Department of Electrical Engineering
College of Engineering
Najran University

PROJECT TILTE (20 WORDS MAX.)

By

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Supervisor:
Dr. xxxxx

Submitted in Partial Fulfillment of the Requirements for the Bachelor Degree, Department of Electrical Engineering, College of Engineering, Najran University, Najran, KSA

December 2016

DEDICATION

Write your dedication here

Example:

To

My father, xxx

My mother, xxx

….

APPROVAL SHEET

This project report entitled "**Project title"** was prepared and submitted by (**student name 1, student name 2 and student name 3**) as the fulfillment of the requirement for the Bachelor of Engineering (**Electrical Engineering**) is hereby accepted.

Approved by:
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Date Approved: xx/xx/1438 H - xx/xx/2016 M

DECLARATION

This report was written by (**student name 1, student name 2 and student name 3**) a student in the Department of Electrical Engineering at Najran University. It has not been altered or corrected as a result of assessment and it may contain errors and omissions. The views expressed in it together with any recommendations are those of the student(s).

NO.	Name	ID	Signature
1.	**Student name 1**	**ID**	
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3.	**Student name 3**	**ID**	

ACKNOWLEDGMENT

Write your acknowledgment here.

Example:

First and foremost I am unconditionally grateful to Allah (God) for all that I am and all that I have. My deepest gratitude and appreciation to my supervisor, Dr. xxxx for teaching, guiding, supporting warmly and offering endless encouragements for me during the development of this project. The correction and assistance he has given to me for this project are most appreciated. Also, my highest admiration dedicated to my loving family and friends for showing compassionate and supported me to the certain extent of strength I needed throughout the entire project progress.

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LIST OF ABBREVIATIONS

ACMSA	Aperture-Coupled Microstrip Antenna
ADS	Advanced Design Software
A-GPS	Assisted- Global Positioning System
AOA	Angle-Of-Arrival
AWGN	Additive White Gaussian Noise
CCS	Code Composer Studio
CRLB	Cramer-Rao Lower Bound
DOA	Direction Of Arrival
DSSS	Direct Sequence Spread Spectrum
E-911	Enhanced 911 Service System
EVD	Eigen Value Decomposition
FCM	Forward Correlation Matrix
FFT	Fast Fourier Transform
GPS	Global Positioning System
IFFT	Inverse Fast Fourier Transform
ISI	Inter-Symbol Interference
LHCP	Left-Hand Circular Polarization
LNA	Low Noise Amplifier
LOS	Line Of Sight

LIST OF SYMBOLS

$\beta_{x,mn}$	Amplitude coefficient of (m, n) mode in x-direction inside the cavity
$\beta_{y,mn}$	Amplitude coefficient of (m, n) mode in y-direction inside the cavity
ε_o	Permittivity of free space
ε_r	Relative dielectric constant
θ	Elevation angle
θ_1	Angle of arrival between tag and reader 1
θ_2	Angle of arrival between tag and reader 2
θ_{AOA}	Angle of arrival
θ_{AOA_error}	Error in the angle of arrival
μ	Magnetic permeability
Σ	Diagonal eigenvalues matrix
Σ_{norm}	Normalized diagonal eigenvalues matrix
σ_n^2	Variance of the additive white Gaussian noise
σ_{noise}^2	Noise power of any received snapshot
σ_{signal}^2	Signal power of any received snapshot
σ_{TOA}^2	Minimum variance of the successive TOA samples
τ	Minimum time difference between two successive paths of the channel power delay profile

PROJECT TILTE (20 WORDS MAX.)

ABSTRACT

- The abstract is a summary of the entire report and should be given the same careful attention as the main text.
- It should not include any reference.
- An abstract should be between **200** and **300** words.
- It includes a brief statement of the problem and objectives of the study, a concise description of the research method and design, a summary of the major findings including their significance, and conclusions.

Example:

The use of Ultra-Wideband (UWB) microwave imaging for tumour detection has gained increase popularity within the bio-medical field. Microwave imaging had been proven successful to some body parts such as breast and brain imaging. This project presents a comprehensive study on the possibility and the effectiveness of UWB microwave imaging technique on lung tumour detection. Simple technique of using reflection method was studied and then applied for lung tumour detection by using UWB antenna. The simulated results show that the proposed method is capable to detect a lung tumour with minimum radius size of 4 mm for different positions inside the lungs at the frequency of 3.67 GHz. It is a promising technique to attract usage in modern UWB imaging systems which demand perfect results at very low cost.

CHAPTER 1

INTRODUCTION

1.1 Background

There are increasing interests in the location-based applications in indoor environments. In RTLS, the determination of location information of the tag with respect to one or more reference reader creates a large number of applications. The commercial applications include asset and personal localization in warehouses and hospitals, locating elderly persons, locating children in public areas, guiding visitors in museums and many other similar scenarios. In public safety and military applications, they are used for navigating the firefighter, police men and soldiers to complete their missions inside or around the buildings.

1.2 Problem Statement and Motivation

The effect of path loss, interference, noise, polarization mismatch, polarization reflection, and multipath on the performance of a radio communications link continues to present one of the major challenges to wireless systems, especially for indoor dynamic environments. The polarization mismatch can degrade the signal by more than 20 dB in a linearly polarized system [1].

