DUAL BAND UWB MICROSTRIP PATCH ANTENNA

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ABSTRACT

Dual frequency band patch antennas may provide an alternative to large-bandwidth planar antennas, in applications in which large bandwidth is really needed for operating at two separate transmitting and receiving bands. When the two operating frequencies are far apart, a dual-frequency band patch structure can be conceived to avoid the use of separate antennas. In this paper, a critical overview of possible solutions for dual-frequency patch antennas is presented, and more perspectives are outlined.

Keywords: Microstrip antennas; multi-frequency antennas

I. INTRODUCTION

Patch antennas are popular for their well-known attractive features, such as a low profile, light weight, and compatibility with monolithic microwave integrated circuits (MMICs). Their main disadvantage is an intrinsic limitation in bandwidth, which is due to the resonant nature of the patch structure. On the other hand, modem communication systems, such as those for satellite links (GPS, vehicular, etc.), as well as emerging applications, such as wireless local networks (WLAN), often require antennas with compactness and low-cost, thus rendering planar technology useful, and sometimes unavoidable. Furthermore, thanks to their lightness, patch antennas are well suitable for systems to be mounted on airborne platforms, like synthetic-aperture radar (SAR) and scatterometers. From these applications, a new motivation is given for research on innovative solutions that overcome the bandwidth limitations of patch antennas. In applications in which the increased bandwidth is needed for operating at two separate sub-bands, a valid alternative to the broadening of total bandwidth is represented by dual-frequency patch antennas. Indeed, the optimal antenna for a specific application is one that ensures the matching of the bandwidth of the transmitted and/or the received signal. Dual-frequency antennas exhibit a dual-resonant behaviour in a single radiating structure. Despite the convenience that they may provide in terms of space and cost, little attention has been given to dual-frequency patch antennas. This is probably due to the relative complexity of the feeding network which is required, in particular for array applications.

The need to operate at dual-frequency can arise in vehicular satellite communication systems where low-cost antennas with an almost isotropic pattern over the upper hemisphere are required; this matches well the characteristics of patch antennas.

The first critical point concerns the design of the active part of the basic transmit-receive (T-R) module. The best solution would be to realize the same MMIC for the two bands, but this is often not practical, due to the large separation between the two frequencies that require different microwave components for each frequency (particularly for the receiving channel). The second issue is concerned with the design of a single feed network for the two frequencies. This is probably the most critical problem to solve, considering that dual-linear polarization is often required. This is strictly related to the architecture of the radiating part, which not only must ensure sufficient physical space for printing the microstrip feed lines, but also good isolation between the two frequencies, as well as between the two polarizations. The two points mentioned above constitute open and challenging problems, and their discussion is beyond the purpose of this paper. Our attention will be focused on the radiating structures of dual-frequency band patch antennas.

II. MICROSTRIP PATCH ANTENNA

A microstrip antenna generally consists of a dielectric substrate sandwiched between a radiating patch on the top and a ground plane on the other side The patch is generally made of conducting material such as copper or gold and can take any possible shape. The radiating patch and the feed lines are usually photo etched on the dielectric substrate.

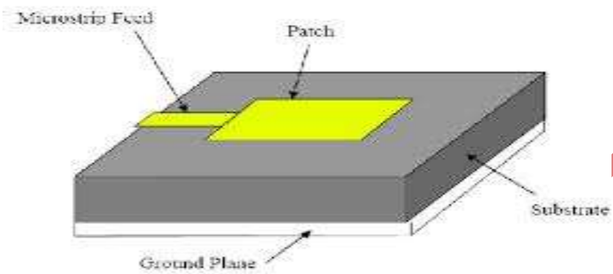

Figure 1 General structure of microstrip patch antenna

III.ANTENNA DESIGN

A. DESIGN SPECIFICATIONS

The following table shows the design specifications of the microstrip patch antenna :

PARAMETER	DESIGN SPECIFICATION
Dielectric constant of substrate ($€_r$)	$2.2 \leq €_r \leq 12$
Frequency (f_r)	3.1 GHz to 10.6 GHz
Thickness of substrate	1.6 mm
Length of substrate (L)	35 mm
Width of substrate (W)	20 mm
Loss tangent of dielectric constant $€_r$, $\tan\partial$	0.025
Length of ground	25 mm
Width of ground	15 mm

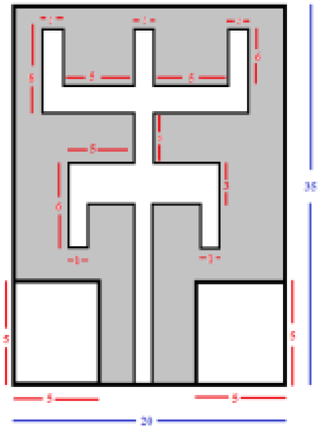

Figure 2(a) Front view of the design

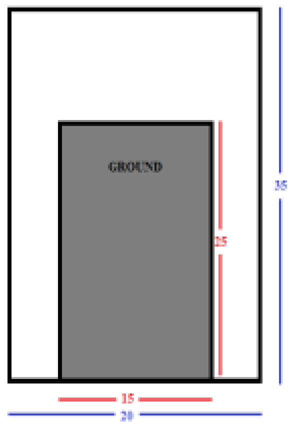

Figure 2(b) Back view of the design

B. SOFTWARE USED IN SIMULATION: HFSS

HFSS is a commercial finite element method solver for electromagnetic structures, from Ansys Corp. HFSS stands for High Frequency Structure Simulator. It is one of the several commercial tools used for antenna *design. It was deve*loped by Prof. Zontal Cendes and his students at Carnegie Mellon University, in the year 1989.

