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Design of a Planar structure of Multifrequency Patch Antenna

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1. Abstract

A planar patch antenna has been proposed to operate at 2.41 GHz 2.79GHz, 3.77GHz, 4.28GHz, 4.97GHz and 5.69GHz and 6.67GHz by introducing gap between adjacent patches. RF MEMS switches also proposed for further reconfiguribility.

2. Introduction

Multifrequency antennas are attractive solutions when several operating systems have to present similar radiation performances (bandwidth, gain, and radiation pattern, for example). Sometimes, in order to cover several operating frequencies, a broadband antenna solution is proposed [1]. Although this technique is simple, radiation pattern and gain usually vary across the band. On the other hand, a broadband solution is sometimes a drawback because the antenna receives other nondesired frequencies and some kind of a filtering network is needed to cancel such frequency range. In this sense, a multifrequency antenna solution focuses only on the frequencies of interest. Recent advancements in antenna technology, the availability of efficient computer-aided design (CAD) tools, and the availability of fast and powerful computers have resulted in a variety of different techniques for designing low-profile, cost effective, and highly efficient multiple-frequency antennas. Many of the techniques used for designing dual-band antennas make use of certain approaches to manipulate the current distribution of one of the higher order resonant modes of the structure to change its resonant frequency as well as current distribution [2-4].

The present paper is focused on designing a multifrequency antenna using microstrip radiators on a planar considering infinite plane on the back of the substrate using a high frequency structured simulator. In this paper, RF MEMS switches also proposed for further reconfigurability in addition to multifrequency operation.

2. Antenna Configuration

The geometry of the proposed planar monopole antenna is shown in Fig. 1. The proposed antenna is excited using a 50-Ω coaxial feed line for the centre patch. The ground plane is considered infinite ground on the back of the substrate. The substrate was chosen alumina with dielectric constant 9.4 and thickness of .75mm. The dimension of the driven patch was chosen to 29mm ×20mm to operate at 2.4GHz and the dimension of the adjacent patches was found after optimization to operate at different multiband operation.

4. Results and Discussions

The simulation was carried out with the commercially available software Ansoft High Frequency Structure Simulator (HFSS). The antenna was designed initially to operate at around 2.4GHz without adjacent patches and feed point is adjusted to obtained optimum performance. The two adjacent patches are then introduced and antenna behaviour was observed by varying the width and

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length of the adjacent patches and as a result multifrequency bands were achieved as shown in Fig.1(a). The frequency ınds are 2.79GHz, 3.77GHz, 4.28GHz, 4.97GHz and 5.69GHz when the dimension of the adjaceı patches are 20mm×20mm. The figure shows that the frequency band 2.4 GHz is shifted to high frequency with incorporating of the adjacent patches. To retain the

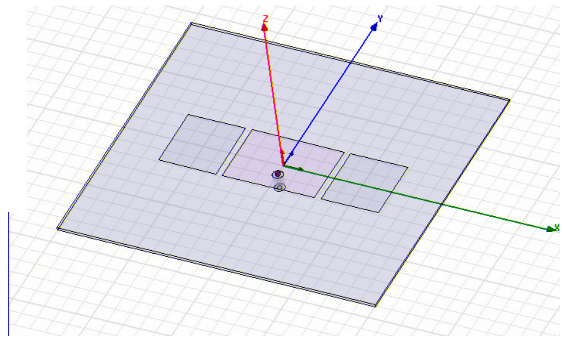

Figure 1: Schematic diagram of proposed multiband antenna.

frequency band at 2.4GHz, a gap was introduced between the centre driven patch and the adjacent patches and their behaviours was studied and presented in Figs. 3 in terms of return loss with the variation of frequency. Fig. 3(a) shows that introduction of gap of 2mm results two frequency bands at 2.41GHz and 6.67GHz which is shown again in Fig. 3(b). Fig. 3(b) shows that the introducing gap caused to operate at two frequency bands 2.41GHz and 6.67 GHz. Therefore, the proposed antenna can be used as multiband operations either at 2.41GHz and 6.67GHz or at five frequency bands at 2.79GHz, 3.77GHz, 4.28GHz, 4.97GHz and 5.69GHz by choosing the type of antenna with or without gap.

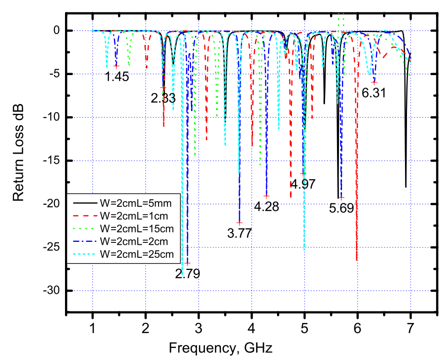

Figure 1: Return loss when the adjacent patches are contact with the center patch.

