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Mutual Coupling Reduction Antenna Arrays using Periodic Structures

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Abstract-- **Mutual coupling is a critical issue in antenna elements is placed in the form of array between the antenna elements. In the present work Jerusalem cross periodic structure is proposed as an effective solution for reducing mutual coupling in a micro strip array antenna with more than one elements. This structures have been Applied between the patches have been Simulated and verified with practical results.**

Keywords: Micro strip array antenna, EBG Mutual coupling, Jerusalem Cross periodic Structure

1. INTRODUCTION

Mutual coupling deals with the concept of electromagnetic interaction relating antennas and antenna arrays. This will be differs in different types of Antenna arrays .This phenomenon has to be considered and to be treated differently. It has impact on small element spacing which will affect the antenna array in different ways [1].

Coupling between the array elements is a very important factor in micro strip arrays design. Most of research have indicated the serious degradation of mutual coupling between elements.[1] surface waves and space waves are also affected by Mutual coupling depend on the thickness of the micro strip substrate with respective to wave length relative permittivity. [3–4], different ground structures along with their etching patterns on specific plane have been concentrated [5–6], , the DGS is a compact structure As a resonator. Proved advantageous in various applications [7–8] concerning the suppression and reduction of mutual coupling between elements in antenna arrays . [9] An effective method of isolation enhancement can be of disorienting the antennas [10]. Suppression of surface currents induced on conducting bodies and reduce the radar cross section of structures can be achieved by using Lossy materials [11], parasitic elements like metallic wall have been applied to reduce the mutual coupling between antennas [12].

II FREQUENCY SELECTIVE SURFACES

Frequency selective surfaces (FSSs) are periodic structures designed on a substrate with metal (usually copper). These metallic structures behave like inductance and capacitance towards incident waves and hence behave as spatial filters. Therefore, an FSS either blocks or passes waves of certain frequencies in free space. Different shapes like a circle, square, cross, hexagon, tripole etc. can be used for FSS fabrication (on the metallic side of a dielectric substrate). Any of these specific shapes are placed periodically a half wavelength from one another (mostly in two dimensions). The wavelength is calculated from the frequency of operation (free space). An FSS can be designed to function as a high-pass, low-pass, band stop or band pass filter.

III. PROPOSED JERUSALEM CROSS PERIODIC STRUCTURE GEOMETRY

In our proposed work, a Jerusalem cross periodic structure is applied to substrate and different patches for minimising the mutual coupling of the micro strip antenna arrays. The corresponding simulation results are obtained with the finite element based on (HFSS). The focusing parameters are length, width and Jerusalem cross spacing in the direction of X and Y. and this results were compared with performance between simulation and experimental results .

IV. JERUSALEM CROSS PERIODIC STRUCTURE

It is depicts a unit cell, its cross periodic structure and array antenna loading by 3 rows of shown in Fig.1 & Fig.2

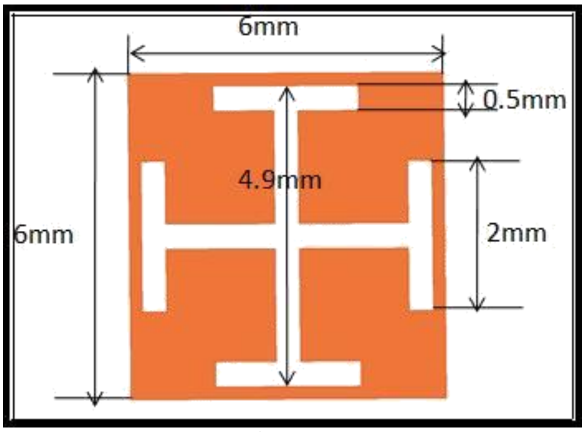

Figure 1: A unit cell of Jerusalem Cross periodic structure

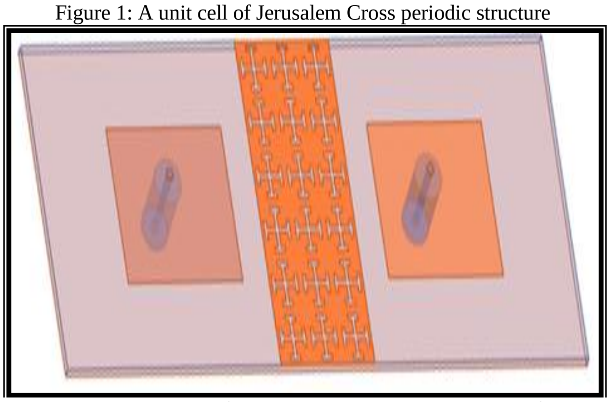
Figure 2. Array antenna of Jerusalem Cross periodic structure for 3 rows

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V. GEOMETRY OF THE ARRAY ANTENNA