1.3 Aim and Objectives

The main aim of this project is to investigate the possibility of lung tumor detection using UWB microwave imaging method. It is further divided into three main objectives:

1. To study the possibility of lung tumor detection by using microwave imaging similar to those used for breast and brain imaging.
2. To analyze the human thorax section in the presence and absence of tumor using UWB Microwave imaging.
3. To suggest a suitable microwave imaging method for lung tumor detection at low cost.

1.4 Scope of Project

The leading purpose of this project is to study the possibility as well as the effectiveness of UWB microwave imaging technique on lung tumour detection. Computer Simulation Technology (CST) Studio Suite software [2]–[4] is required to run a 3D electromagnetic simulation of the UWB antenna detecting the lung tumour. The operating frequency of UWB antenna usually used for microwave imaging is roughly between 0.3 to 30 GHz. Other than that, the dielectric properties of the tissues in human thoracic are also considered in this project.

1.5 Project Organization

Chapter 1: This chapter introduces a background study and motivation of lung tumour detection since microwave imaging has not been implemented to other tumour detection.

Other than that, aim and objectives as well as the associated problems are being stated in this chapter. The scope of study is also discussed.

Chapter 2: Literature review is a chapter that contains all the relevant information related to the project. Previous research studies have been reviewed and divided into several sections: Lung Anatomy, Microwave Imaging Technique, Dielectric Properties of Human Biological Tissue, and Microwave Propagation into the Human Thorax.

Chapter 3: In the methodology, the flow and the method of developing the project are elaborated and also the components needed in the simulation such as the design UWB antenna, human thorax layer section and tumour are identified.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This section contains the literature review of all related information, components, theories, equations, studies, facts and other relevant sources that were used in the completion of this project. These reviews will be the principal references in the study of applying UWB microwave imaging for lung cancer detection.

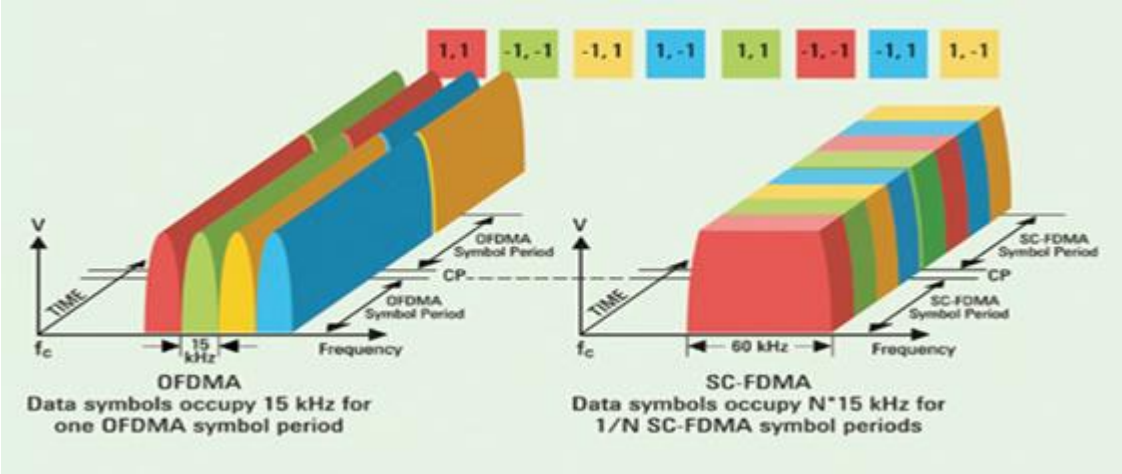


Figure 2.1 Xxx

Table 2.1 : Myths and fact about Mobile Phones and Base Stations

MYTH	FACT
• Mobile phones cause brain cancers - look at all those people who used mobile phones and are ill.	• Despite individual cases, there is no scientific evidence that brain cancers are caused by mobile phone use.
• Mobile phones are so powerful that they can damage your brain.	• Mobile phones typically have an output of less than 1 watt that may increase the temperature of the brain by fractions of a degree, less than normal exercise.
• You are safer using a mobile phone in a car because it shields you from the radiation.	• Mobile phones automatically increase their input in a car to overcome the shielding.
• Using mobile phones in a car does not affect your driving skills.	• You are four times more likely to have an accident crash because of divided attention, and it is similar to drunk-driving.

The effect of path loss, interference, noise, polarization mismatch, polarization reflection, and multipath on the performance of a radio communications link continues to present one of the major challenges to wireless systems, especially for indoor dynamic environments. The polarization mismatch can degrade the signal by more than 20 dB in a linearly polarized system [3]. The effect of the reflection in a multipath channel can reflect Right-Hand Circular Polarization (RHCP) wave and change it to Left-Hand Circular Polarization (LHCP) wave or vice versa [5]. The received signal can be lost due to the effect of the polarization reflection if transmitting and receiving antennas do not have the same circular polarization sense.

$$x_{1,2} = \frac{-\mathrm{b} \pm \sqrt{\mathrm{b}^2 - 4\mathrm{ac}}}{2\mathrm{a}} \tag{2.1}$$

$$(x+a)^n = \sum_{k=0}^{n} \binom{n}{k} x^k a^{n-k} \tag{2.2}$$

The implementation of an antenna with a narrow beam-width helps to combat impairments such as path loss and interference. The effects of the Polarization mismatch and the polarization reflection will be eliminated if both the transmitting and the receiving antennas have circular polarization diversity. The implementation of circular polarization is more suitable for indoor wireless dynamic environments because it does.

