RADIATION PATTERN RECONFIGURABLE ANTENNA FOR LTE APPLICATIONS

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RADIATION PATTERN RECONFIGURABLE ANTENNA FOR LTE APPLICATIONS

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To my parents, for their endless love and support
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ABSTRACT

This project proposes a radiation pattern reconfigurable antenna for LTE applications. Long Term Evolution (LTE) is an advanced system in the wireless telecommunication development. Compared to previous standards, LTE offers improved performance. The main advantage of this project is to steer the radiation pattern to a particular direction. The radiation pattern steering is achieved by applying progressive phase shifting. The transmission line model is used to obtain design parameters of the antenna. By using the progressive phase shift concept, three different configurations of patch array antennas are designed at 2.6GHz operating frequency. The three different directions had been formed at -15°, 0°, 15°. FR4 substrate is used for designing the reconfigurable antenna with thickness of 1.6mm. Measured and simulated results are well matched, but with some minor deviations. The gain of the antenna is 4.4dB with broadside direction and the gain is 4.6dB when the beam steers to either ±15°.
ABSTRAK

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LIST OF ABBREVIATIONS

1G - First Generation
2G - Second Generation
3G - Third Generation
4G - Fourth generation
LTE - Long Term Evolution
CST - Computer Simulation Technology
MTS - Mobile Telephone Systems
AMTS - Advanced Mobile Telephone Systems
PTT - Push To Talk
IMTS - Improved Mobile Telephone Service
GPRS - General Packet Radio Service
WLAN - Wireless Local Access Network
FDMA - Frequency Division Multiple Access
CDMA - Code Division Multiple Access
GSM - Global System for Mobile Communication
EDGE - Enhanced Data Rates for GSM Evolution
UMTS - Universal Mobile Telecommunication Systems
HSDPA - High-Speed Downlink Packet Access
3GPP - 3rd Generation Partnership Project
MIMO - Multiple Input Multiple Output
OFDM - Orthogonal Frequency Digital Multiplexing
MBWA - Mobile Broadband Wireless Access
WiMAX - Worldwide Interoperability for Microwave Access
LIST OF SYMBOLS

$Z_0$ - Characteristics Impedance
$Z_{in}$ - Input impedance
$I$ - Current
$V$ - Voltage
$A$ - Ampere
$W$ - Width
$L$ - Length
$L_{eff}$ - Effective length
$\Delta L$ - Change in length
$C$ - Speed of light
$M$ - Micron
$dB$ - Decibel
$dB_{i}$ - Decibel reference to isotropic antenna
$\lambda$ - Wavelength
$\lambda_0$ - Free space wavelength
$\lambda_{eff}$ - Effective wavelength
$\Delta$ - Conductivity
$\epsilon_r$ - Relative permittivity
$\epsilon_{eff}$ - Effective permittivity
$\Omega$ - Ohm
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CHAPTER 1

INTRODUCTION

1.1 Problem Background

In wireless communications, four generations have been implemented until now. The 1st generation (1G), or analog, 2nd generation (2G), or digital, 3rd generation (3G), or broadband, 4th generation (4G), or digital broadband. Long Term Evolution (LTE) is the technology of 4G [1]. LTE is the advanced system in telecommunication and it offers improved performance.

There are different types of antennas, wire antenna, aperture antenna, reflector antenna and microstrip antenna. Microstrip antenna is easy and low cost to fabricate, low-profile, ease of installation, high-performance, less in size, light weight, and its exit in different shapes such as rectangular, square, circle and triangle are the most common shapes. However, the main drawback of microstrip antenna is that, it has narrow bandwidth [2].

The drawback of fixed radiation pattern is less coverage area, and to overcome this problem, pattern reconfigurable antennas are implemented. Pattern reconfigurable antennas, switch the radiation pattern towards a particular direction and provide more coverage area.

For some applications, single element antennas are unable to meet the gain or radiation pattern requirements. Combining several single antenna elements in an array can be a possible solution. Antenna arrays have the advantages of providing the capability of a steerable beam (radiation direction change) [3].
This chapter starts with an introduction, problem statement, objectives, and scope of the project.

1.2 Problem Statement

Microstrip patch antennas built on printed circuit board (PCB) substrate, are attractive due to their various features like light weight, low cost, easy to fabricate. Obviously, the microstrip element suffers from the inherent limitation of narrow impedance bandwidth and high substrate losses and low radiation efficiency. To relax the precision problem of conventional microstrip antenna, it is proposed to fabricate the antenna using lossless low permittivity substrates.

In general, an antenna design with very directive characteristics (very high gains) to meet the demands of long distance communication. Usually the radiation pattern of a single element microstrip radiator is relatively wide and each element provides the low value of directivity (gain). Enlarging the dimensions of the single elements offer high directivity, but this is not a practical solution. Another simple way is to form an assembly of radiating elements in an electrical and geometrical configuration. This multiple element is referred to as antenna array.

A conventional array antenna is capable of producing a single directional beam pattern, therefore it limited to a fixed direction of the main beam. This limitation can be overcome by using a beam reconfigurable antenna, which is upgrading the single antenna into a multifunctional antenna. Therefore, Beam reconfigurable, which capable to steer the main beam at three different places in the single antenna design was proposed in the present research. There only one beam can be steered at one time within the proposed design. Practically user’s position is not stable, to maintain the connection, the antenna maximum radiation must always be pointing towards the base station. This requires a beam steerable antenna array.
1.3 **Objective**

The main objectives of this project as follows:

1. To model and design a microstrip antenna for LTE applications.
2. To steer the radiation pattern towards a particular direction.
3. To fabricate and measure the proposed antenna design.

1.4 **Scope of the work**

The scopes of this project starts with understanding the concept of radiation pattern and micro strip patch array antenna. The two element micro strip patch antenna operating at 2.6 GHz has been chosen and simulated by using a CST microwave studio. The measured return loss of the proposed antenna obtained below -10 dB and the gain of the antenna is almost similar, when steering the radiation pattern. Finally, the proposed antenna design has been fabricated and the simulated and measured results are compared.

1.5 **Summary**

This chapter presents the introduction of the project and an overview of the antennas, radiation pattern and array elements. The chapter also covers the problem statement, the objectives, scope of the work.
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