Design and Analysis of a Tri-band Notch UWB Monopole Antenna

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Abstract:

This paper introduce the Monopole ultra-wideband antenna with tri-band-notched characteristics etched Complementary split ring resonator(CSRR) structure and return type slot, and by turning the size of CSRR, it's easily achieved tri-band-notched characteristics. In wireless communication system, antenna has especially importance ,also for the development of UWB systems, the research of UWB antennas has the extremely crucial sign order to avoid the interference of service that work in the UWB . It is necessary to design the UWB antennas with band-notched characteristics. Tri band-notched function in ultra-wideband is achieved by corrosion a CSRR structure on the circle radiating patch and embed slot in the feed line. The simulation result shows that the antenna gain and radiation efficiency significantly decrease over these tri-band-notched frequency sets.

I.Introduction:

Ultra wideband is a radio technology that can be used at very low energy levels, reduced fading from multipath, and low power requirements for short range high-bandwidth communications While Ultra Wideband technology may represent a revolutionary approach to wireless communication at present, it certainly is not a new concept. The first UWB radio, by definition, was the pulse-based Spark Gap radio, developed by Guglielmo Marconi in the late 1800's. This radio system was used for several decades to transmit Morse code through the airwaves. In recent year ultra wide band (UWB) communication system becomes popular among the researchers after the allocation of commercial UWB frequency band of 3.1–10.6 GHz by federal communication commission (FCC).

UWB has traditional applications in non-cooperative radar imaging. Most recent applications target sensor data collection, precision locating and tracking applications. Unlike spread spectrum, UWB transmits in a manner that does not interfere with conventional narrowband and carrier wave transmission in the same frequency band. Ultra-wideband is a technology for transmitting information spread over a large bandwidth (greater than 500MHz); this should, in theory and under the right circumstances, be able to share spectrum with other users.

There are many methods used for notch filter in UWB antenna. Some of them notched band antennas are in circular notch antenna, with fractal tuning stub and ground slot plane with this type of structure one can achieve the notch filer. Rather using some C, H, and L shaped slots ,one can use complementary split ring resonator (CSRR), complementary spiral loop resonator (CSLR) and in addition of parasitic elements for notch band filter design. By adjusting the slot dimensions resonance frequency is achieved. These methods are not useful to avoid lower WLAN frequency successfully. The above methods can change the antenna design and its characteristics. In the basic design, a complementary split ring resonator (CSRR) metamaterial was used as a patch that was followed by a feed line and a short ground in the back. The basic idea behind it is that due to the coupling effect, the radiating element of the antenna is sensitive to the presence of the CSRR.

II Geometry:

The configuration of the proposed antenna is illustrated in Fig. 1. It can be seen that the proposed tri-band-notched antenna is comprised of two circles in the surface of the substrate and a slot in the feed line. The proposed antenna is printed on a FR4 substrate whose permittivity is 2.65 and its thickness of 1 mm. The proposed antenna is optimized by using CST and the slot structure in shown in Fig.1. The dimensions are L = 23 mm, w = 2.8 mm, H = 30 mm, h1 = 9 mm, h2 = 0.9 mm, R = 10 mm, R1 = 4.9 mm, R2 = 4.5 mm, R3 = 3.5 mm, R4 = 2.9 mm, L1 = 2 mm, L2 = 1 mm, L3 = 4.5 mm, D = 0.2 mm.

III Simulation Results:

The proposed antenna simulation has been carried out in CST microwave studio.

