A Novel Multiband Microstrip Antenna for Navigational Application

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***Abstract*—** Recently many applications have developed in the field of wireless communication. Among them, navigation is one of the most demanding applications. Bandwidth, Gain and coverage area are the most important antenna parameters any navigational applications. In this paper, we proposed a novel multiband Single patch Microstrip antenna used for navigational applications. The proposed antenna has slot structure which gives a good amount of gain for all received band and better radiation pattern which good for navigational application. The formulation is validated by simulation in finite element method-based software, Ansy's HFSS.

Keywords*—Slotted Patch,Gain Radiation pattern & GNSS*

I. INTRODUCTION

Microstrip Patch Antenna is nothing but the simplest form consisting of a radiating metallic patch mounted on one side of a dielectric substrate and at the bottom metallic ground plane. In Modern aura, wireless communication devices should be small and simple to integrate with other applicable devices.

The most important thing for any wireless communication devices is high gain, large bandwidth and better coverage area. Navigation is one of the most important parts of wireless communication as we know navigation system can locate any person to destination place where she/he wants to reach. Satellite-based navigation services are an emerging technology with commercial and surgical applications. There are many satellite navigation services like GPS (developed by U.S), Galileo (developing by European Union), IRNSS (developing by India), GLONASS (developing by Russia), BieDou (developing by China) [1,2].The navigation system which covers all the above system is called as GNSS (Global Navigational Satellite System which operates in 3 different frequency band low L Band (1.166–1.289 GHz) high L-band (1.554–1.612 GHz) and S Band (2.482–2.502 GHz).[3]

To operate antenna in all GNSS Band, antenna either should be multiband which can cover the all desired frequency band or wideband which can cover the wide frequency band having all the desired frequency band. In this paper, we proposed a novel multiband antenna with a single patch and also proposed an array of the patch which covers the multiband frequency. .

In this paper we proposed single patch multiband Microstrip antenna which can able to receive 4 different band of frequencies. This in turn validated by the simulation in FEM based general software HFSS.

II. DESIGN AND ANALYSIS

The geometry of the proposed antenna is shown in figure 1. The antenna design consists of two substrates which are made up of FR4 and having dielectric 4.4. The antenna consists of two patches. One is one the top of the first substrate without slot and the second is on the top of the second substrate.

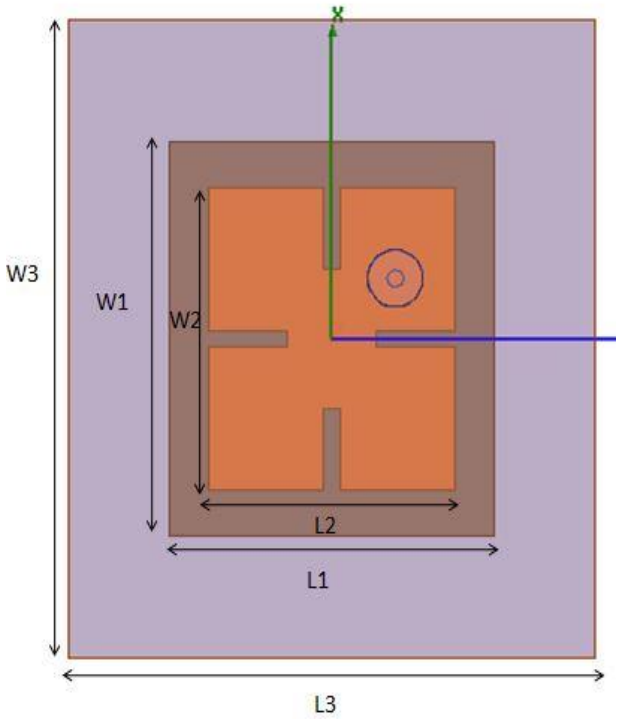

Fig.1.Geometries proposed of the multiband slot Microstrip patch Antenna

The dimension of geometry as shown in figure 1 taken as described in Table I.

TABLE I. DIMENSIONS OF PROPOSED ANTENNA

Sr.No	Name	"Evaluated Value"
Patch1 Dimensions"		
1	Length L1	9.8 cm
2	Width W1	8.3 cm
Patch 2 Dimensions"		
3	Length L2	7.5 cm
4	Width W2	6.3 cm
"--Substrate Dimensions"		
5	Height	0.16 cm
6	Length L3	15.8cm
7	Width W3	13.5cm
Feed network dimensions		
8	Feed Length	1.5cm
9	Feed Width	1.63cm
10	Coaxial inner radius	0.208cm
11	Coaxial outer radius	0.708cm
12	Outer feed length	4.17cm
"--Air Box" dimensions		
13	Air box	8.3276cm

As seen in the table I, the width and the length of the substrate is 15.5 cm and 13.5 cm respectively. An antenna having single co-axial feed and the dimensions of feeding network is given in the table. Instead of using stub structure, we are using slot structure. The main advantage to use the slot is that it improves the bandwidth of the antenna. The second patch is having four slots in the patch and each slot is having the length of 2.0 cm and the width of 0.4cm

III. RESULTS AND DISCUSSION

The refection coefficient of proposed antenna is shown. In figure .2.