2.1.1 Sub-subheading 1

The implementation of an antenna with a narrow beam-width helps to combat impairments such as path loss and interference. The effects of the Polarization mismatch and the polarization reflection will be eliminated if both the transmitting and the receiving antennas have circular polarization diversity. The implementation of circular polarization is more suitable for indoor wireless dynamic environments because it does.

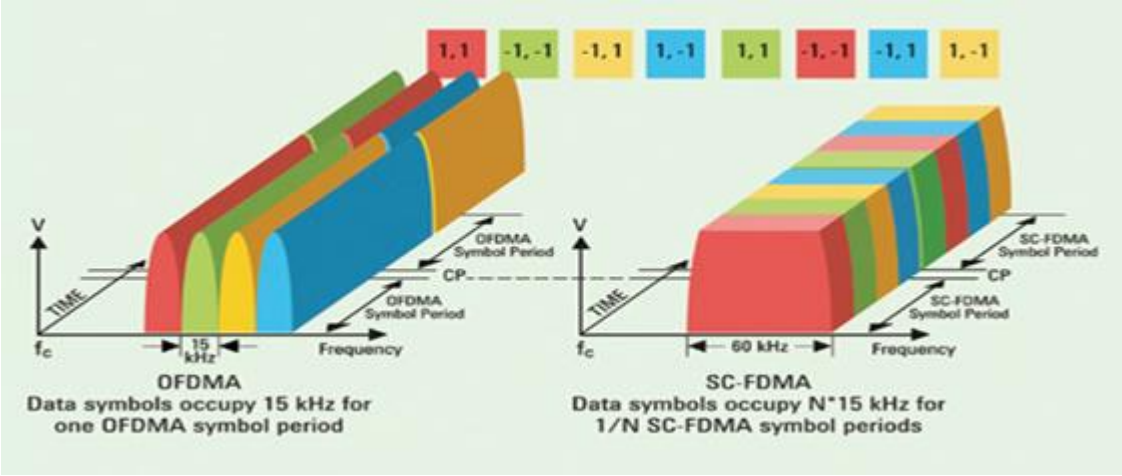


Figure 2.2 Xxx

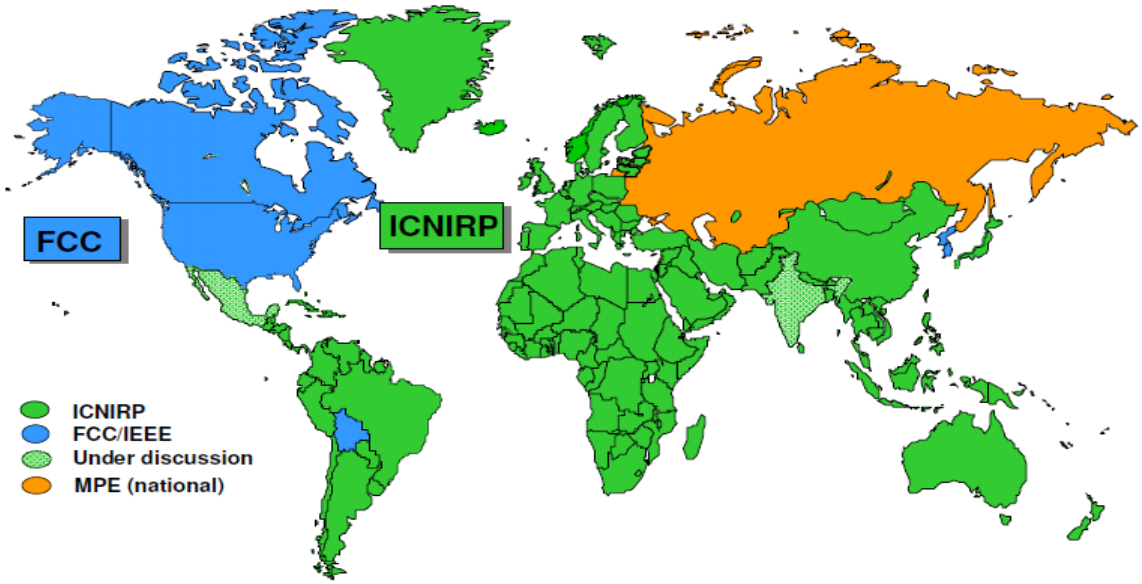
2.1.2 Sub-subheading 2

The implementation of an antenna with a narrow beam-width helps to combat impairments such as path loss and interference. The effects of the Polarization mismatch and the polarization reflection will be eliminated if both the transmitting and the receiving antennas have circular polarization diversity. The implementation of circular polarization is more suitable for indoor wireless dynamic environments because it does.

$$(x+a)^n = \sum_{k=0}^{n} \binom{n}{k} x^k a^{n-k} \tag{2.3}$$

2.1.3 Sub-subheading 3

The implementation of an antenna with a narrow beam-width helps to combat impairments such as path loss and interference. The effects of the Polarization mismatch and the polarization reflection will be eliminated if both the transmitting and the receiving antennas have circular polarization diversity. The implementation of circular polarization is more suitable for indoor wireless dynamic environments because it does.



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The implementation of an antenna with a narrow beam-width helps to combat impairments such as path loss and interference. The effects of the Polarization mismatch and the polarization reflection will be eliminated if both the transmitting and the receiving antennas have circular polarization diversity. The implementation of circular polarization is more suitable for indoor wireless dynamic environments because it does [5]–[10].

