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Entitled

ULTRA-WIDE BAND MICROSTRIP ANTENNA ENHANCED PERFORMANCE USING METAMATERIAL

by

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Abstract

Antenna engineering is very important in the development of communication systems and the requirements for low profile antennas that cover a wide spectrum of frequencies increase number of researches in this field. Accordingly, scientists have focused on UWB microstrip antennas that cover range from $3.1\ GHz\ to\ 10.6\ GHz$ but others concentrate on enhancing its performance using special type of materials called metamaterials.

The main objective of this work is to enhance frequency bandwidth, antenna gain, and radiation pattern for the UWB circular microstrip antenna by employing the Split Ring Resonator (SRR) technique, which is one type of metamaterials.

Circular and square split ring resonators are investigated as an enhancement method after studying their characteristics. Multiple techniques are applied to these two structures before being implemented at antenna's backside. This include different SRR schematics such as the SRR position with respect to the ground, inner and outer ring rotation, positive and negative rotation angle, number of SRR units, SRR size, SRR design, in addition to using the complementary SRR. Furthermore, two techniques are combined together in some designs to observe how antenna's performance will be affected. The proposed techniques rely on the variation in capacitance and inductance which will affect the resonant frequency of the SRR unit cell. Then some SRR Schematics were implemented in the proposed circular antenna design to test the functionality within WiFi frequencies $2.4\ GHz$ and $5\ GHz$. The enhancement can be summarized in increasing antenna bandwidth and transmitting or rejecting specific frequency bands. The results of the study reveal an enhancement in circular antenna's performance. UWB circular antenna with elliptical rings has a frequency bandwidth between $3.5\ GH\ to\ 9\ GHz$ and a maximum gain around $5\ dB$; during the enhancement process using the previous mentioned techniques the frequency bandwidth increased to cover the range from $2.2\ GHz$ to $9.8\ GHz$ along with some bands rejection. It was noted that some rejected bands have shifted to higher frequencies when applying inner or outer ring rotation. To emphasize this, WiFi frequencies $2.4\ GHz$ and $5\ GHz$ are inspected by using the suitable size of S-SRR to decide which frequency to reject or transmit depending on the communication applications.

The outcomes of this work should assist in designing antennas with SRR depending on required communication applications and operating frequencies.

Keywords: Microstrip antenna, metamaterial, SRR, circular and square SRR, rotation, CSRR, WiFi.