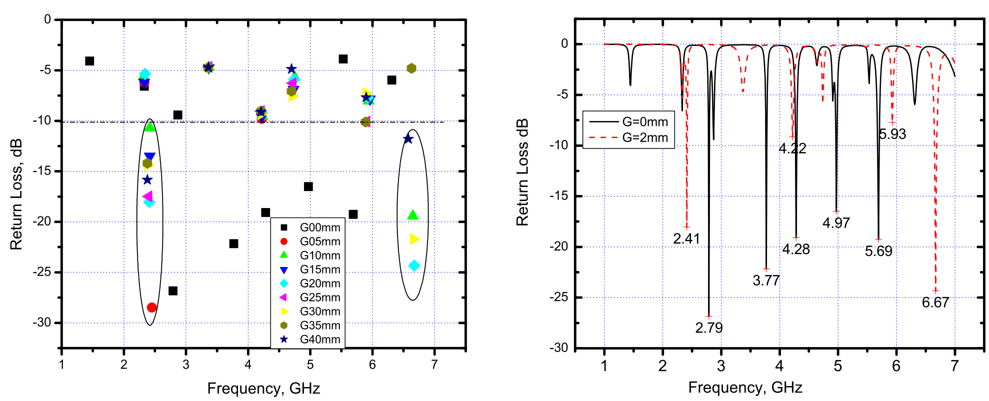

Figure 3: Return loss when the adjacent patches are in-contact or non-contact with center patch.

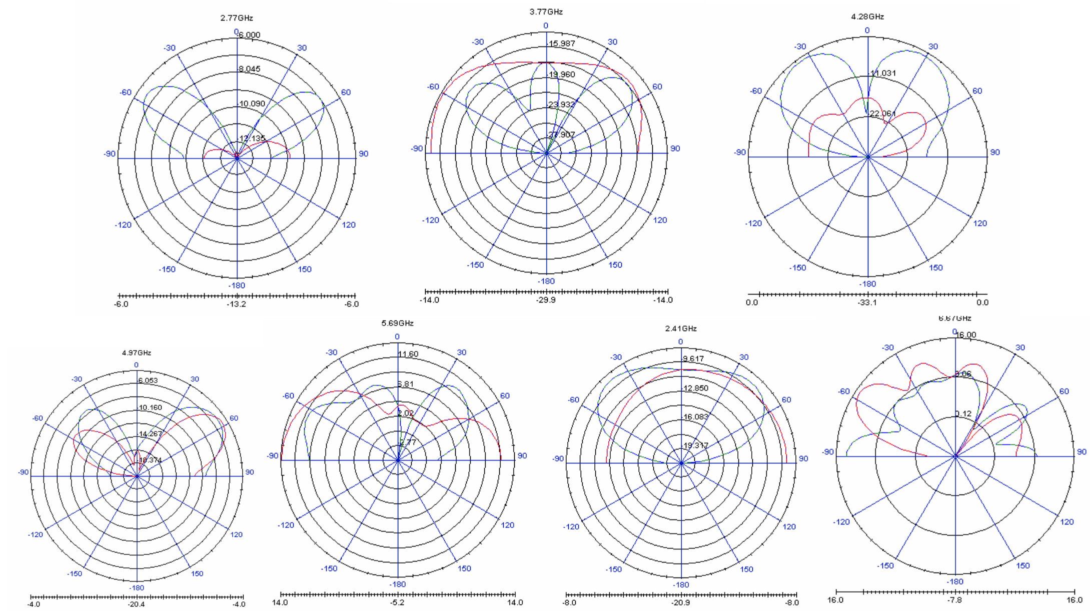

Figure 4: Radiation pattern at resonant frequencies.

Finally, radiation patterns are computed at the central frequency of each band in order to see the multifrequency behavior (Fig. 4).

4. Conclusions

A multiband microstrip antenna is developed in this work. The proposed antenna structure comprises a planar patch antenna. The gap between driven patch and the adjacent patches have been optimized to obtained multiband frequency operation. The antennas are operated at 2.79GHz, 3.77GHz, 4.28GHz, 4.97GHz and 5.69GHz. It is suggested that further reconfigurable can be obtained by using RF MEMS switches to close the gap to operate at 2.41GHz and 6.67GHz. The proposed antennas are good candidates for multiband communication applications.

Acknowledgments

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