CHAPTER I
INTRODUCTION

1.1 Background

Small displacement is an indicator of problems in several fields such as monitoring the health of building structures, landslides, monitoring of vibrations in large mechanical structures and in health fields such as respiration and heart rate. This problem can be identify from the phenomenon of shifting with a small size in the order of millimeters to centimeters. The phenomenon of small displacement does not allow it to be measured directly, measurements need to cover a large area. Small displacement have been proven in several studies such as monitoring the health of building structures, landslides and in health fields such as respiration and heart rate [1, 2, 3].

The use of radar systems as a potential non-contact scanning method is a technological solution in a number of fields. Radar is proposed as a method for scanning human breathing or heart rate so that measuring the patient can provide better comfort and psychological impact. The technology also allows measurements to be carried out more efficiently, as it enables multiple-target detection. Radar has long been developed to detect more than one object [4]. So that it is possible to detect multiple objects at the same time.

A number of studies have been conducted using Frequency Modulation Continuous Wave (FMCW) radar [5, 6] and Impulse [7]. The radar system has also begun to be studied for scanning shifts in large structures such as large bridges to monitor the health condition of the bridges. To obtain shift data that is capable of representing large structures, the installation of contact sensors will require many sensors and complexity in their integration. The shifts that occur in the structure will then be an indicator of the normal condition of the structure. A number of experiments that have been carried out include using the FMCW system to detect the small shifts that are modeled on each trihedral reflective object which will then be installed in a number of positions on the structure. [8, 9, 10].

The problem that will be examined in this thesis is related to the shortcomings of the FMCW radar system relies on a wide bandwidth to detect small

displacements in various fields. The advantage of the FMCW system is that it can detect the target position precisely but to detect small displacement requires a wide bandwidth. By considering the capabilities of the FMCW radar system, modifications to the FMCW radar system are carry out for these needs. However, the effect of each modified FMCW system parameter on system performance in detecting small displacement needs to be identify. Noise is a common problem that affects the detection results and needs to be investigate in system development. Implementation testing using the Vector Network Analyzer (VNA) device was carry out on the modification of the FMCW radar in computer simulation so that it could provide more actual images, narrow bandwidth requirements, and the ability to detect small displacements.

1.2 Problem Identification

The FMCW radar is a very well established radar system and has been widely used in various applications. However, to detect small displacement with a size of cm to mm requires a very wide bandwidth, so it is not possible to use the conventional detection concept using beat frequency. The technique to add detection capability to the FMCW radar will then provide an opportunity for the FMCW radar to use to detect small displacement by changing the detection method.

Noise is a common problem in a wireless system, including radar. Therefore, it is necessary to study its effect on the results of the proposed small displacement detection.

1.3 Objective

The objective of this thesis are:

1. Designing a small displacement detection method on FMCW radar.
2. Conduct simulations and experiments to determine its detection ability.
3. Analyze the performance of the detection method in noise conditions.

1.4 Scope of Work

The scope of work in this thesis are:

1. Thesis based on the detection of the small displacement at a number of points without having to duplicate the sensor to measure a large area with a modified

FMCW radar system on a scale of 2 mm - 1 cm, narrow bandwidth, and low power.

2. The object or target used is the aluminum plate.
3. Noise amplitude is a noise aspect that will be study in the proposed method of the FMCW radar system in detecting small displacements.
4. The testing stage was carry out with computer simulations and continued with laboratory testing with VNA implementation experiments.

1.5 Research Method

In this study, the FMCW will modified in order to provide in detecting of small displacement. Therefore, it can detect small displacement in various fields such as landslide monitoring, bridge health monitoring and respiratory detection in humans. FMCW radar system parameters will examined as an object of study. FMCW radar system parameters are frequency, bandwidth, power, and noise. From these parameters studied by simulation using computer simulation and laboratory experiments. In this study the FMCW radar system was modify in order to detect small displacement in various fields. Because the needs of each parameter in a different field, the modified FMCW radar system is make to be able to detect in various fields that can detect small displacement.

1.6 Hypothesis

In this study, we can detect small displacement with the FMCW radar method by modifying the radar system using computer simulation as a stage in the experiment to prove the FMCW radar concept so that it can provide an actual image, the need for narrow bandwidth, and the ability to detect small displacement. Because FMCW radar has the advantage of detecting targets precisely but the disadvantage of not being able to detect small displacement.

1.7 Structure of the Thesis

The rest of this thesis is organized as follows:

CHAPTER 1 INTRODUCTION

This chapter contains the background, problem identification, objectives, problem boundaries, research methodology, hypotheses, and writing systematically.

CHAPTER II BASIC CONCEPT

This chapter contains basic concepts and theories related to thesis.

CHAPTER III RESEARCH METHODOLOGY

This chapter as a whole discusses the methods proposed for research and the structural plan for the methods to be use in the research.

CHAPTER IV RESULT AND ANALYSIS

This chapter discusses the results of simulations and experiments that have been carry out.

CHAPTER V CONCLUSION

This chapter contains conclusions from the results of research that has been carry out.