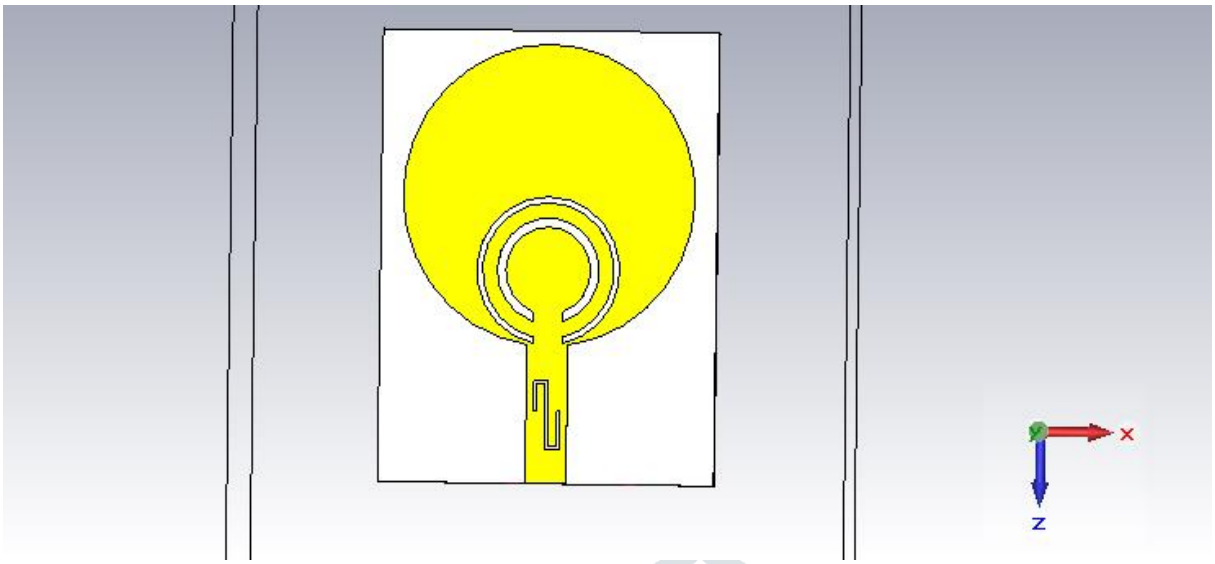

Fig 1: Designed Antenna

Here, *S*-parameters, radiation patterns are investigated by using the CST.

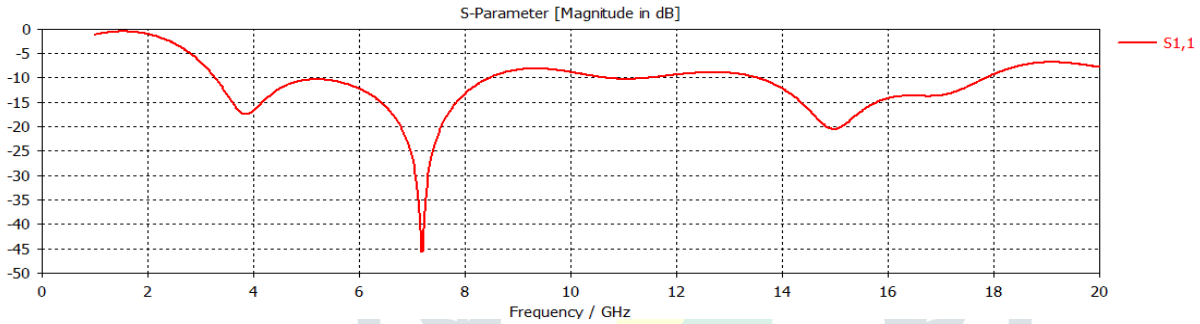

Fig 2: S_{11} parameters of antenna with out CSRR and feed line slot.

The *S*-parameter of the proposed antenna is shown in Fig. 2 and Fig 3 without and with of the CSRR and slot structure. The CST-predicted tri-band notches cover the bands: 4.1–4.9 GHz, 6.9–7.1 GHz and 11.9–12.3 GHz. As shown in Fig. 2. The antenna gain and radiation efficiency significantly decrease over these tri-band-notched frequency sets. By using the CSRR and slot structures, the proposed antenna can highly reduce the interference of service that work in the UWB band such as RADIO and TELEVISION (6.9 -7.1 GHz) and Broadcast satellite communication system (11.9 - 12.3 GHz) application.

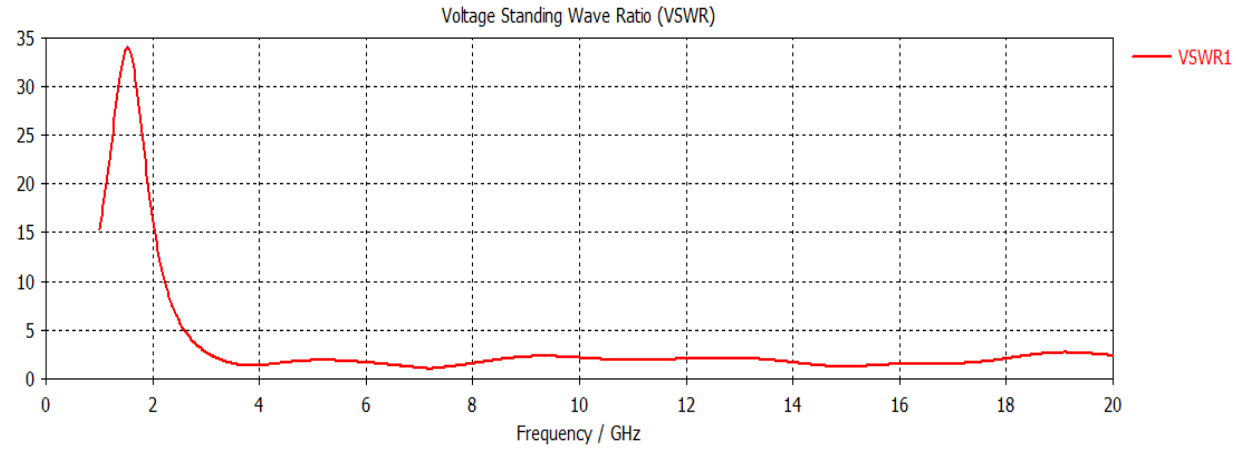

Fig 3 VSWR with out CSRR and feed line slot.

