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Design and Research of Modified Split Ring Resonator for Reduction of Mutual Coupling in Microstrip Patch Antenna Array

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ABSTRACT--- In this document, we proved a new technique for eliminating the impact of mutual connection amongst elements in an antenna array by integrating the Metamaterial Hybrid Split Ring Resonator (HSRR). The HSRR suggested unit-cell consists of a single circular ring resonator, each rounded with two symmetrical divisions, with one hexagonal ring resonant. The insulation of over 13 dB without affecting the working frequency and radiation features shall be accomplished by integrating the HRSR metamaterial framework near the correct side of the standard radiating patsch of the antenna array running at 2.4 GHz. The efficiency of the HSRR antenna array proposed has been numerically assessed

Keywords : Antenna Array, Mutual Coupling, Metamaterial, Spilt Ring Resonator.

I . INTRODUCTION

Microstrip antennas have dragged their attention towards present day wireless communication system due to their special properties like light weight, minimum cost and other superiorities, [1]. More capacity and great quality are the results of MIMO technology [2, 3]. Mutual coupling effect which is a major issue in array antenna system will degrades the quality of MIMO configuration [4]. Techniques like defected ground structures (DGS) [5], electromagnetic band gap structures (EBG) [6] can be applied for the suppression of mutual coupling effect with destroyed ground structure. In [7, 8] different techniques have been introduced to suppress mutual coupling effect using Metamaterial structure. But the radiation characteristics have been affected by using these techniques in Metamaterial based MIMO antenna. Along with confirmative procedure to prove the characteristics of Metamaterial, its multiple resonances within the microwave frequency range have been analyzed for hexagonal shaped spilt ring resonator [9]. Also it is necessary to suppress the coupling effect without degrading the radiation features.

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In this context, we project a novel method to reduce antenna coupling effect by using HSRR Metamaterial structure. Isolation between the two antenna components is enhanced at approximately 12dB, whereas the working frequency and radiation features are hardly influenced.

II. PROPOSED ANTENNA DESIGN

The proposed range of antennas running at 2.4 GHz are initially intended with the relative permittivity of the FR4 epoxy substrate, loss tangent 0.002 and the thickness 1.57 mm. The suggested HSRR cell consists of a single circular ring resonator, each of which contains two symmetrical fractions, surrounded with a unique hexagonal ring resonator. The HSRR unit cell is placed at the left end of the patch between the two radiating patches, and the HSRR unit cell distance is 1 mm. The entire geometry of the suggested HSSR structure of microstrip antenna array is shown in Fig. 1(a). The hybrid metamaterial structure of the simulated unit cell is shown in Fig. 1(b) and 1(c).

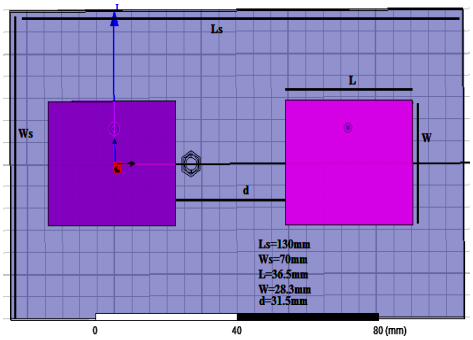

Fig.1(a) Simulated Geometry of Microstrip Patch Antenna with hybrid spilt ring resonator structure

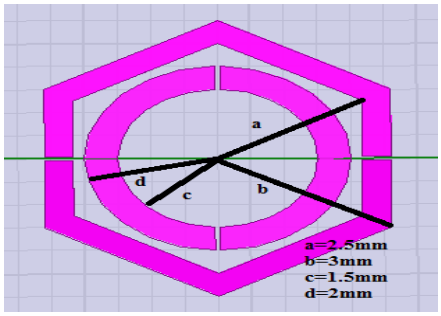

Fig. 1(b) Hybrid Metamaterial Structure unit cell

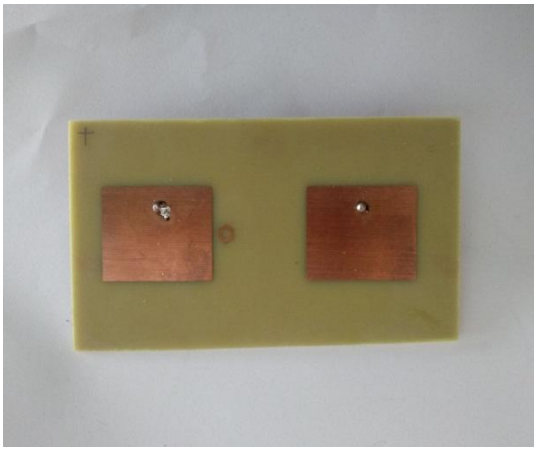

Fig.1(c) The fabricated of 2x1 patch antenna array with hybrid spilt ring resonator structure

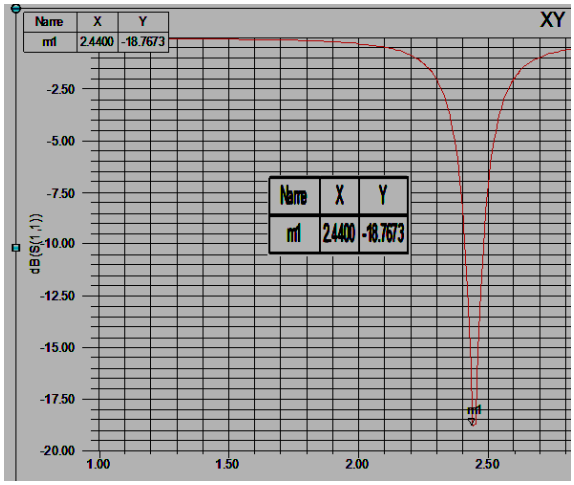

Fig. 2(b) Return Loss vs. Frequency of Microstrip Patch Antenna with hybrid SRR Metamaterial

