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Multi-Resonant Antennas for Modern Communication

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Abstract: The multi-resonant antennas are game-changing concepts in the communication field. A multi-frequency antenna designed for the frequencies 3.1 GHz (IMT services),5.1GHz(Wi-Fi) and 7.2GHz(fixed link PMSE applications) is designed using a split-ring resonator(SRR) using FR4(ε_r=4.4) epoxy substrate material. The antenna has 5.52 dB gain and it can be used for multiple applications from vehicle telemetry in autonomous and semi-autonomous vehicles to wireless communications in the medical field.

***Index Terms* – Antenna, Multi-Resonant, Wi-Fi, FR4 Epoxy, Communication**

I. Introduction

The 5G is the future of communication, its most advanced commutation ever built. The advancement of any communication system is defined by the number of services it could provide and the maximum data rate. With different services there comes the need for different frequency bands to avoid overlapping. Modern devices also come with many services and require multiple operating frequencies. But it would be a waste of resources to use multiple antennas on a single device. It also leads to an increase in the size of the devices. This problem can be solved using multi-resonant antennas. Multi-resonant antennas are capable of resonating at multiple operating frequencies. These multi-frequency antennas can be used to enhance the modern communication system by allowing the device to be compact and saving resources.

It's hard to design the antenna for multi-frequency using a regular rectangular shape. But by using split-ring resonators it can be achieved with less effort. Split ring resonators can be custom-tailored to any required frequency very easily, but the antenna designed only with the split ring resonators doesn't have the required level of S11 and gain. To increase the radiation efficiency and gain its always preferred to use the coplanar waveguide (or CPW) configuration..

II. Methodology

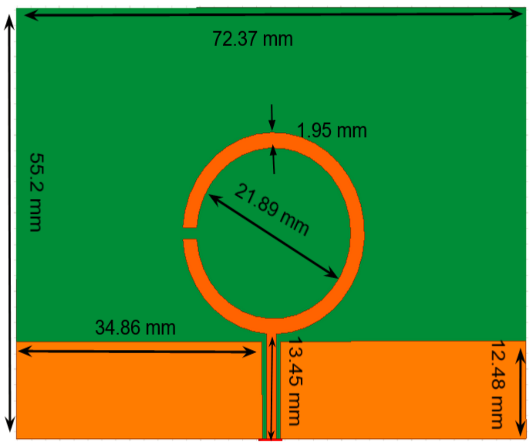

Fig.1 Antenna Layout

The multi-resonant antenna is modelled and simulated using HFSS v15 software. The FR4 epoxy is used as the substrate material, the substrate has a length and width of 72.37 mm x 55.2 mm respectively as in fig 1. The SRR has an inner radius of 21.89 mm with a width of 1.95mm. The ground structure has a length of 34.86mm and a width of 12.48 mm, the feed line has a length of 13.45 mm. The dimensions of the antennas are tabulated in the table 1.

Table 1 Dimensions

Parameters	Values
Substrate length	72.37 mm
Substrate width	52.2 mm
Height of substrate	1.6 mm
The inner radius of SRR	21.89 mm
Width of SRR	1.95 mm
Length of ground	34.86 mm
Width of ground	12.48 mm
Length of the feed line	13.45 mm

III. RESULTS

The antenna has three operating frequencies as shown in the graph fig 2 with the gain of 5.56dB as shown in the fig 3, the three frequencies are 3.48GHz, 5.14GHz & 7.4GHz respectively. The first frequency 3.48GHz has a return loss of -17.7373 dB, the second frequency 5.14GHz has a return loss of -19.5859dB and the third frequency 7.4GHz has a return loss of -23.3458dB the results are tabulated in the table 2. This antenna supports communication services such as 3.1 GHz (IMT services), 5.1GHz(Wi-Fi) and 7.2GHz(fixed link PMSE applications).

Fig.2 Return Loss

Table 2 Antenna Results

SL	Frequency in GHz	S11 in dB
1	3.4837	-17.7373
2	5.1479	-19.5859
3	7.4336	-23.3458

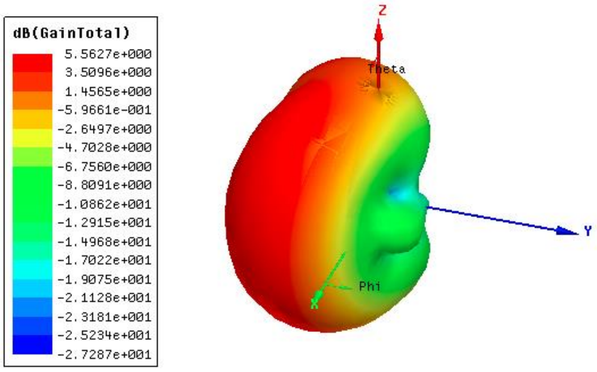

Fig.3 Gain plot

IV. Conclusion

The designed antenna supports major communication services such as 3.1 GHz (IMT services), 5.1GHz(Wi-Fi) and 7.2GHz(fixed link PMSE applications). it's suitable for the machine to machine communication and semi-autonomous and fully autonomous vehicles. In the future it the antenna performance can be improved with the aid of metamaterial structures.

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