

**DETECTING THE OCCURRENCE OF GROUND ULF  
ELECTROMAGNETIC SIGNAL PRIOR TO  
EARTHQUAKE EVENTS**

Thesis presented in partial fulfillment for the award of the  
Bachelor of Electrical Engineering (Hons)  
UNIVERSITI TEKNOLOGI MARA



**MOHD SYAKIRAN BIN SAMSUDIN**  
**FACULTY OF ELECTRICAL ENGINEERING**  
**UNIVERSITI TEKNOLOGI MARA**  
**40450 SHAH ALAM**

## ACKNOWLEDGEMENT

First and foremost, praises to Allah S.W.T., for the strength and blessing given to me in order to complete my final year project and thesis. Peace upon our Prophet Muhammad S.A.W. who has given the light to mankind.

I would like to take this opportunity to express my grateful appreciation and sincere gratitude to my supervisor Dr. Norsuzila bt Ya'acob, for the commitment and effort in helping me completing this project. Her wide knowledge and her logical way of thinking have been a great value for me. Her understanding, encouraging and personal guidance have provided a good basis for the present thesis.

I also wish to convey my thanks to my beloved father, Samsudin bin Hamzah and my lovely mother, that gave me space and always encouraged me in completing this project. Their kindness will always get a special place in my heart. Furthermore, thanks to Mr. Clark Dunson from Quakefinder for giving me the permission to use their data.

Last but not least, a special appreciation to my friends for being supportive and helpful in process for preparing this project and thesis. I would not make it this far without their support, patience and encouragement along this period.

## ABSTRACT

This project is emphasizing on detecting the occurrence of ground Ultra Low Frequency (ULF) signal prior to the earthquake events. An earthquake is a trembling of the ground those results from the sudden shifting of rock beneath the Earth's crust that creates seismic waves. Earthquakes are caused mostly by rupture of geological faults, volcanic activity, landslides, mine blasts, and nuclear experiments. Once earthquake happened, it will damage everything just in second. The destructive power is comparable to a nuclear bomb, depending on the magnitude. It is important to get early information about the occurrence of earthquake in order to minimize the risks caused by the earthquake. Geology researchers have made numerous attempts to define the relationship between some events and earthquake, and thereby use them as an earthquake precursor tool. The ULF frequency band (0.001 Hz to 10 Hz) is considered as most promising frequency range in ground base observation where electromagnetic earthquake precursors may be found. The ULF signal appeared as a burst-like emission and it can be observed around three hours earlier before the earthquake event occurred. This project used three set of real time data from California region which is on 06.08.2010 at Yucaipa-607 station, 11.10.2010 at OcotilloWells-606 station and 08.01.2011 at EastMilpitas-609 station. The data was taken from Quakefinder websites which owned magnetometer station along the California fault region. The observation was made several days before and on the day of the earthquake event occurred. The software used to analyze data is Matlab. From the results obtained, it shows strong correlation between ULF signal and determination of earthquake precursors.

## **TABLE OF CONTENTS**

<b>DECLARATION</b>	<b>iv</b>
<b>ACKNOWLEDGEMENT</b>	<b>v</b>
<b>ABSTRACT</b>	<b>vi</b>
<b>TABLE OF CONTENTS</b>	<b>vii</b>
<b>LIST OF FIGURES</b>	<b>ix</b>
<b>LIST OF TABLES</b>	<b>x</b>
<b>LIST OF ABBREVIATION</b>	<b>xi</b>

<b>CHAPTER</b>	<b>PAGE</b>
<b>1 INTRODUCTION</b>	
1.1 BACKGROUND OF STUDY	1
1.2 PROBLEM STATEMENT	3
1.3 OBJECTIVES	3
1.4 SCOPE OF PROJECTS	3
1.5 THESIS ORGANIZATION	4
<b>2 LITERATURE REVIEW</b>	
2.1 INTRODUCTION	5
2.2 EARTH STRUCTURE	5
2.3 EARTHQUAKE	8
2.3.1 EARTHQUAKE CHARACTERISTICS	9
2.3.2 TYPE OF EARTHQUAKE	10
2.3.3 EARTHQUAKE DETECTION AND MEASUREMENT	11
2.3.4 EFFECTS OF EARTHQUAKE	14
2.3.5 EARTHQUAKE PREDICTION	17
2.4 ULTRA LOW FREQUENCY (ULF)	18
2.4.2 CLASSIFICATION OF ULF	20
2.4.3 RELATIONSHIP BETWEEN EARTHQUAKE AND ULF	21
SUMMARY	22

# CHAPTER 1

## INTRODUCTION

### 1.1 BACKGROUND OF STUDY

Earthquake is the result of a sudden release of energy in the earth's crust that creates seismic waves and can be recorded in terms of Richter scale by using seismometer or seismograph [1]. Earthquakes are produced at plate boundaries where two plates sliding past each other. The movement of the Earth's plates bends and squeezes the rocks at the edges of the plates and puts great pressure on the rocks. If the pressures become too great, the rock layer will break and release the energy stored in it then causes seismic wave to be produced. This seismic wave generates the destruction that can accompany an earthquake by shaking, and cracking the ground as they pass through an area. The seismic activity of an area refers to the frequency, size and type of earthquakes over a period of time.

Earthquakes are caused by the release of built-up stress within rocks along geologic faults or by the movement of magma in volcanic areas. They are usually followed by aftershocks. Most of the earthquake event occurred along the plate boundaries called Plate Tectonics. It consists of some major and minor plates that form the ground, mountain, trenches and also volcano. Earthquakes primarily occur at the boundaries where the 100 km-thick tectonic plates converge, diverge, or slide past each other [2]. Although the plate moves steadily, their boundaries are often "locked", and do not move most of the time. However, on time of a few hundred years, the boundary slips suddenly, and the accumulated motion is released in an earthquake.