CHAPTER 1
INTRODUCTION

This chapter discusses the background which underlie this thesis and also the objective of this thesis. Scope of problems, research methodology, and the structure of this thesis are included.

1.1 Background

An object movement begin with a small displacement, it can be in centimeter or milimeter range. For example, a huge landslide on a hill begins with a small displacement of the ground itself. Not only on a hill, but also on a building. A small displacement on its construction, can rise the probability of a building to be collapsed. If these kinds of displacement can be detected earlier, a preventive action can be done and it may save many lives.

For conventional RADAR, to detect a small displacement, it needs a high resolution system. The higher the resolution, the more accurate the system. A wide bandwidth usage is caused by a high resolution system, and it is needed to make this kind of system.

Synthetic Aperture RADAR (SAR) has been used for small displacement detection. Some studies have been developing SAR technology that applied to detect a landslide [1] [2] [3].

SAR technology is using pulse waveform. This technology use an ultra-wideband (UWB) RADAR [4], it provides a fine resolution and accurate sensing by using a wide bandwidth in the system [5]. However, a wideband RADAR signal usage, gives some consequences such as increasing the realization complexity and giving interference in mitigations problems. Those problems above, underlie this thesis to use Continuous wave (CW) RADAR.

CW RADAR can detect the velocity of the target by recognizing the frequency change of the echo-signal in the receiver. The change of echo-signal frequency is named as doppler effect [6]. Afterward, a CW RADAR can only be applied on a dynamic target such as a vibration. A vibration may be viewed as a time-varying small displacement event that occured on an object. CW RADAR with its narrow bandwidth and simple structure feature, make it potential to be developed as the RADAR system for small displacement detection.

According to this situation, this thesis propose a system modification by using dual frequency to detect the displacement of a static target. The dual frequency usage helps the system to get the sinusoidal echo signal in the receiver. So then, the displacement can be detected by recognizing the phase shift of the echo signal.

HB100 is a motion sensor which used to performs the experiment. It is a Doppler transceiver module, which transmits 10 GHz frequency [7]. Then, it is a suitable frequency for small displacement detection in mm orde. This frequency is resulting a value of wavelength (λ) 30 mm, which means this system might detect any small displacement of a range under 30 mm.

The main aim of this thesis is to make a CW RADAR system which can detect a small displacement by recognizing the phase shift of the echo-signal. This thesis simulates the system by using MATLAB and performs the experiment by using HB100.

1.2 Problems Formulation

Based on the background above, there are some problems formulation of this dual frequency continuous wave RADAR. This thesis discusses about how to detect a small displacement by using CW RADAR, and the post processing of the proposed RADAR to recognize the small displacement.

1.3 Objective

The objective of this thesis is to design, simulates and performs the experiment of the dual frequency CW RADAR system.

1.4 Scope of Problems

The scopes on this thesis are as follows :

1. Frequency is chosen at 10 GHz.
2. The system is simulated by using MATLAB.
3. HB100 is used for the experiment of the system.
4. The system is applied on a single target.

1.5 Research Methodology

This thesis are divided into the following steps :

1. Literature Study
   The aim of this step is to collect data from books, papers, and journals related to continuous wave RADAR work principle.

2. Designing the System
   The system of dual CW RADAR is designed based on the collected datas.

3. Simulation
   In this step MATLAB software is used to simulate the designed system.

4. Experiment
   This thesis performs experiment by using HB100.

5. Performance Evaluation
   In this step, the obtained data from simulation and experiment is processed.

1.6 Structure of Thesis

The rest of the thesis is as follows:

1. Chapter 2 BASIC CONCEPTS
   This chapter explains the concept of CW RADAR, the phase, and the I/Q demodulator.

2. Chapter 3 THE PROPOSED DESIGN AND SYSTEM MODEL
   Contains the proposed design of dual frequency CW RADAR. Hardware and software specifications are included.

3. Chapter 4 PERFORMANCE EVALUATION
   This chapter discusses the result and the analysis of this thesis.

4. Chapter 5 CONCLUSION AND SUGGESTIONS
   Contains the conclusion and the suggestions of this thesis.