Performance Investigation of Rectangular and Triangular Thoothed Serrated Ultra-Wideband (UWB) Microstrip Antenna

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***Abstract*——In this article, the behavior of a rectangular patch antenna fed by microstrip transmission line was studied according to a parameter namely the edge of the antenna, one wavy with rectangular bands and the other with saw tooth serrations. The results show us that the change of these parameters influence the resonance frequency, the gain and the impedance adaptation. The simulations were made with the CST Studio solver.**

Keywords- Ultra-Wideband

I. INTRODUCTION

Wireless communications are increasing in popularity, and new solutions are needed to satisfy the demands of high data-rates and rarefied bands. Ultra-Wide Band (UWB) technology may be a promising solution to this problem.

The flexibility of printed technology offers the possibilities of innovative radiating structures well suited to various systems requirements by giving them any form. The systems often need specific radiation patterns such as shaped, specific directive but here we will focus on the large bandwidth (3.1 GHz to 10.6 GHz) with its radiation efficiency and the realized Gain.

The different effects that can be produced by different antenna shapes are one of the objects of this paper. Indeed, the goal is to observe in a graphical way the behavior of different antennas through antenna modeling software. In fact the triangularly serrated patch have the best improve on bandwidth and coefficient reflection from the convention rectangular patch but which on average on the 3.1 10.6 GHz band efficiency less than the others.

II. DESIGN, ANALYSIS AND OPTIMIZATION OF RECTANGULAR PATCH ANTENNA

A. Design

The structure of the antenna is shown in Figure 1. The parameters are optimized to operate the antenna within UWB. A rectangular monopole of dimension 12 mm×16mm is on one side of an FR-4 substrate of thickness 1.6 mm and relative permittivity 4.4 with the partial ground plane located on the other side. The dimension for the substrate is 30 mm×32mm

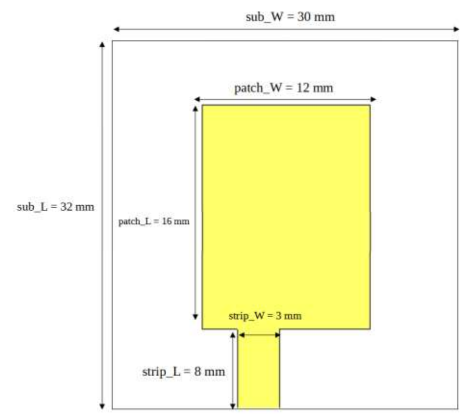

Figure 1. Triangulary serrated pacth

B. Analysis, optimization and result

To design the UWB antenna, I chose to modify 3 parameters to see the effect they have on the reflection coefficient, including the length of the ground plane and width of the feedline and the position of the feed line from the center of the patch. Therefore, the simulation was done by varying these different parameters. The best performance is obtained for an offset position of 2 millimeters from the supply line and 3 millimeters wide and for a ground plane of 7 millimeters. Note that the bandwidth decreases with a shorter ground plane. We also observe that the bandwidth is not very sensitive to the width of the feed line. However, the impedance increases when the width of the feed line decreases. Here are the results below with the values kept.

III. DESIGN, ANALYSIS AND OPTIMIZATION OF RECTANGULAR CORRUGATED PATCH ANTENNA

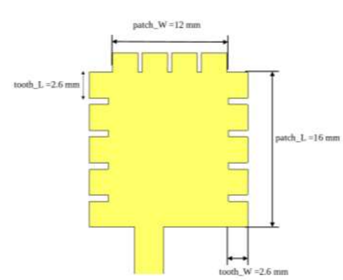

Figure 2. Rectangulary serrated pacth

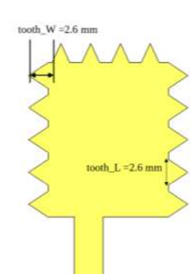

Figure 3. Triangulary serrated pacth

In order to see the effects of this modification made to the antenna, I optimized the results by varying the length and width of each rectangle and saw tooth serration. At first, I varied their lengths without changing their width and then by varying their widths. For the rectangle the best performances are obtained for a **length of 2 mm** and a **width of 2.66 mm** and a **spacing of 0.41 mm** between them on top and **0.66 mm** on sides. To be able to compare these two structures, I chose to have the height of each triangle the same length as for the rectangles, therefore 2 mm and to keep the same width of 2.66 mm. As shown in the figures below, for the reflection coefficient there is a significant increase in dB at 9.7 GHz for the serration which reaches – 57 dB that is more than 15 dB than the other antenna, and a second peak appears.