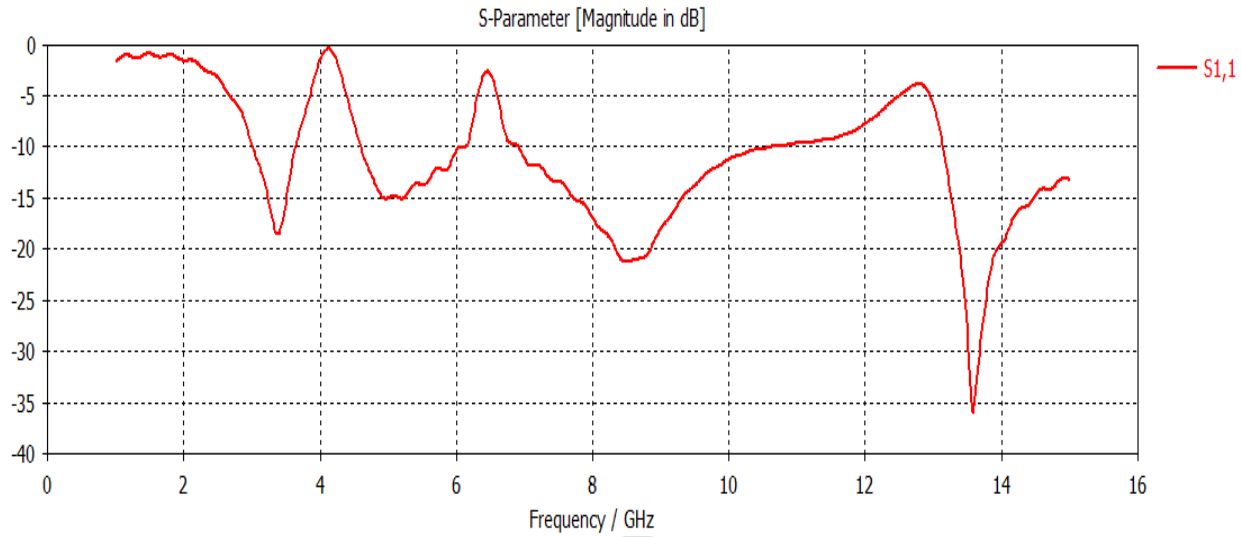

Fig 4: S_{11} parameters of antenna with CSRR and slot.

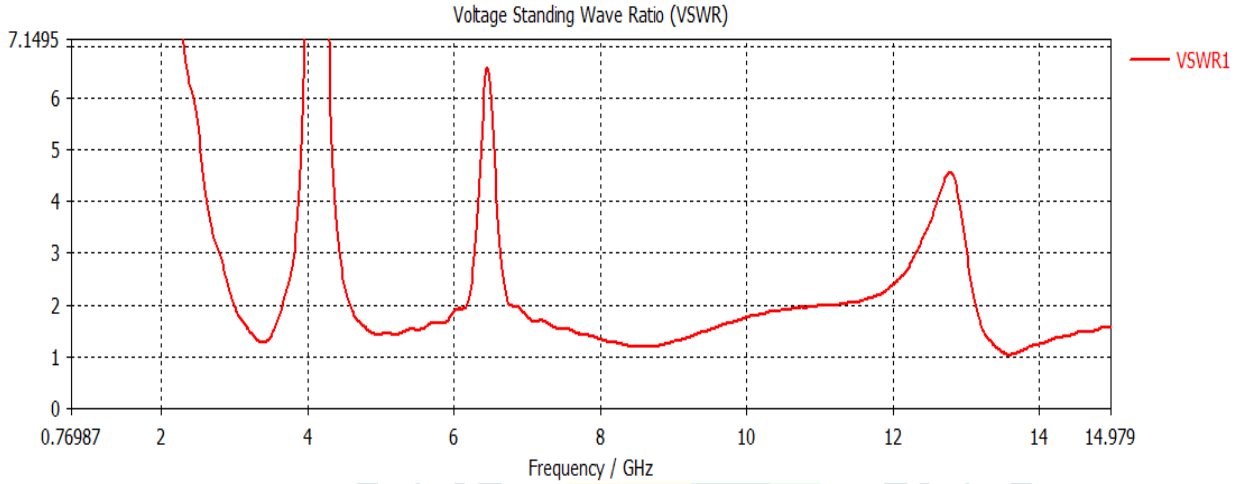

Fig 5 : VSWR with CSRR and line slot.

