Design of Compact Frequency Selective Surface

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Abstract: In this paper, a novel compact Frequency Selective Surface (FSS) is designed. The proposed FSS is 95% compact. The FSS is theoretically analyzed by ANSOFT designer Software. There can be numerous applications of this kind of FSS, as it operates in C band. It can be used in fiber optic communication, Satellite Communication, cordless telephone, IEEE 802.11a Wifi,etc.

IndexTerms **- FSS, multi frequency, patch, Method of Moment, Normalized Transmitted Electric Field.**

I. Introduction

FSS is being investigated for the last few decades for its wide range of applications.[1-4]. Two dimensional periodic array of metallic patches on a dielectric sheet or apertures made on a metallic sheet supported by dielectric is called FSS. When a FSS is illuminated by an electromagnetic wave, some part of it is reflected and some part is transmitted. So they behave as frequency filters. The patch type FSS behaves as Band reject filter and the aperture type FSS behaves as Band pass filter. Depending upon the shape of the constituting elements its operating characteristic like resonant frequency, bandwidth, compactness etc. varies.

In this paper, a novel patch type FSS is designed. The FSS is constituted by two dimensional array of patches. Each patch has a rectangular loop slot inside it. The dimensions of the unit cell is shown in Fig.1. The resulting FSS resonates at C band. So the designed FSS can be used in fibre optic communication, Satellite Communication, cordless telephone, IEEE 802.11a, Wifi,etc.

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II. Design of the FSS

The designed FSS consist of two dimensional array of patches. Each patch is of size 10 mm x 15 mm. On each patch, one rectangular loop slot have been cut out. Periodicity is taken 16mm in x direction and 18 mm in y direction. The patches are present on one side of a thin dielectric slab of thickness 0.8mm and copper coating on the other side of the slab is completely removed. The dimensions of each unit cell is shown in Fig.1. and the two dimensional array of patches is shown in Fig. 2.

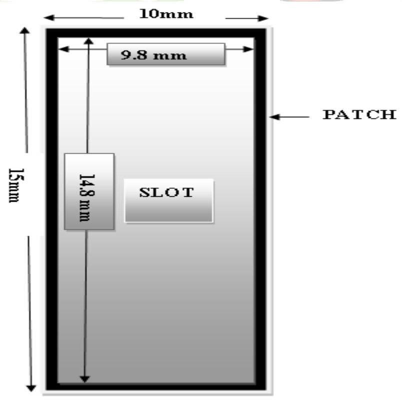

Fig.1 Unit cell (Patch with one rectangular loop slot) under investigation.

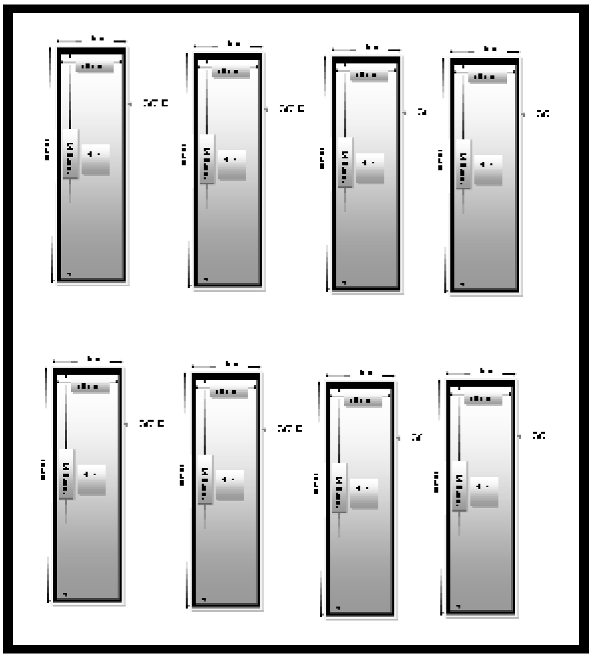

Fig.2 Two dimentional array of Unit cell (Patch with one rectangular loop slot) under investigation.

III. RESULT

The FSS consisting of only Patches and FSS consisting of Patches with rectangular loop slot of different widths are simulated. The best result have been plotted for comparison. This has been shown in the Fig. 3. The comparative plot shows that FSS consisting of rectangular patches without rectangular slot resonates at 12GHz and FSS consisting of rectangular patches with rectangular loop slot resonates at 5.4GHz. So a tremendous reduction in resonant frequency is achieved by cutting a rectangular loop slot inside the patch. The results are also given in Table 1,2,3.