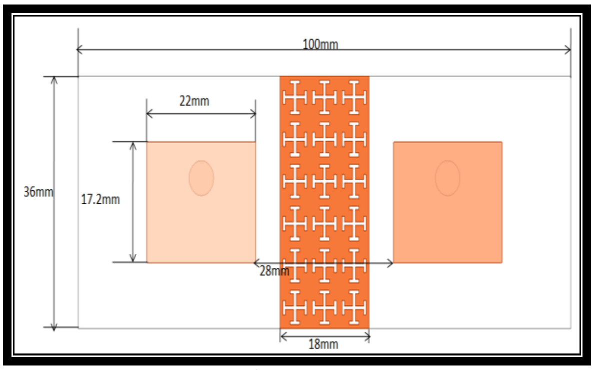

Figure 3: Top view of two coupled micro strip antenna patch

The micro strip array antenna consists of a substrate , substrate's dimension, patch elements. And the distance of the elements, and relative permittivity, shown in Fig. 3. And the above parameters have been simulated for the practical dimensions

VI. RESULTS AND DISCUSSION

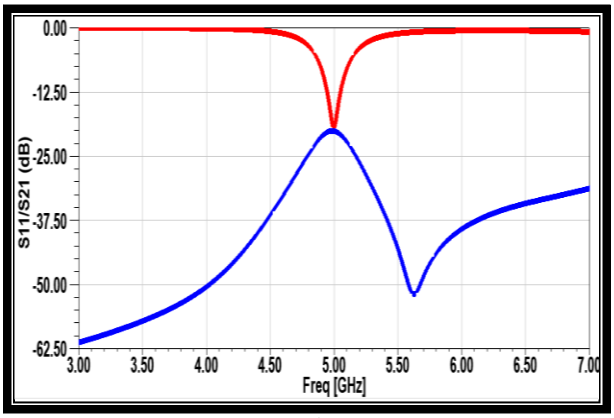

Figure 4: S_{11} Vs S_{12} and frequency without FSS

Conclusion observed from the graph:
The above graph is plotted for S_{21} Vs Frequency without FSS and the value obtained without FSS slot -20.1315dB

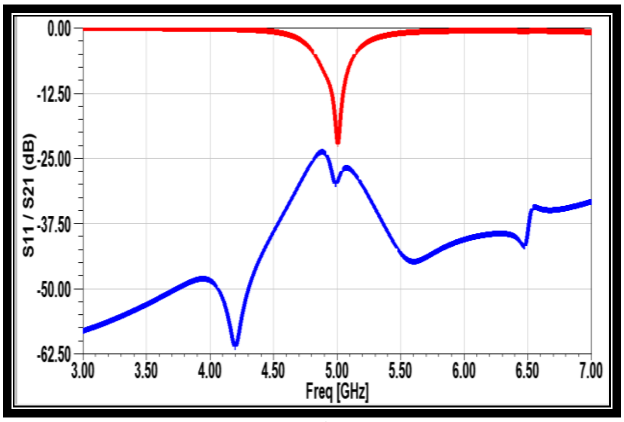

Figure.5 S_{11} Vs $S_{21}$and frequencies with FSS

Conclusion observed from the graph:
The above graph is plotted for S_{21} Vs Frequency with FSS and the value obtained with FSS slot -29.6077dB