In Fig 6 and Fig 7 the simulated radiation patterns with out and with CSRR and feed line slot have been shown with the frequencies .

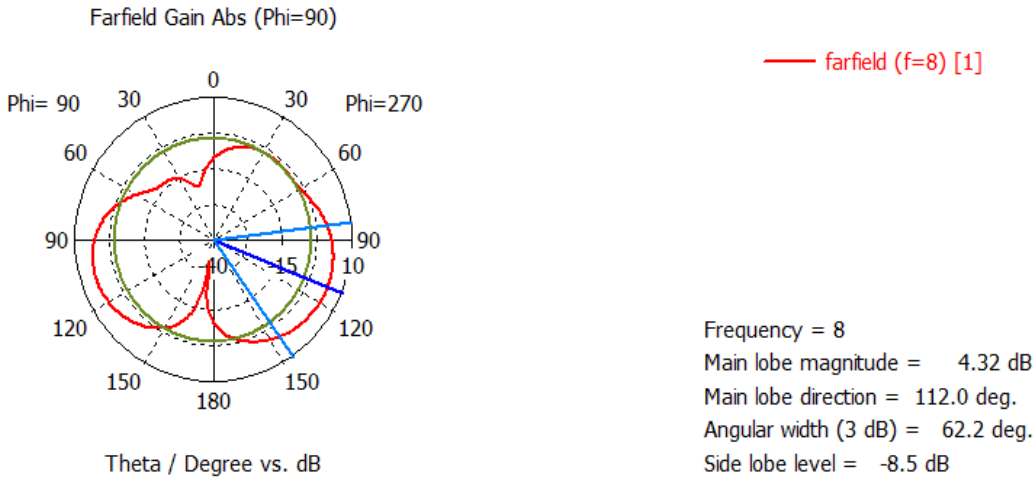

Fig 6 :CST simulated radiation patterns with out CSRR and feed line slot.

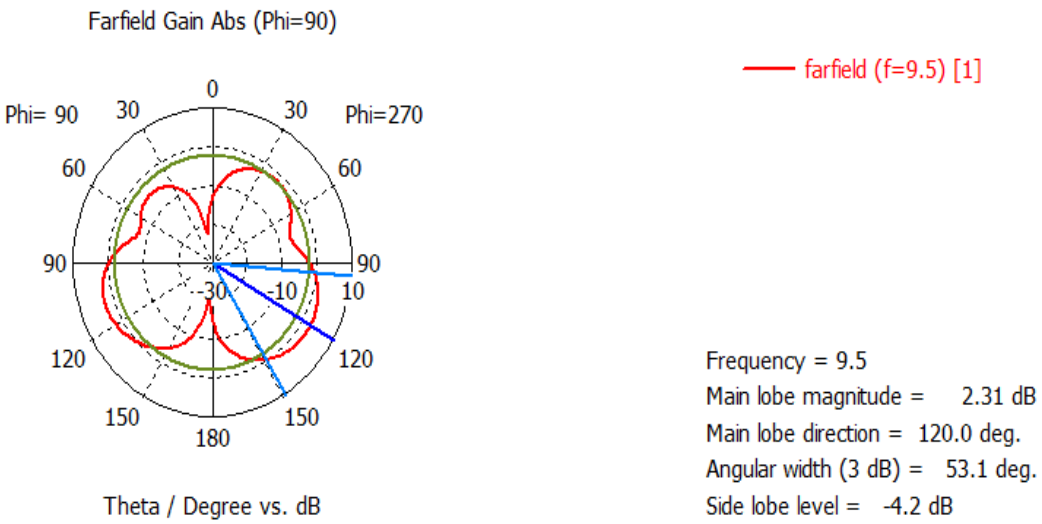

Fig 7: CST simulated radiation patterns with CSRR and feed line slot

IV Conclusion:

A novel ultra-wideband (UWB) antenna with tri-band-notched characteristics operating at 3.5 GHz has been proposed and its performance has been investigated by using CST. The tri-band-notched characteristics is achieved by etch a slot in feed line and CSRR. Tri-band notches cover the bands: 4.1–4.9 GHz, 6.9–7.1 GHz and 11.9–12.3 GHz, has been successfully achieved in comparison with the antenna without slot and CSRR. The proposed antenna can be used for communication applications.

V References:

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