Table 2.2 : Myths and fact about Mobile Phones and Base Stations

MYTH	FACT
• Mobile phones cause brain cancers - look at all those people who used mobile phones and are ill.	• Despite individual cases, there is no scientific evidence that brain cancers are caused by mobile phone use.
• Mobile phones are so powerful that they can damage your brain.	• Mobile phones typically have an output of less than 1 watt that may increase the temperature of the brain by fractions of a degree, less than normal exercise.

2.3 Summary

In brief, these are all elaboration of the relevant and useful information that is related to the project. Every section in this chapter explained the basic concepts that are needed for the development of this project to detect lung tumour using UWB microwave imaging method including the fundamental anatomy of the lungs itself and the dielectric properties of the human tissue especially.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter is to record the development of the project. The project is conducted entirely on CST Microwave Studio software as it is solely a research using simulation. It is important to understand that the aim of this project is to investigate whether it is possible to detect lung tumour by using UWB microwave imaging as well as to investigate how effective the method is. Above all, this chapter contains the main components needed for the project and also the method of implementation. A proper planning has been prepared in order to have a smooth flow of finishing this project of research. The planning includes a flowchart of workflow and a Gantt chart. Figure 3.1 illustrates the workflow while Table 3.1 depicts the Gantt chart schedule.

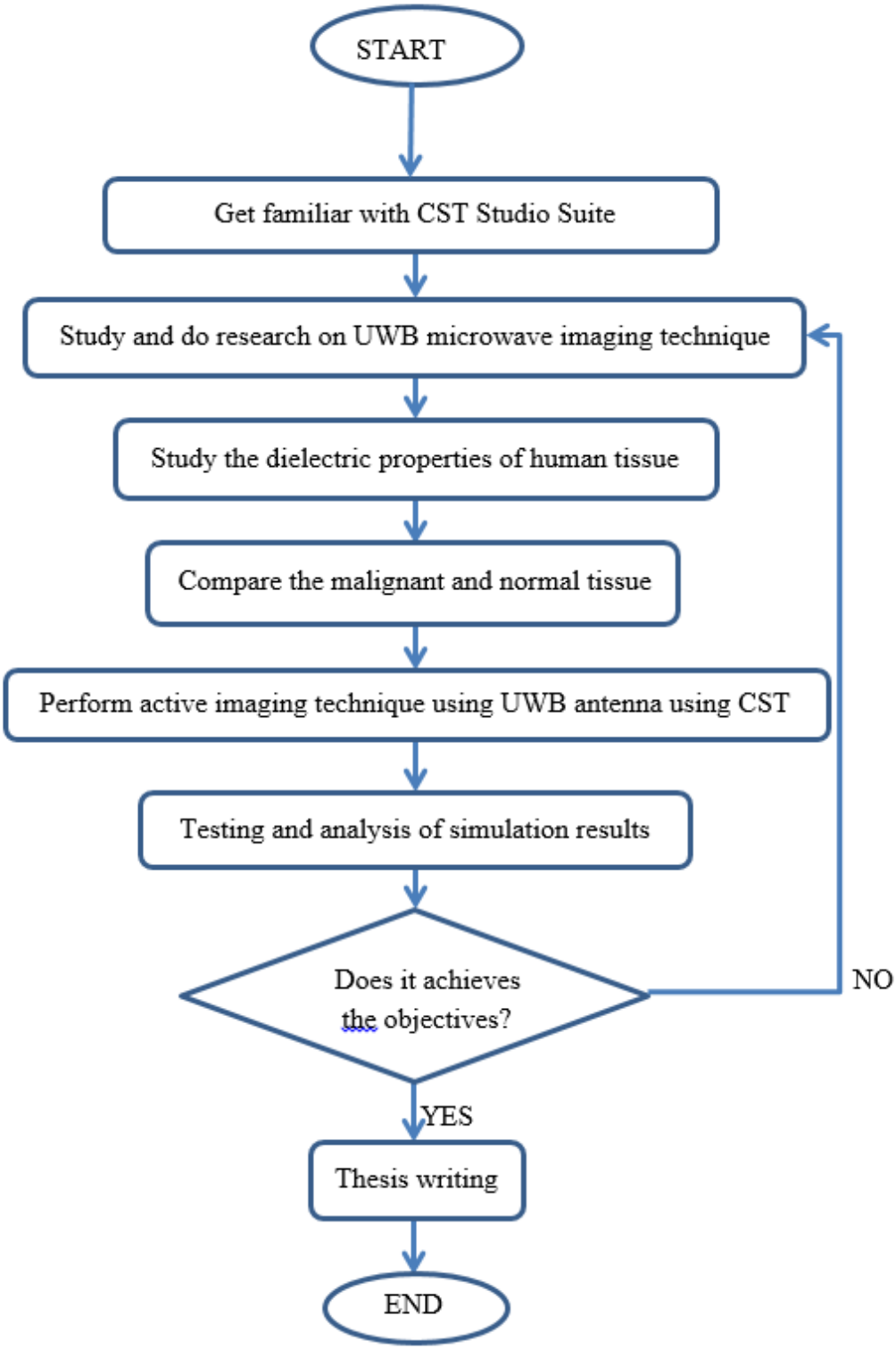

Figure 3.1 The workflow of project

3.2 The Proposed System Design

In this work, the main objective is to minimize the average outage probability over the *M* transmitting users for a cellular mobile communication network. In the cellular networks, communications among the users are supervised by the base station. This type of centralized controller has the complete information of all the channels between the users and channel between users and the base station. This algorithm identifies the partners in the network such that each user will have the best partner (coupling neighbor). Thus, the overall performance of the communication is improved for all the users.