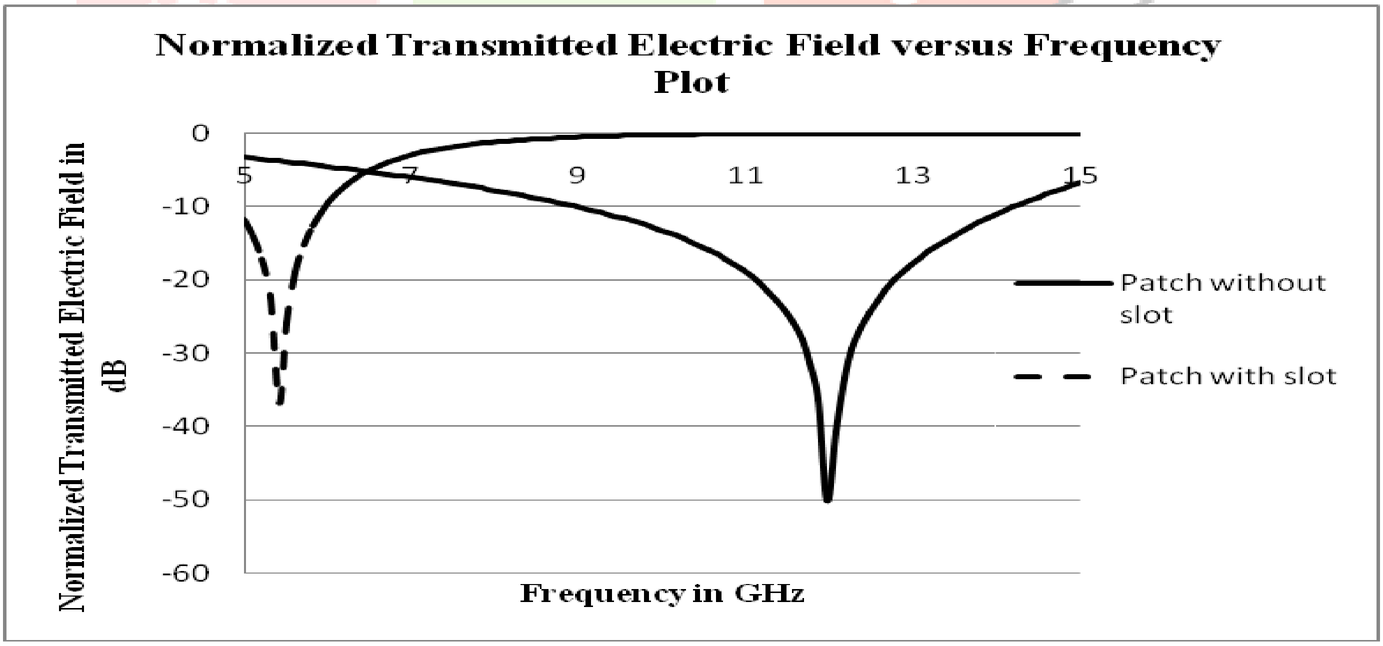

Fig.3. Graph showing comparative plots of FSS consisting of patches without slot and patches with rectangular loop slot.

IV. RESULTS IN TABULAR FORM

Table 1 when patch size is10mm*15mm and periodicity is a=15mm and b=20mm

Table 2 When patch size is 10mm*15mm and aperture size is 9.8mm*14.8mm

Rectangular Slot Size(mm)	Resonant Frequency(GHz)	Gain(dB)
9.8*14.8	5.4	-36.7
9.6*14.6	5.92	-36.12
9*14	6.34	-37.91
8*13	7.18	-56.59
7*12	7.99	-44.64
6*11	8.91	-44.37
5*10	9.91	-54.51
4*8	11.00	-48.58
3*7	11.32	-50.01
2*6	12.37	-50.38

Periodicity Vary(mm)	Resonant Frequency(GHz)	Gain(dB)
A=16 B=18	4.72	-40.60
A=15 B=20	5.64	-41.85
A=13 B=17	5.27	-33.84
A=18 B=16	4.90	-38.34
A=25 B=20	5.35	-27.08
A=27 B=22	5.44	-34.23
A=20 B=25	5.73	-33.24
A=22 B=27	5.71	-35.33
A=25 B=30	5.63	-25.28

Table 3 When periodicity is A=15mm and B=20mm and aperture size is 9.8mm*14.8mm

Patch Size(mm)	Resonant Frequency(GHz)	Gain(dB)
10*15	12.73	-60.50
12*17	13.94	-62.77
5*10	12.28	-36.80
6*10	12.68	-40.17
7*10	13.09	-43.90
8*10	13.59	-55.07
9*10	14.05	-42.84
10*10	14.35	-21.03
9*15	11.92	-61.92
8*15	11.16	-60.12

IV. OBSERVATION

It can be observed from table 1 that, When the slot size is varied (Keeping the patch size and periodicity fixed) and resonant frequencies are observed it is found that as the slot size is increased the resonant frequency reduces to 5.4GHz with 36.7dB Gain. From Table 2,3 it is observed that periodicity and patch size does effect the resonant frequency.

V. CONCLUSION

With the help of the plots and results obtained, It is observed that the designed FSS operates at C band and resonates at a frequency of 5.4GHz. Simulated results shows that patch type FSS without slot resonates at 12 GHz. It is observed with the help of the plot and Table 1, that with the increase in the width of slot, the resonant frequency decreases gradually. It reaches minimum resonant frequency of 4.72 GHz (Table 2) at slot dimension 9.8*14.8. Here size reduction obtained is approximately 95% percent. So a compact Frequency Selective Surface is designed.

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