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# PYTHAGOREAN TREE FRACTAL FOR MULTI-BAND PATCH ANTENNA.

**Abstract**

Fractal mathematics has been a very interesting and intriguing area of mathematics and its impact on antenna development, development of meta-materials and fractal based cloaking devices has been profound.

In this paper, we explore use of a Pythagorean tree for application in X-band (8-12GHz). We use a square patch antenna as an initiating structure, and a Pythagorean triangle to progress the fractal. A similar approach has been taken by Agarwal. A and Kartikeyan. M. V in [2], in which the operating frequency is 2 to 5 GHz. For that case a 45-45-90 Pythagorean triangle has been used for progression, which gives same size patches in the next iteration. In this paper, it has been observed that using 45-45-90 triangle, gives such a size for the next iteration that operation is no longer in the X-band range. For this reason, a 30-60-90 triangle is used for progression, which give, unequal patches in the iteration process. In the first iteration, we receive resonances at 8.2 GHz, 9.2 GHz and wide band performance around 16 GHz and 18 GHz. Since we are concentrating more on the behavior in X-band, we can ignore the higher frequency resonance, but can be considered as a plus, if the antenna has to be used in that frequency range. Employing fractal progression, affects the radiation pattern of the antenna, and we no longer get a broadside radiation similar to the one in a regular patch antenna. For this reason, we propose employing an array of such elements, which not only will provide a broadside radiation, but a more directive radiation with lower side-lobe levels. Using a Pythagorean triangle for progression primarily gives great control over operating frequencies. This is primary reason why this style has been selected for this application after having tried various different fractal geometries. Further in this research attention can be given on the feeding networks, employing beam forming networks, and also work with steering the radiation beam.

Reference

[1] Mandelbrot, B. The Fractal geometry of nature, W. H. Freeman and Co., 1982

[2] Agarwal. A, Kartikeyan. M.V, “Pythagoras tree: A fractal patch antenna for multi-frequency and ultrawideband width operations.”