In this work, it is assumed that the signal from the base station (downlink) serves all the *M* users in a single cell. The *M* users are randomly distributed within the cell and base station is located at the center of the cell. It is also assumed that the received signals SNRs from all the users at the base station are random and the inter-user SNRs channels also exhibits random values. Since the base station supervises all the users in the cell, it has all information about all other users i.e (location, SNR for uplink channels and SNR for inter-user channels).

The coupling algorithm selects the best uplink SNR among the entire uplinks available and also indentifies the weakest uplink (lowest SNR) connection available in the network. Then, these two uplinks are coupled to make one cooperation grouping. This will help to increase the average outage probability for M users as compared to the non cooperation scheme.

Figure 3.1 shows the typical wireless mobile communication network system, where several users are confined in a particular cell. As for illustration, the first cell consists of two-user grouping cooperation, the second cell consists of three-user grouping and the

third cell consists of both the grouping style i.e. the three-user and the two-user grouping. This figure shows one of the possible scenarios of the mobile communication network, and the grouping style (content of the cell) may vary in random.

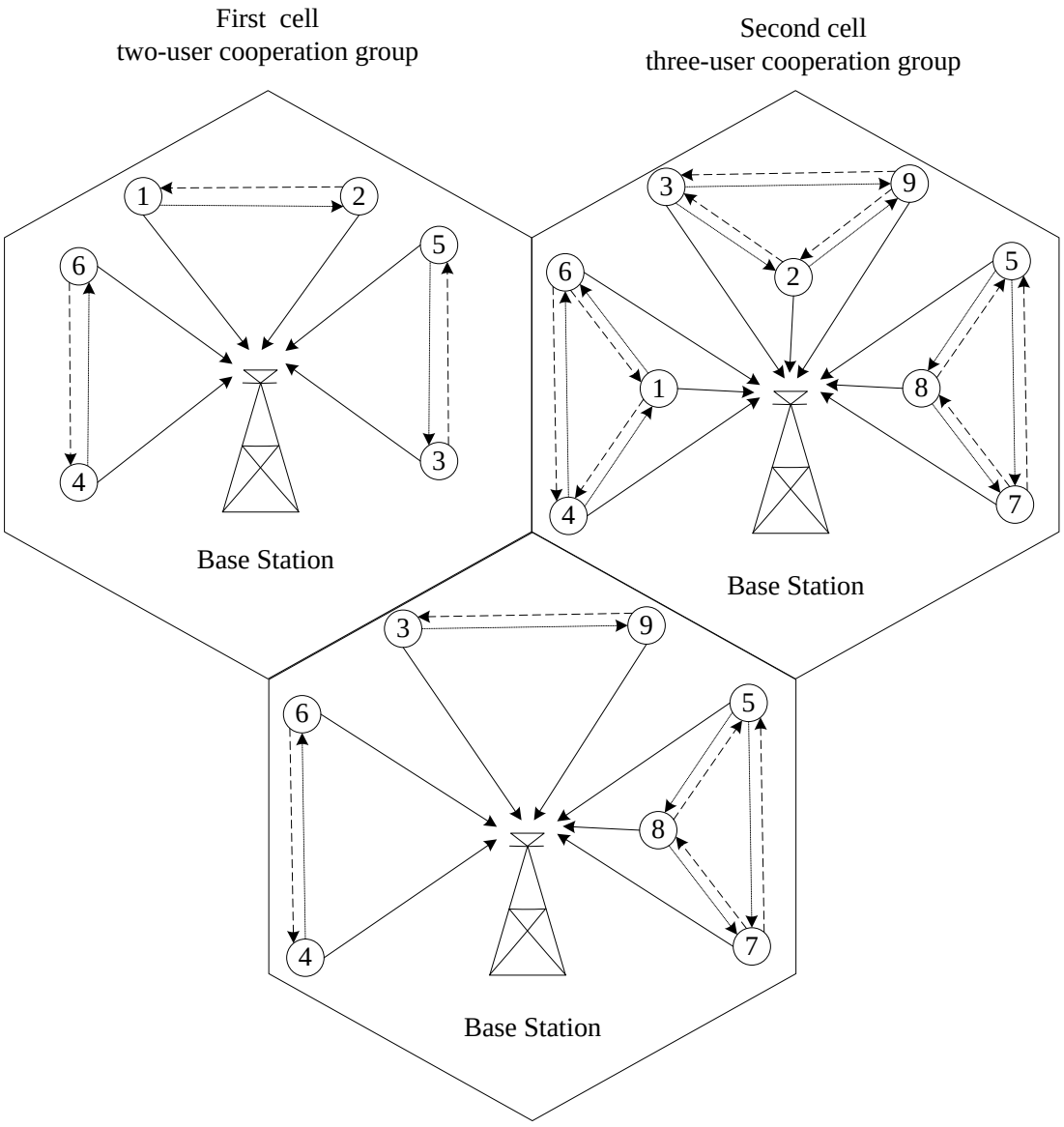

Figure 3.1 Partner coupling for user RS coded cooperation

Performance result for the algorithm is obtained by averaging the users outage probability metrics and the results are obtained by using Monte Carlo simulation. The results for the coupling partner algorithm are obtained by using Monte Carlo simulation. The Monte Carlo method is a class of computational algorithms that repeat the random samples as the input in order to compute their results. For more details on the Monte Carlo method are readily available in [6].

