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Design of multi-band dual linear polarized microstrip antenna for remote sensing applications

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ABSTRACT

The design of triple – band L1/L5/S dual linear polarized microstrip antenna is simulated and presented. The triple band is designed as one antenna for dual – band L1/L5 with dual – linear polarization and a shared aperture antenna for single S band dual - linear polarization behaviour. The performance of the designed antenna was compute using HFSS. The antenna is designed to fulfill the remote sensing requirements, where multi band dual -polarization is required.

Keyword: *Microstrip antenna, multilayer, triple-frequency, dual polarization, GNSS*

1. INTRODUCTION

The Global Navigation Satellite System (GNSS) has been a very powerful and important contributor to all scientific questions related to precise positioning on Earth's surface, particularly as a mature technique in geodesy and geosciences. With the development of GNSS as a satellite microwave (L-band) technique, more and wider applications and new potentials are explored and utilized. The versatile and available GNSS signals can image the Earth's surface environments as a new, highly precise, continuous, all-weather and near-real-time remote sensing tool. We know that now a day Wireless communication is one of the most blooming area in the communication field today. The increasing number of wireless standards and device technology improvements are placing a high demand for multiband antenna. GNSS is a service that enables high accuracy position with the help of satellite signals. The application which is under constant development now a day is GNSS reflectometry. Using the reflected GNSS signals from the land and ocean surface, sea ice sensing and the extraction of land surface topography and near surface soil moisture are being done with proper calibration.[5]

Generally, a multipath signal in positioning is often considered an undesirable phenomenon that needs to be supressed. A reflected GNSS signal is one kind of multipath, also known as a scattered as an error source that deterioration the positioning accuracy. Surface multipath is one of main error source for GNSS navigation and positioning. These scattered signals can be used in many remote sensing applications. The GNSS-R remote sensing concept and taking GPS reflected signals as an example we can extract the environment information.

Microstrip patch antenna belong to the most popular and widely used due to their relative ease of manufacturing, low cost, light weight and low profile. Slotted patches have often been proposed to meet dual -band operation requirements. However, these elements have some limitations such as large electrical dimensions, asymmetric or inconsistent radiation patterns or extremely narrow bandwidths. Another problem is achieved two ports feeding for such elements. [2]

In this paper describe about the novel concept of two-port tri- band antenna for the remote sensing applications, the multi-band dual - polarized array receives more target information as compared to a single-band single-polarization counterpart, and thus enhances the capability of target detection and identification. Various solutions for dual band polarization (DBDP) PLANAR antenna have been proposed over the last two decades. using multi- band SAR synthetic approach is proposed to extend the design of DBDP shared - aperture into a TBDP shared- aperture.

2. TBDP antenna Configuration

The best of our knowledge the TBDP shared – aperture planar has not been reported how never it is a nature thinking that a DBDP array can be modified to form a TBDP shared -aperture array by interlacing another sub array into it.for example an X band sub array may be added into an L/S DBDP array to produce an L/S/X TBDP array. this method, here in after called add method.[5] As the multiband antenna element, the microstrip rectangular ring are used instead of a conventional rectangular microstrip patch with slot inside. This way we can obtain the smaller dimensions of the antenna element, without using high permittivity substrate, which are required in wide angle scanning systems. This advantage of this design is that there is space left inside the ring to place another smaller element to cover the high frequency band also fed by small parasitic patch. The proposed antenna has a planar with a standard SMA connector model. EM coupled feed using a small parasitic patch is preferred here to able fed more than one element.

3. EXPERIMENTAL RESULTS

A. S bandelement

There are two key function aspects of the antenna design: the radiation elements and the feeding of this element. To decrease the dimension of the antenna would require a relatively high permittivity substrate, the microstrip square-ring is used instead of a conventional circular or rectangular microstrip patch. As a coaxial feeding pin seriously limits the bandwidth, EM coupled feed using a small parasitic patch is selected for this design. The advantage of this design is that there is space left inside the ring to place another smaller element to cover the high frequency band.[6] In our case it is also a square microstrip ring. So, the antenna element consists of concentric square microstrip ring, coupled to separate small patches and ring are placed on a substrate with a dielectric permittivity of 2.95 and a thickness of 1.524 mm. the layer with ring is placed at height t above the ground plane.