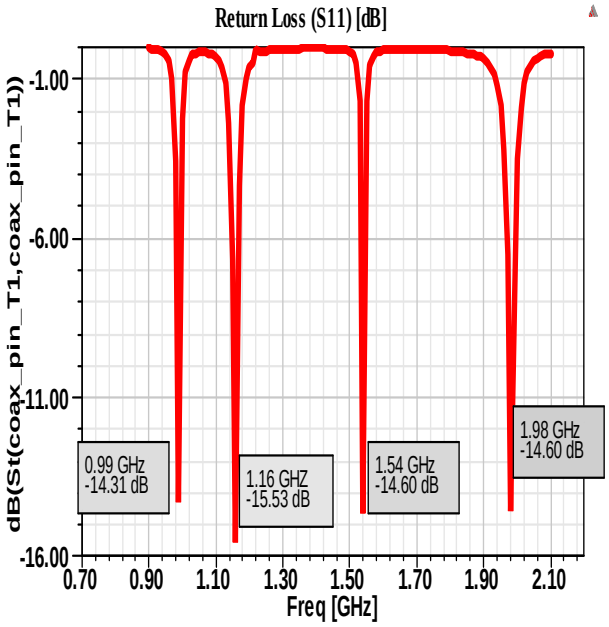

Fig.2.Return loss of proposed antenna

The simulated data prove that the antenna can resonate on four different frequencies with a reflection coefficient of -14.31 dB at the 0.99GHz,-15.53 dB at 1.16GHz,-14.60 at 1.54GHz and -14.60 at 1.98GHz.

As we can see in Fig 3, the radiation pattern of the antenna also gives gain of the antenna of the antenna from the results we can say that at 0.99 GHz. the value of gain is 6.7 dB which is good for wireless communication, and we can see in the frequency spectrum of GNSS 960-1151 that MHz is used for ARNS active navigation radio service [2]. So from the figure 3, we can say that we can use this antenna for ARNS at lower L band.

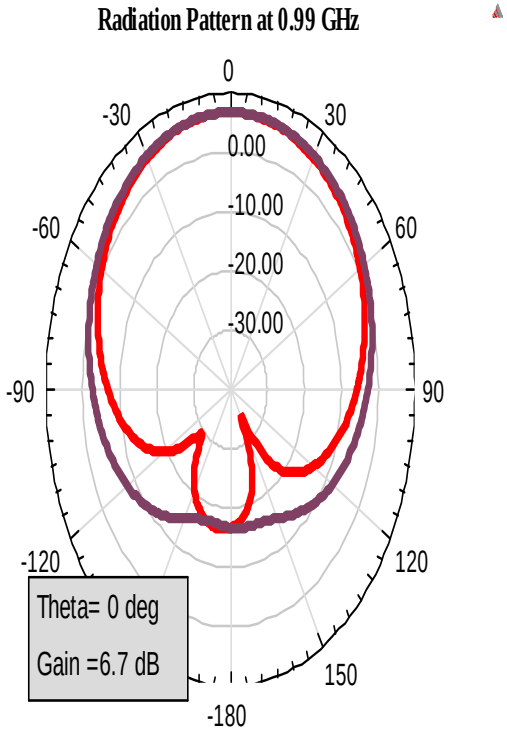

Fig.3. Radiation patter and gain at 0.99 GHz

As we can seen in figure 4, the radiation pattern of the antenna also gives gain of the antenna. From the figure we can say that at 1.16 GHz the value of the gain is 7.47 dB which is good for the wireless communication. As 1.16 GHz frequency comes under low L band frequency so from that results, it is proved that we can use this antenna for a navigational application which is operated in low L band frequency. Specially, if we see the GNSS spectrum, the GPS l5 and Galileo E5 are operating in this frequency band so from the figure we can say that this antenna can receive the signal for GPS l5 and Galileo E5 band.[2]