The result performance can be obtained after taking the following steps;

1. Compute the number of user in the cell (donated by M).
2. Received coefficient γ value on the uplink and inter users signals for each user from users to base station.
3. Select the partners according to the partner coupling algorithm as shown in **خطأ! لم يتم العثور على مصدر المرجع.**
4. Compute the desired metrics for an arbitrary user based on the given partner selection.

The outcomes of Step 4 are then averaged over 100 iterations taken to produce the desired result. This number of iteration taken based on experiment, where the lower number of iteration, say 50 produces fluctuating results (unsmooth curve).

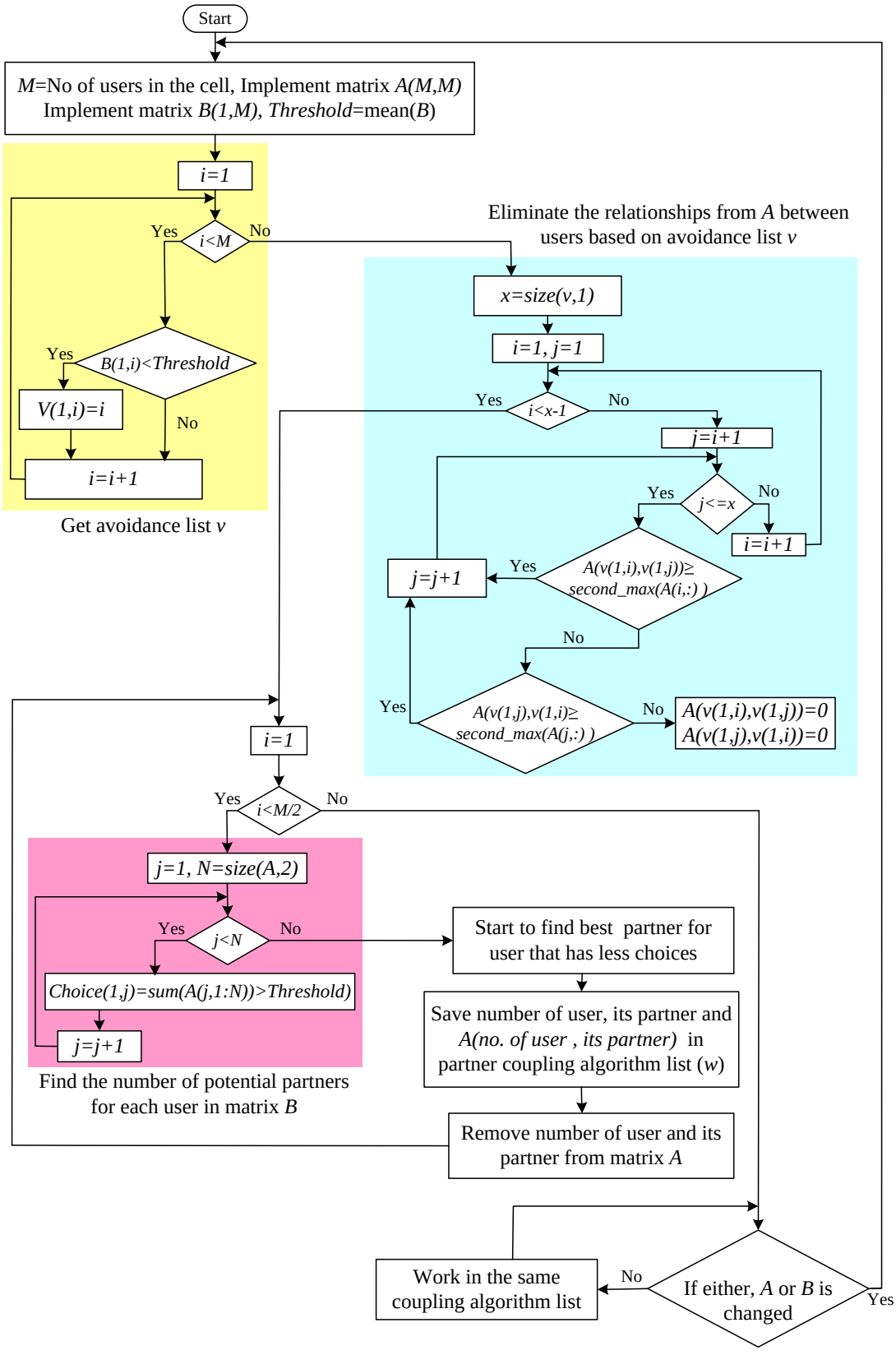

Figure 3.2 Flow chart for partner coupling algorithm

Following example 1 explains the details of the steps involved in the partner coupling algorithm as shown in flow chart in Figure 3.2 and Pseudo code for partner coupling algorithm shown in appendix D with 10 users and couple two user in every cooperation group.

$$x_{1,2} = \frac{-\mathrm{b} \pm \sqrt{\mathrm{b}^2 - 4\mathrm{ac}}}{2\mathrm{a}} \tag{3.1}$$

$$(x + a)^n = \sum_{k=0}^{n} \binom{n}{k} x^k a^{n-k} \tag{3.2}$$

The implementation of an antenna with a narrow beam-width helps to combat impairments such as path loss and interference. The effects of the Polarization mismatch and the polarization reflection will be eliminated if both the transmitting and the receiving antennas have circular polarization diversity. The implementation of circular polarization is more suitable for indoor wireless dynamic environments because it does.