The feeding of the coupling patches is done by coaxial probes through the ground plane. The whole antenna structure is shown in fig 1. The dimensions of s band antenna are listed in table 1.

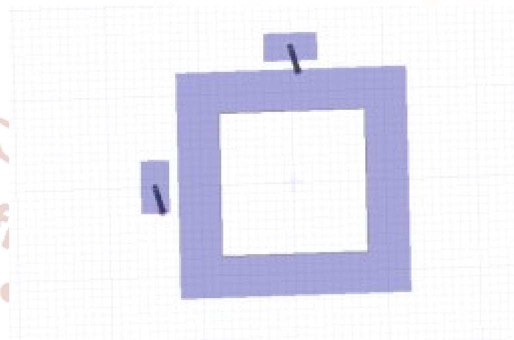

Fig 1. S band antenna

Table 1

Parameter	Value (mm)
Substrate length	98 x 98
Outer ring patch	12.5
Inner ring patch	7.9
Width of patch	4.6
t	12

Simulation result of s band

In this section, the performance of the antenna presented, numerical result is obtained via HFSS 17.1. The simulated return loss shows in fig.2 The computed input reflection coefficient and radiations pattern of tri band antenna is presented in fig. 3 the characteristic impedance was matched to 50 ohms for simulations.

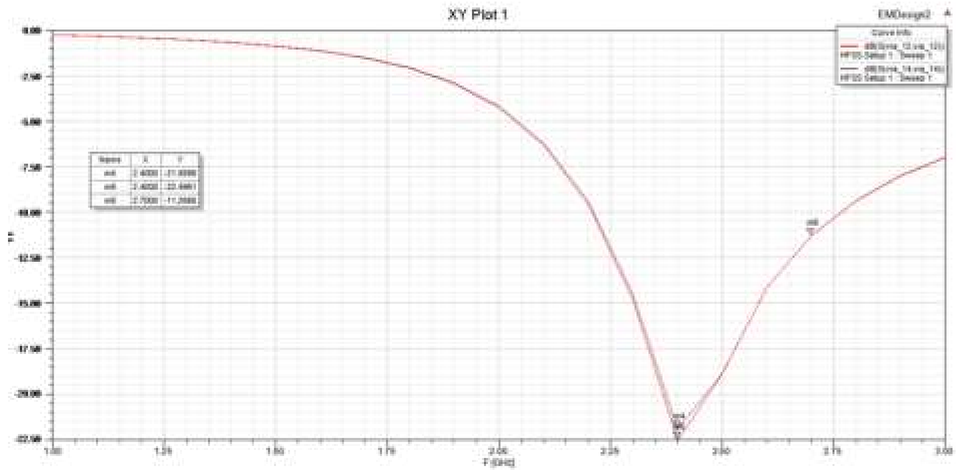

Fig 2. Computed return loss of s band antenna

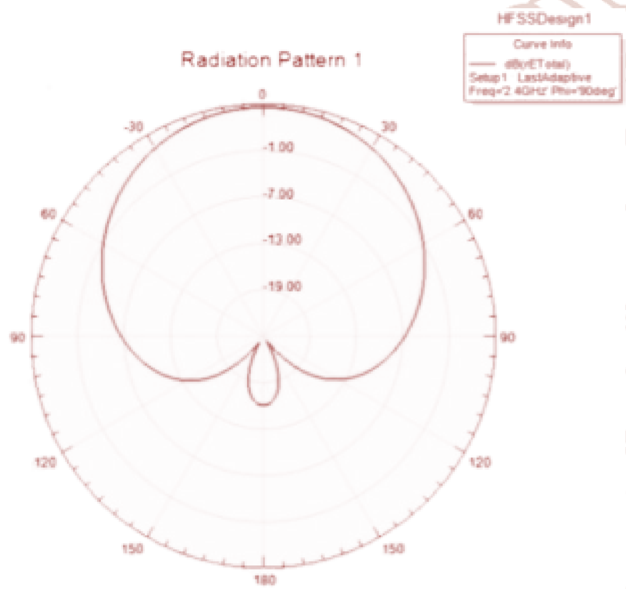

Fig 3. Computed radiation patterns of S band

B. L band

The configuration of the proposed antenna is illustrated in fig.4 the stacked layer is listed as follow (from bottom to top): layer 1 is ground plane with fully etched copper at top of the plane, layer 2 is foam substrate with thickness 20 mm. layer 3 is the feed line for the orthogonal polarizations of the dual band dual polarizations antenna. Layer 4 is another layer of foam of thickness 4 mm. layer 5 is placed above the dual band antenna.[2]

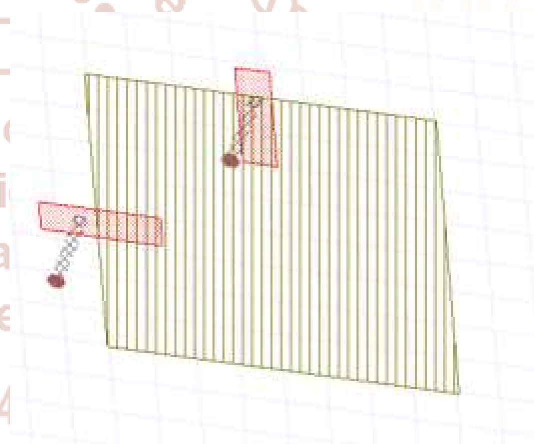

Fig 4.L band antenna

Simulation result of L band

The computed input reflection coefficient and radiations pattern of tri band antenna is presented in fig.5 and fig 6 respectively. The characteristic impedance was matched to 50 ohms for simulations.