III. SIMULATED AND MEASURED RESULTS

ANSYS HFSS numerical simulation and measures on a Vector Network Analyzer (Rohde & Schwarz, German make ZVK Model No.1127.8651), as shown in the Fig. 2(a) assessed the efficiency of the suggested HSRR charged antenna array. The simulated and measured antenna loss plots with HSRR metamaterial structures are shown in the Figure. 2(b) and (c), respectively. The measured results accord with the simulated result. The simulated plot of antenna coupling with and sans HSRR Metamaterial geometry is illustrated in Fig. 2(d) which shows 13.6dB of isolation between the elements of an antenna. To validate the simulated mutual coupling results, S(1,2) is measured using the same network analyzer and the results is shown in Fig. 2(e). The directivity of the design microstrip patch antenna array with HSRR is 3db at phi=00as shown in Fig. 2(f).

Fig. 2(a) Experimental set up

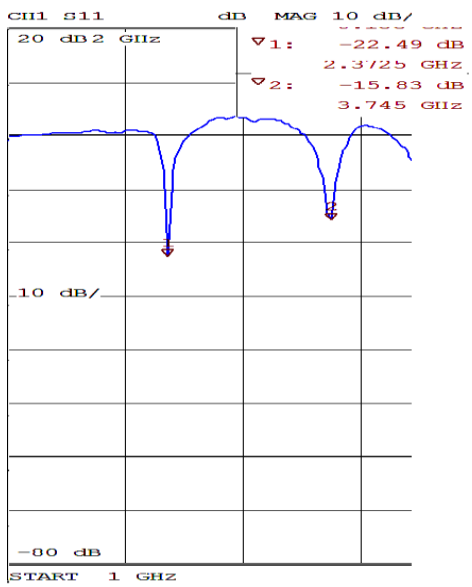

Fig. 2(c) Measured Return Loss graph of Microstrip Patch Antenna with hybrid SRR Metamaterial

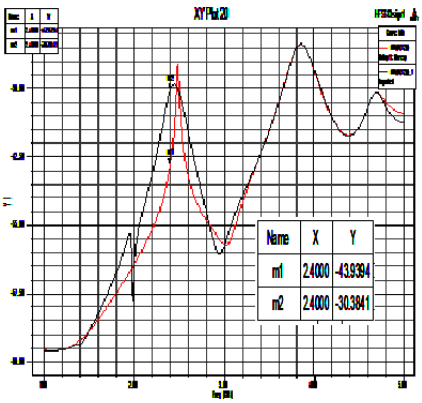

Fig 2(d) Simulated Mutual Coupling Plot

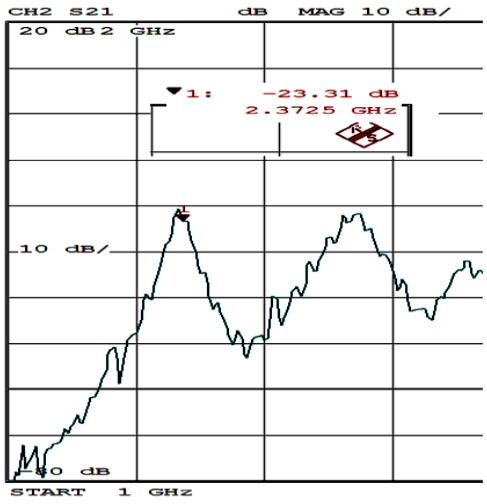

Fig 2(e) Measured Mutual Coupling Plot

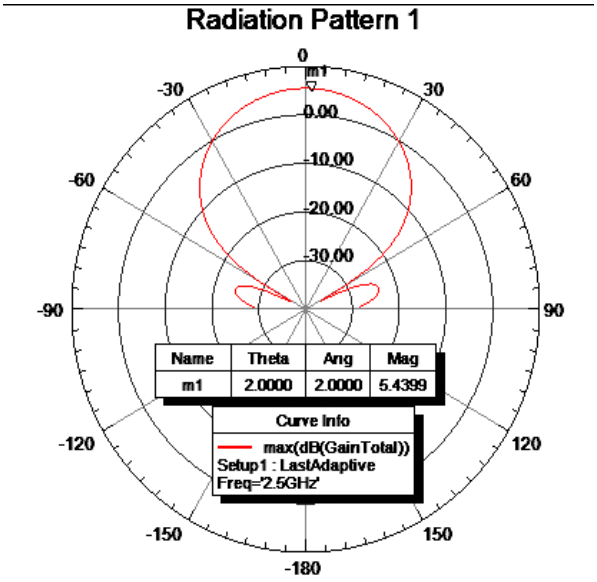

Fig. 2(f) Directivity graph in dB for λ/4 Spacing between the Elements of an anrray

Table- I: Summary

Parameters	Antenna Design	
	Without HSRR	With *HSRR*
Operating frequency	2.4GHz	2.44GHz
Mutual coupling	-30.3dB	-43.9dB

IV. CONCLUSION

In this article design and investigation of 1x2 patch antenna with a novel hybrid split ring resonator structure (HSRR) is carried out. It is observed about 13.3dB of isolation is achieved between an array of two radiating patch with 5.3dB directivity using HSRR structure. The designed antenna is simple and cost effective and operates at 2.4GHz which suits for ISM band frequency applications.

V. ACKNOWLEDGMENT

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VI. REFERENCES

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