3.2.1 Sub-subheading 1

The implementation of an antenna with a narrow beam-width helps to combat impairments such as path loss and interference. The effects of the Polarization mismatch and the polarization reflection will be eliminated if both the transmitting and the receiving antennas have circular polarization diversity. The implementation of circular polarization is more suitable for indoor wireless dynamic environments because it does.

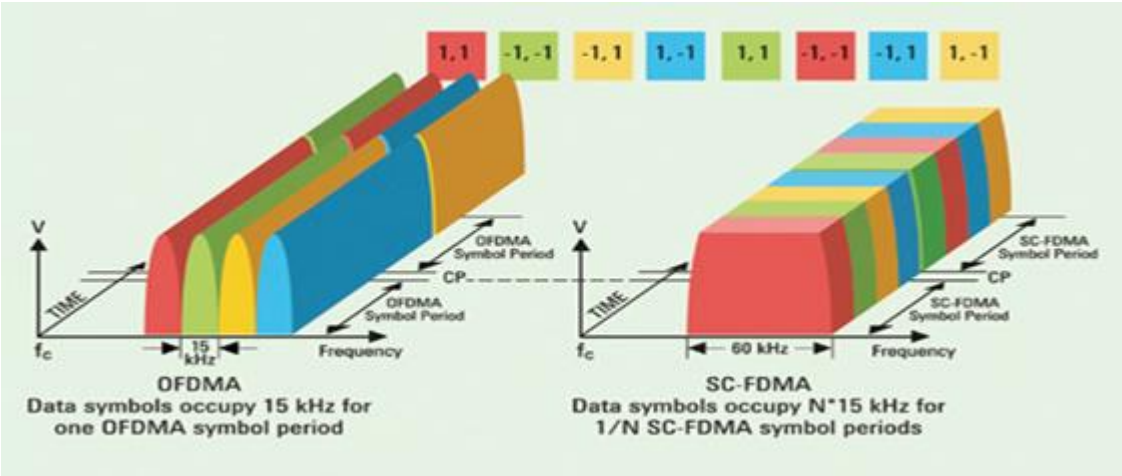

Figure 3.2 Xxx

3.2.2 Sub-subheading 2

The implementation of an antenna with a narrow beam-width helps to combat impairments such as path loss and interference. The effects of the Polarization mismatch and the polarization reflection will be eliminated if both the transmitting and the receiving antennas have circular polarization diversity. The implementation of circular polarization is more suitable for indoor wireless dynamic environments because it does.

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3.2.3 Sub-subheading 3

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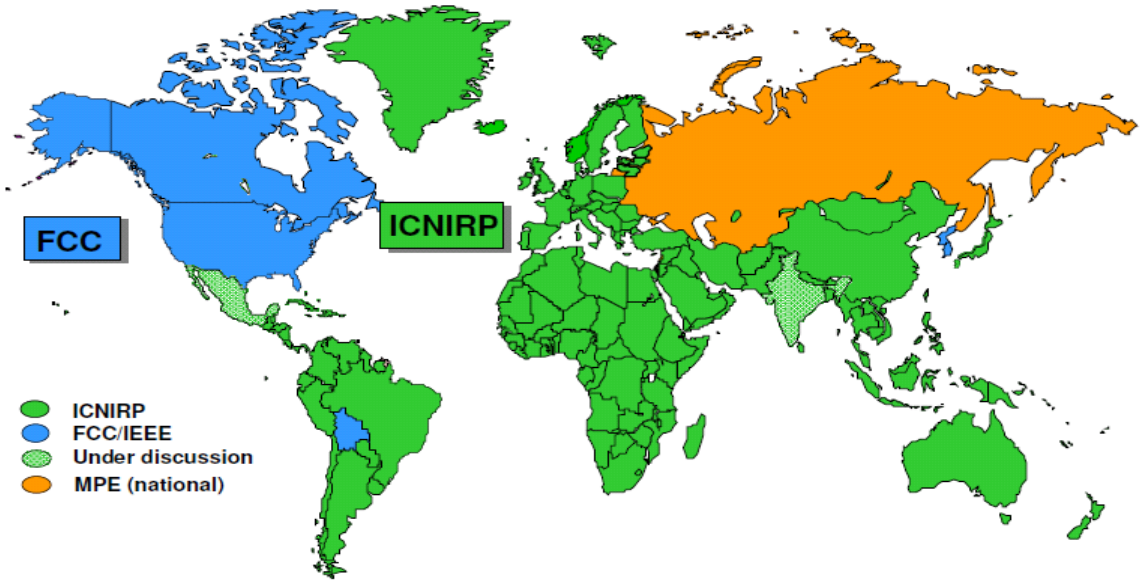

Figure 3.3 Xxx

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The implementation of an antenna with a narrow beam-width helps to combat impairments such as path loss and interference. The effects of the Polarization mismatch and the polarization reflection will be eliminated if both the transmitting and the receiving antennas have circular polarization diversity. The implementation of circular polarization is more suitable for indoor wireless dynamic environments because it does.