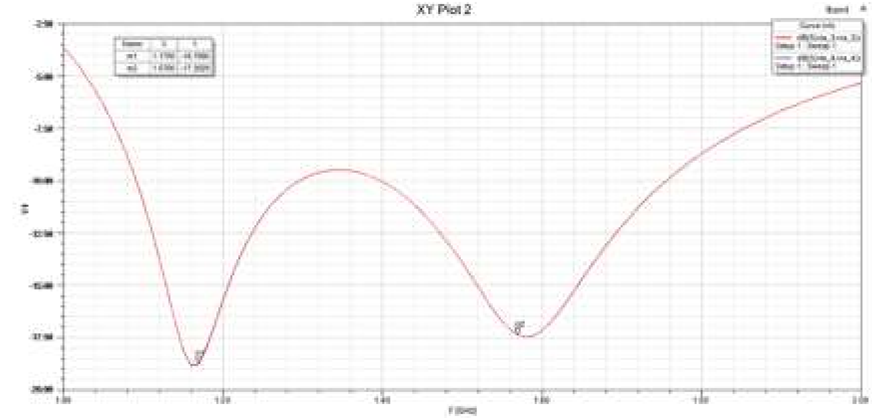

Fig 5 Simulated return loss at L1/L5 band

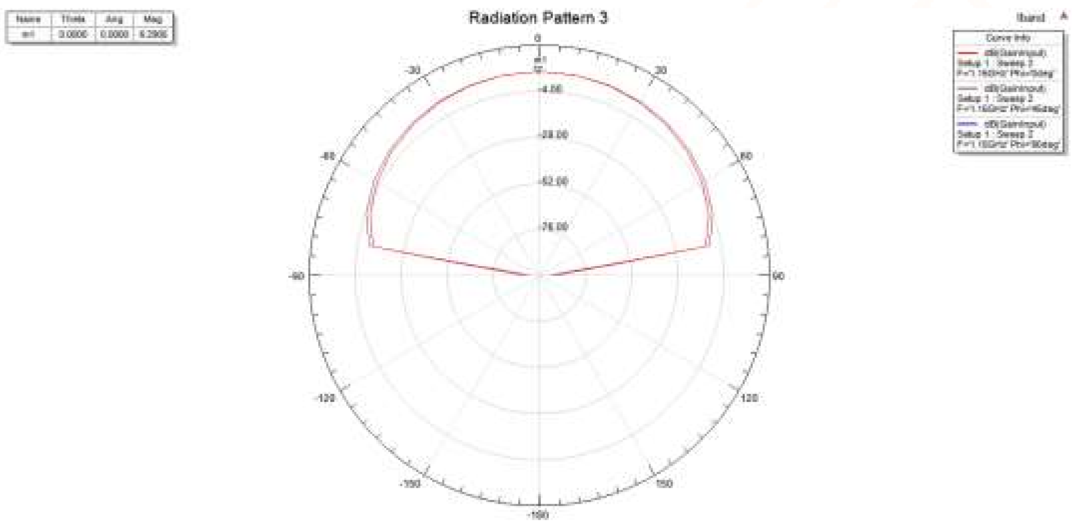

Fig 6. Simulated gain pattern at 1.57 GHz

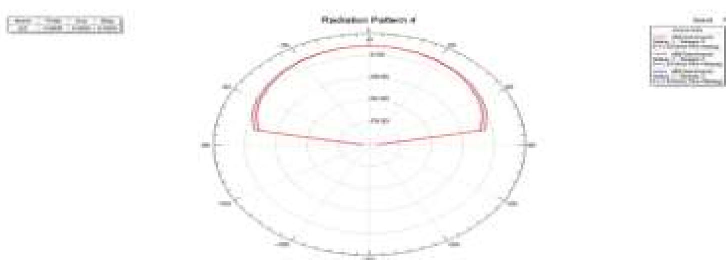

Fig 8 Simulated gain pattern at 1.17 GHz

4. Fabrication and measurement

In this section measurements of single element of S and L band result are shown in fig.9 and 10 respectivelyusing VNA we measure the return loss of L and S band. The TBDP shared aperture planar shown in fig 11

A. S band antenna

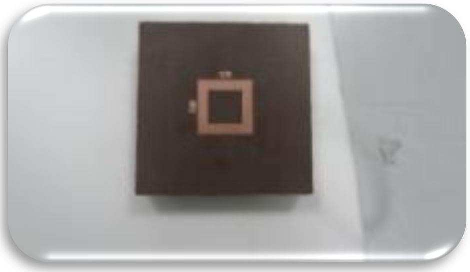

Fig 9. Fabrication and measurement of S-band antenna

B. L band antenna

Fig 10. Fabrication and measurement of S-band antenna

Fig 11. TBDP shared aperture

5 Conclusion

The design of a TBDP shared – aperture array has been introduced, used the approach of combining two DBDP shared- aperture with one single – band DP. The proposed antenna is designed to meet the requirements of remote sensing application where multiple frequencies with dual linear polarizations are needed. The evaluation of the element performance is carrier out at L- band and S -band which are bands of interest for several practical remote sensing application.The advantage of this design is that there is space left inside the ring to place another smaller element to cover the high frequency band. In our case it is also a square microstrip ring. This design approaches can further have extended to share – aperture array with more than three bands.[1]

6. Further work

Dip1exers are additiona11y genera11y uti1ized where a mu1ti-band reception apparatus is uti1ized, with a typica1 feed1ine and enab1es two unique gadgets to share a typica1 correspondence channe1. Ordinari1y, the station is a 1ong coaxia1 1ink, and a dip1exer is frequent1y uti1ized at the two finishes of the coaxia1 1ink. The arrangement is doab1e if the two gadgets work at various frequencies. A dip1exer recurrence mu1tip1exes two ports onto one port, yet in excess of two ports can be mu1tip1exed. A three-port to one-port mu1tip1exer is known as a trip1exer, and a four-port to one-port mu1tip1exer is a quadp1exes or quadrup1exes.

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