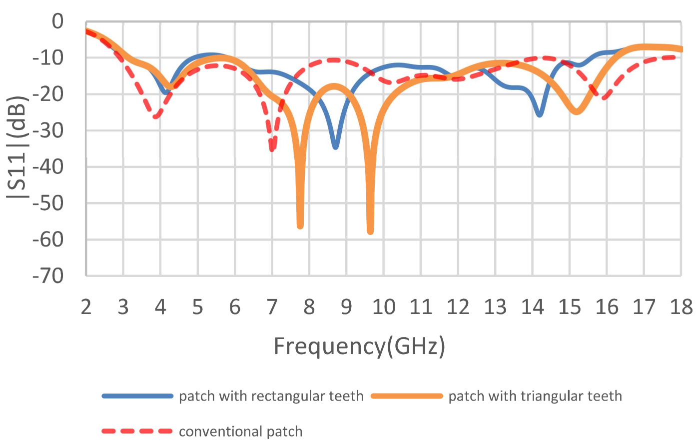

Figure 2. Comparison of the reflection coefficients of the 3 types antennas

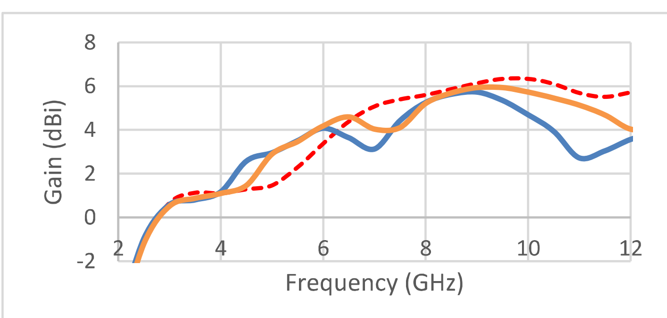

Figure 3. Realized Gain comparison of the 3 types antennas

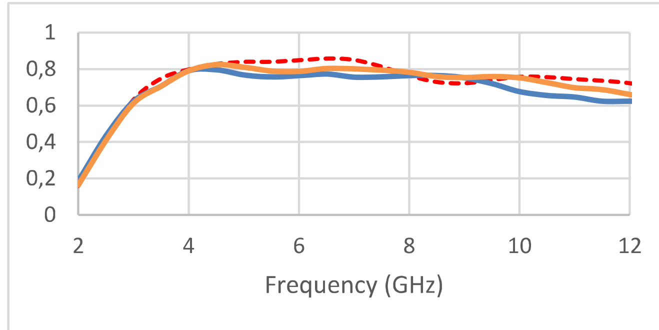

Figure 4. Efficiency comparison of the 3 types antennas

TABLE I. COMPARATIVE TABLE BETWEEN THE THREE DIFFERENT ANTENNAS.

Characteristics	***Conventional patch antenna***	***Patch antenna with rectangular borders***	***Patch antenna with triangular border***
Maximum S11	- 42 dB	- 47 dB	- 57 dB
Bandwidth	2.9 to 14.3 GHz	3.1 to 15.5 GHz	3.1 to 16.2 GHz
Covered area of the 3.1 to 10.6 GHz frequency band	152%	165%	174%
Efficiency (between 3.1 to 10.6 GHz)	74%	70%	66%
Maximum Gain	6 dBi	5.5 dBi	6 dBi

IV. CONCLUSION

We notice that the addition of a corrugated border allows us to widen our bandwidth. I opted for 2 new structures by adding 2 different serrations on the patch. I tried to optimize them to their maximum based on the parametric study which consists of fixing all the parameters and changing a single parameter to see their influence on the characteristics of the antenna. The results obtained can satisfy the bandwidth requirements, with excellent gain but an efficiency that has become low compared to the conventional antenna but remains correct. The results obtained show that the proposed antennas respond well to the specifications, to transmit in the frequency band 3.1 GHz to 10.6 GHz.

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