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MYTH	FACT
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	temperature of the brain by fractions of a degree, less than normal exercise.
• You are safer using a mobile phone in a car because it shields you from the radiation.	• Mobile phones automatically increase their input in a car to overcome the shielding.
• Using mobile phones in a car does not affect your driving skills.	• You are four times more likely to have an accident crash because of divided attention, and it is similar to drunk-driving.

3.4 Expacted Results

xxxxxxx

3.5 Summary

In general, this chapter is to describe in depth of the process of lung tumour detection using UWB microwave imaging technique. To study the effectiveness of the technique, steps in conducting the project is by designing a UWB antenna and creating human thorax tissue model and tumour model and simulate it in CST.

References

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APPENDIX A: Gantt Chart

		Progress of Project - Gantt Chart														
No.	Task	Action/Week	Dec	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Choosing a Project Title	Projected														
		Actual														
2	Analysing the Circuit of the Project	Projected														
		Actual														
3	Purchasing Components	Projected														
		Actual														
4	Project Brief	Projected														
		Actual														
5	Assembling the Circuit	Projected														
		Actual														
6	1st Progress Report	Projected														
		Actual														
7	Testing of Project	Projected														
		Actual														
8	Oral Presentation	Projected														
		Actual														
9	Testing and Improvement	Projected														
		Actual														
10	2nd Progress Report	Projected														
		Actual														
11	Final Project Report	Projected														
		Actual														
12	Designing Flyers and Posters	Projected														
		Actual														
13	Final Preparation on Project	Projected														
		Actual														
14	Poster Presentation	Projected														
		Actual														

APPENDIX B: Project Budget

NO	COMPONENT	QUANTITY	PRICE	TOTAL
1	DC MOTOR	1	RM 70.00	RM 70.00
2	FAN BLADES	1	RM 50.00	RM 50.00
3	VOLTAGE STABILIZER	1	RM 50.00	RM 50.00
4	TOWER	1	RM 50.00	RM 50.00
5	OTHER COMPONENT		RM 50.00	RM 50.00
	TOTAL COST			RM 270.00

APPENDIX C: ADS Schematics to Design Path 3 and Path 4 of the Planar Microstrip Antenna Arra.y with 4×4 Butler Matrix

Figure A.1 shows the ADS schematic for path 3 which connects between antenna 3 and 4×4 Butler matrix. The ADS schematic to modify the length of path 3 is shown in Figure A.2.

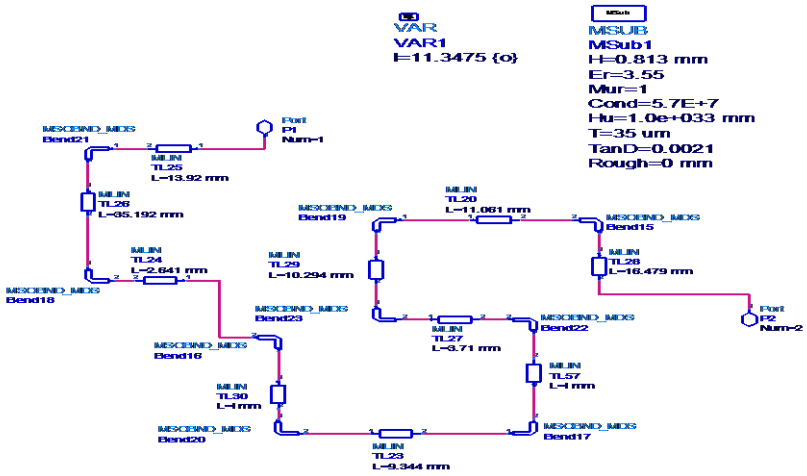

Figure A.1 ADS schematic for path 3

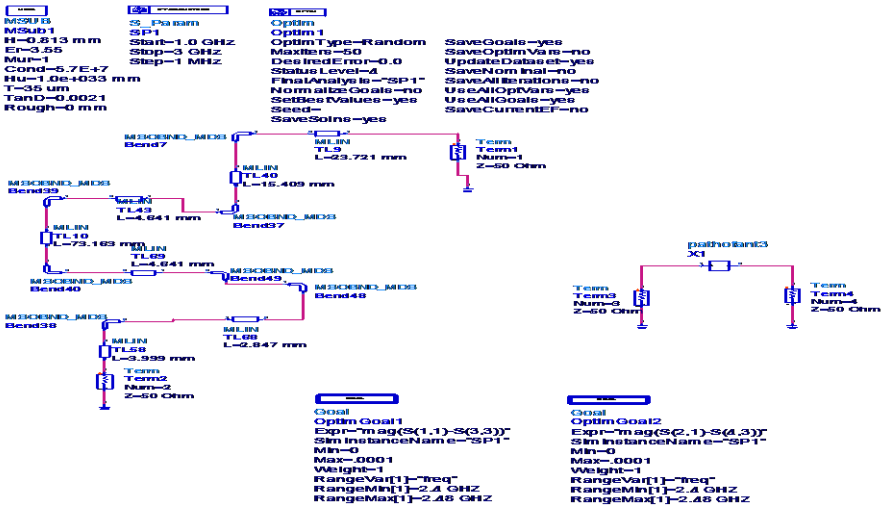

Figure A.2 ADS schematic to modify the length of path 3

APPENDIX B: Propagation Constant Inside the Cavity

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