AN ENHANCEMENT OF BANDWIDTH IN PATCH ANTENNA USING METAMATERIAL

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ABSTRACT

This project proposed a new generation of antenna that applies metamaterial as based construction of the antenna. Current bulky size antenna can easily be replaced by invented metamaterial antenna. The simulations of the metamaterial antenna as substrate have positive results with respect to the bandwidth and size of the antenna, while metamaterial antenna as cover also have positive results with respect to the bandwidth and directivity of the antenna. The omega structure was made of combination of two materials; Flame Retardant 4 and Perfect Electric Conductor which this design's resulting the formation of metamaterial. An investigation of the S-parameters has been carried out in determining the negative permittivity of this newly produced metamaterial. The return loss from the simulated metamaterial antenna as substrate is almost similar to the conventional antenna. Directivity of the conventional antenna was improved significantly with the use of metamaterial slab as cover of the antenna. The antennas lead to enhancing the technology to ease the customers by giving a smaller, cheaper and better performance of device.

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CHAPTER 1

1.0 INTRODUCTION

1.1 BACKGROUND STUDY

Metamaterials are structured composite materials with unique electromagnetic properties due to the interaction of electromagnetic waves with the finer scale periodicity of conventional materials [1]. Metamaterial synthesized by embedding various constituents or inclusions with novel geometrical shapes and forms in some host media [2]. The person who is responsible in discovering the concept of metamaterials is Veselago in 1967 [2, 3]. Veselago assumed the unknown materials has negative permeability and permittivity in the same frequency range and it show abnormal electromagnetic properties when he studied the uniform plane-wave propagation [2-5]. Veselago also found that the Poynting vector of the plane wave is anti-parallel to the direction of the phase velocity [5-7]. As a result, Veselago referred the material as left-handed material (LHM) which has reverse basic feature of light, such as negative refractive index (NRI) and he also suggested the metamaterial support backward wave propagation which contribute to backward wave material (BWM) [5, 8].

Negative permittivity means the material produce may not be easily available in nature, physically unique and has unusual realizable response function [2, 5]. The metamaterial also can be mention as double-negative materials (DNG), negative-index materials (NIM), negative phase velocity media (NPV) and electromagnetic band gap (EBG) structured materials [5]. Surprisingly, Veselago got only little attention for his work until came to year 2000 when Smith further studied the LHM and realized this material is a periodically-arranged conducting concrete [4]. This artificial material is very different from the natural material and shows extraordinary properties such as presence of anomalous refraction in the material [2, 4, 9]. The first structure that was used to prove the existing of metamaterial was split ring resonators (SRR) invented in 2001 by Shelby, Smith and Schultz at the University of California which this structure inspired by the