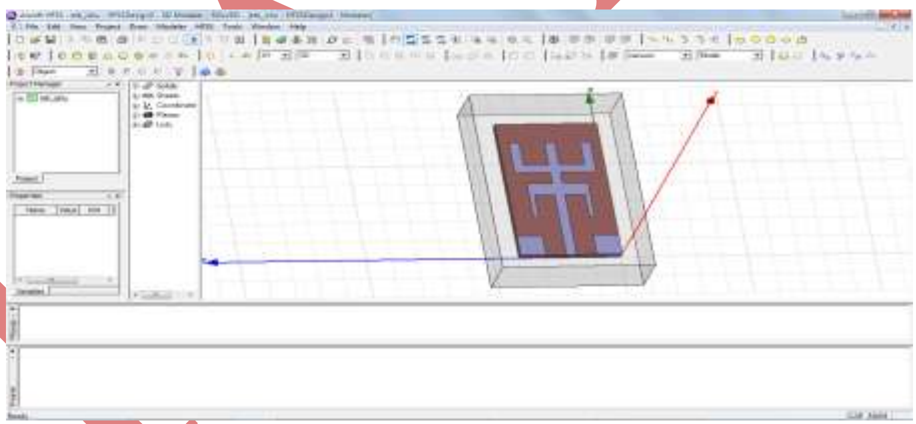

Figure 3:HFSS SOFTWARE IMPLEMENTATION

IV SIMULATION RESULTS

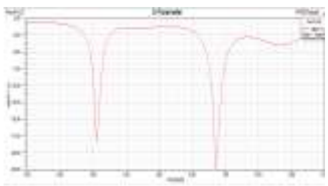

Figure 4. S-Parameter Magnitude in dB

The above S-Parameter Magnitude Plot for Return Loss was obtained. We obtained the cut off frequencies at 3.1 GHz and 6.85 GHz. Clearly, a dual band frequency result was obtained by simulating the designed antenna.

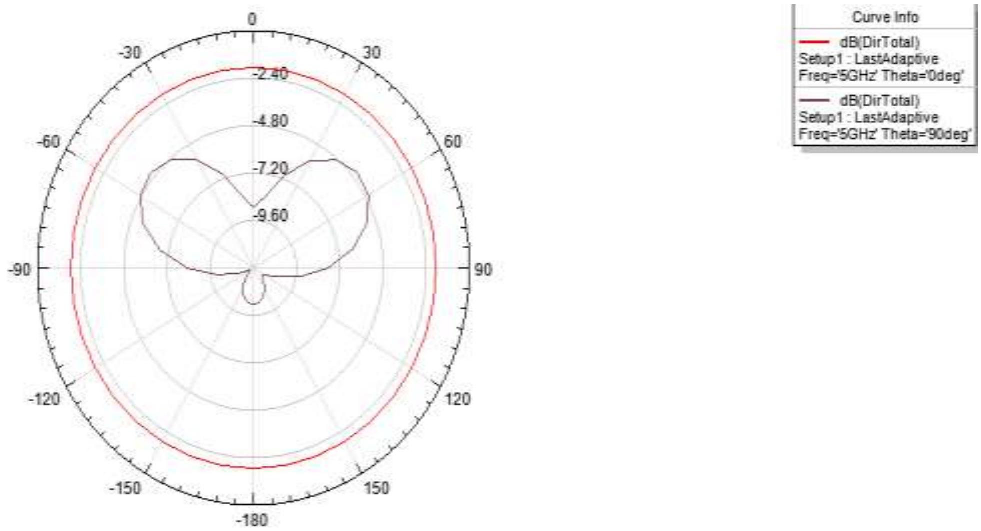

Figure 5 Radiation pattern of the dual band microstrip patch antenna

V. CONCLUSION

The microstrip patch antenna was designed using HFSS software. The performance of the antenna has been studied by comparing the Return loss, VSWR, Z parameter, Gain, azimutal and elevation patterns and the rectangular plot of the S parameter, that's shows the dual bands with appropriate expectable bandwidths.

Dual band operation were successfully incorporated into the patch design. The effect of varying the slit length, slit width and slot length were studied under great details with the help of experimental results. The propose patch yield desirable results throughout the operating frequency range. Above all, the antenna was found to produce a gain of around 18.5dBi to 22.5dBi and bandwidth of around more than 10% at the cut off resonant frequencies 3.1 GHz and 6.85 GHz.

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