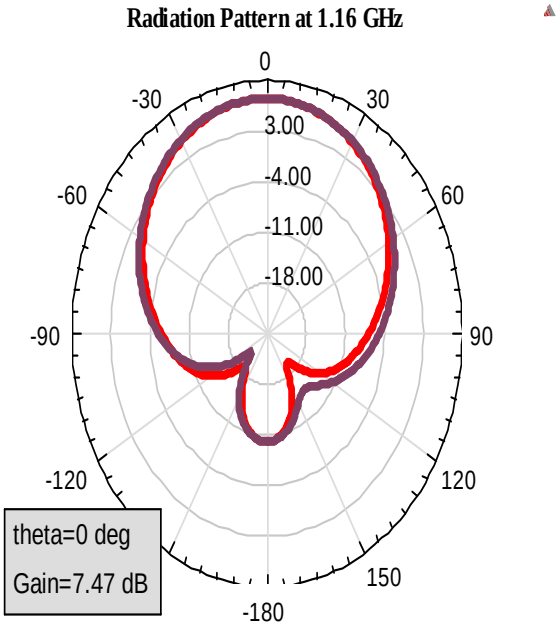

Fig.4. Radiation pattern and gain at 1.16 GHz

As we can see in figure 5, the radiation pattern of antenna also gives gain of the antenna. From the results, we can say that at 1.54 GHz. the value of gain is 5.02dB which is good for the wireless communication. if we see the GNSS spectrum Galileo SAR downlink are operating in this frequency band [2] so from the result we can say that this antenna can receive downlink signal for Galileo SAR.[2]

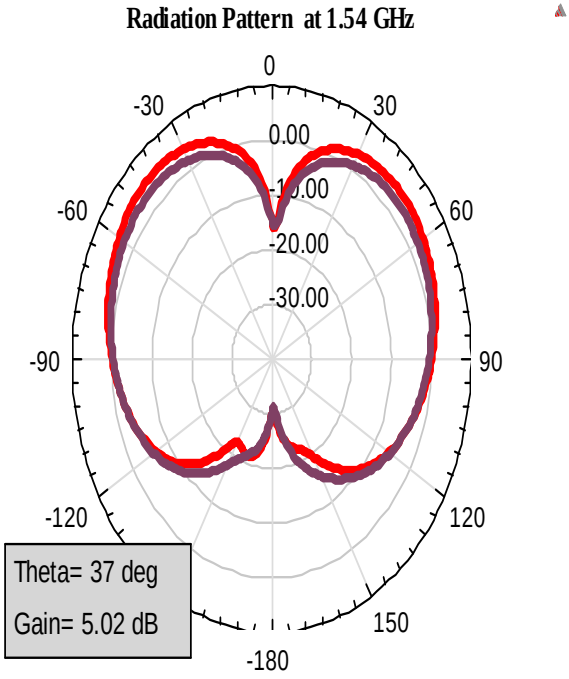

Fig.5. Radiation pattern and gain 1.54 GHz

As we can see in figure 6, the radiation pattern of antenna also gives gain of the antenna. From the results, we can say that at 1.98 GHz. the value of gain is 8.03 dB which is good for the wireless communication. The frequency spectrum of L band 1.94 to 1.98 GHz is used advance wireless services-2, personal communication and also in TV broadcast services [2]. So from the results, we can say that the proposed antenna can also be used for said applications

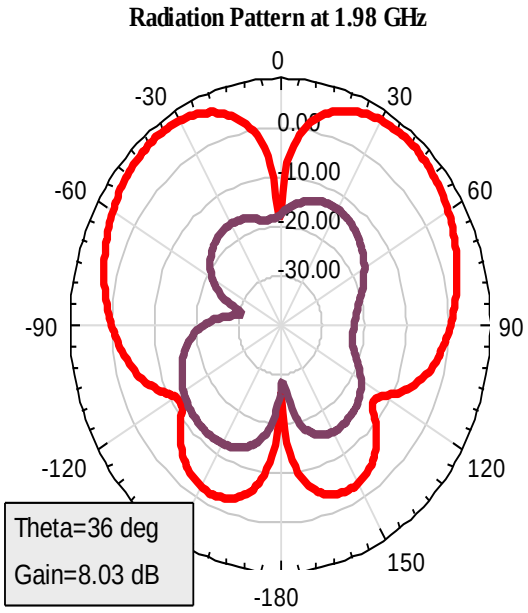

Fig.6. Radiation pattern and gain 1.98 GHz

VI. CONCLUSION

In this letter, a Multi -band single-patch covering four different frequencies with a reflection coefficient of -14.31 dB at the 0.99GHz, -15.53 dB at 1.16GHz,-14.60 at 1.54GHz and -14.60 at 1.98GHz is proposed by adopting slot patch configuration. Proposed slot patch antenna have good amount of gain also having VSWR is lies betwwen 1to 2 for all desire frequency. As gain in more than 5dB in all we can say that proposed anteena can be uesd for active navigation radio service, GPS l5 and Galileo E5, Galileo SAR downlink, personal communication also in TV broadcast services.

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