pp. 1-4.
3. A. M. Yusuf, H. Wijanto and Edwar, "Dual C-X-Band E-Shaped Microstrip Antenna Array 1x8 for Synthetic Aperture Radar on UAV," 2019 IEEE International Conference on Signals and Systems (ICSigSys), Bandung, Indonesia, 2019, pp. 186-189.
4. H. Xu, J. Zhou, K. Zhou and Z. Yu, "Low-profile circularly polarised patch antenna with high gain and conical beam," in *IET Microwaves, Antennas & Propagation*, vol. 12, no. 7, pp. 1191-1195, 13 6 2018.
5. N. Yan, K. Ma and H. Zhang, "A Novel Substrate-Integrated Suspended Line Stacked-Patch Antenna Array for WLAN," in *IEEE Transactions on Antennas and Propagation*, vol. 66, no. 7, pp. 3491-3499, July 2018
6. P. Sanchez-Olivares, P. P. Sanchez-Dancausa and J. L. Masa-Campos, "Circularly conformal patch array antenna with omnidirectional or electronically switched directive beam," in *IET Microwaves, Antennas & Propagation*, vol. 11, no. 15, pp. 2253-2259, 10 12 2017.
7. M. Long, W. Jiang and S. Gong, "Double-layer miniaturised-element metasurface for RCS reduction," in *IET Microwaves, Antennas & Propagation*, vol. 11, no. 5, pp. 705-710, 15 4 2017.
8. W. Lin and H. Wong, "Polarization Reconfigurable Aperture-Fed Patch Antenna and Array," in *IEEE Access*, vol. 4, pp. 1510-1517, 2016.



9. D. Guan, Y. Zhang, Z. Qian, Y. Li, W. Cao and F. Yuan, "Compact Microstrip Patch Array Antenna With Parasitically Coupled Feed," in *IEEE Transactions on Antennas and Propagation*, vol. 64, no. 6, pp. 2531-2534, June 2016.
10. A. A. Gheethan, A. Dey and G. Mumcu, "Passive Feed Network Designs for Microfluidic Beam-Scanning Focal Plane Arrays and Their Performance Evaluation," in *IEEE Transactions on Antennas and Propagation*, vol. 63, no. 8, pp. 3452-3464, Aug. 2015.
11. Q. Bai, A. Tennant and B. Allen, "Experimental circular phased array for generating OAM radio beams," in *Electronics Letters*, vol. 50, no. 20, pp. 1414-1415, 25 September 2014.
12. J. S. Chieh, B. Pham, A. Pham, G. Kannell and A. Pidwerbetsky, "Millimeter-Wave Dual-Polarized High-Isolation Antennas and Arrays on Organic Substrates," in *IEEE Transactions on Antennas and Propagation*, vol. 61, no. 12, pp. 5948-5957, Dec. 2013.



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