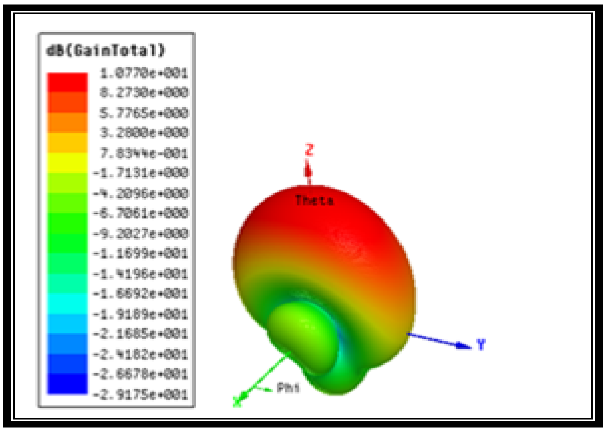

Figure 6: Gain Vs theta and frequency without FSS

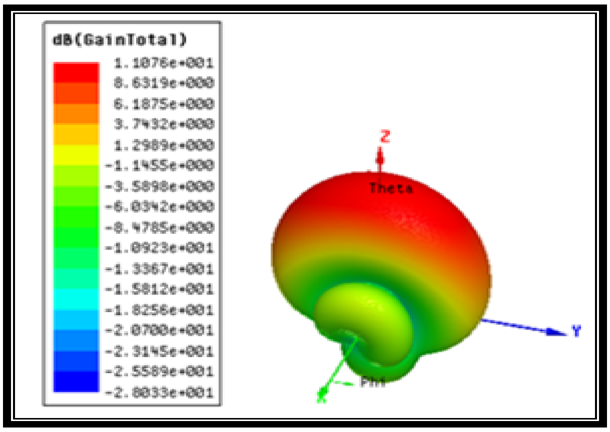

Figure 7: Gain Vs theta and frequency with FSS

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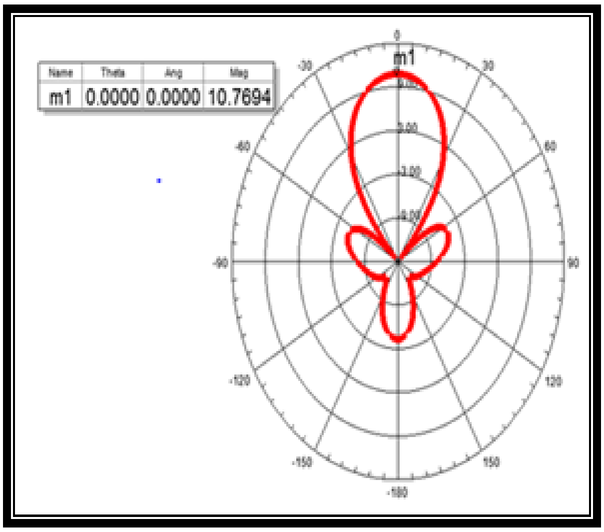


Figure 8: Gain obtained without FSS

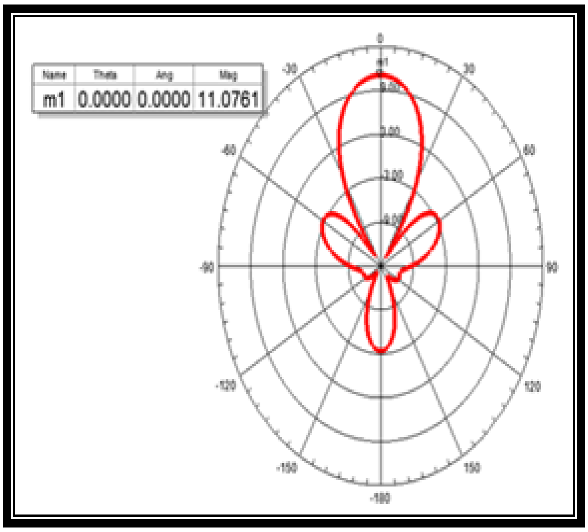
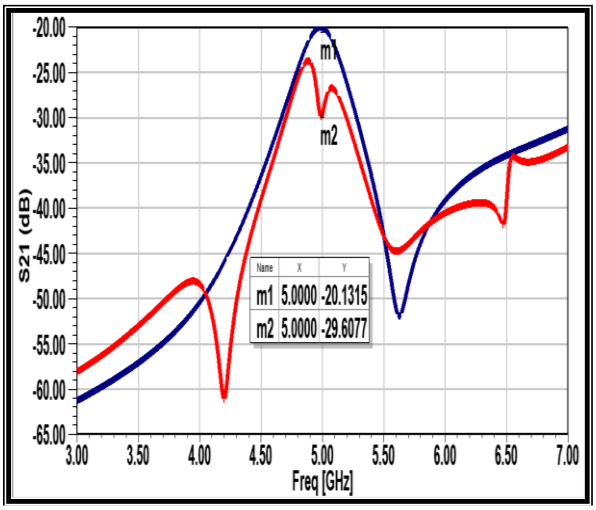


Figure 9: Gain obtained with FSS

5.3 Conclusion observed from the graph:

The above 2D polar plot shows the gain obtained from the without FSS Slot 10.7694dB and with FSS slot 11.0761dB



Figurer 10: Comparison of S_{21} Vs frequency with and without FSS

The above graph is plotted for S_{21} Vs Frequency with and without FSS the value obtained without FSS slot -20.1315dB and with FSS slot -29.6077dB. The mutual coupling is reduced by placing the JCS slot between the two elements of array antenna.

Figure 11: Plot of VSWR with FSS

From the figure 11 and 12 give the information regarding the mutual coupling reduction between the antenna array elements .the details of graphs proved that the unique competence of the proposed structure in reducing mutual coupling between elements of array antenna.

Figure 12: Plot of VSWR without FSS

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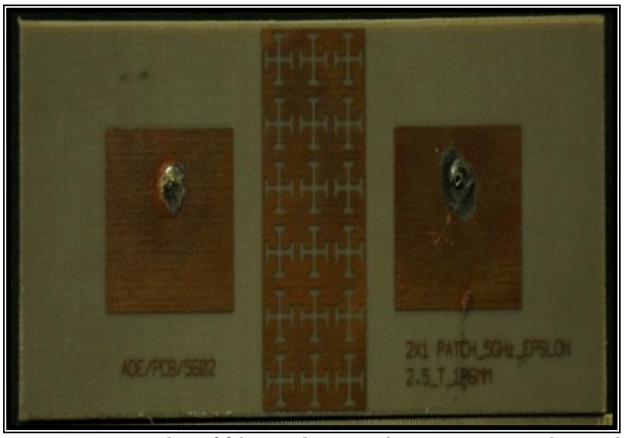

Figure 13: Snapshot of fabricated 1x2 patch antenna array with FSS slot

Figure14: Snapshot of fabricated 1x2 patch antenna array without FSS slot

Table 1: Difference between the simulated and the measured results of the MSPAA designed for Mutual coupling

Simulated result	Measured result
-20.1315dB to-29.0677dB	-21.898dB to -37.913dB

CONCLUSION

It is found from simulation and measured results that the effect of mutual coupling in array is reduced using JCPS as described

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