CHAPTER I
INTRODUCTION

1.1 Background

Vehicle security systems in cars use a lot of radar technology and are useful to avoid friction with other vehicles on the road and prevent theft and vandalism in the parking lot. Therefore, it can be said that radar technology (radio detection and ranging) is the main technology for this purpose. Its market breakthrough spread throughout the world, covering nearly all types and models of vehicles from all manufacturers. Although there are no regulations governing this, radar technology has become a standard that must be installed in every vehicle.

In many applications, vehicle security detection systems are more often used in outdoor environments. This means that the stability of its performance is very vulnerable to changes in conditions and weather. The main reason why radar technology was chosen is because its sensitivity is not affected by heavy rain, fog, or snow. The reason above is that radar technology is considered superior compared to other sensors such as cameras and LiDAR [1].

Radar that uses Frequency Modulated Continuous Wave (FMCW) is more widely used because of its wide bandwidth. The working frequency in vehicle or car applications is set in the range of 24 or 77 GHz because the equipment continues to work optimally beyond various types of objects and situations at this frequency. Japan and European countries, soon to be followed by the United States and Canada, have confirmed a frequency range of 77-88 GHz to be used as the scope of short-range automotive radar detection applications.

A number of studies have been conducted to test the reliability of automotive radar as a tool to prevent traffic accidents [2]. These studies utilized the FMCW radar, which occupies frequencies from 77 to 81 GHz [3]. The researchers chose to focus on detecting short-range radar at 79 GHz Split Resonator (SRR). The first rationale is that this frequency has a wide bandwidth (up to 4 GHz). Then, the second reason is because many sensors will be installed around the car body, so economic considerations are taken into consideration. The third reason is that the number of pieces of equipment to be tested is more than one or two devices, in addition to the number of signal processing implementations that will be simulated using mathematical equations (Matlab).

The problems that will be reviewed in this thesis are related to the lack of existing security systems in vehicles, which can result in collisions or traffic accidents because blind spots are not available. Therefore, in this study, an automotive radar system was created using the

FMCW radar to detect cars around the car being driven by the driver to avoid traffic accidents that could harm the driver and local residents in that location. The advantage of the FMCW radar is that it provides good range and relative speed estimation with high accuracy in terms of cost and efficiency. According to AUTO2000, the blind spot is the area around the car where, at that point, no object or vehicle will be detected. Since the blind spot area or blind spot is an area that cannot be seen by the driver, in general, the larger the vehicle, the wider the blind spot area (no zone) will be, as shown in Figure 1.1. According to Inbok Lee et al. (2011), the blind spot is the viewing angle area at the rear of the left and right sides of the vehicle that is not covered by regular internal and external mirrors. The largest blind spot is located to the right of the driver, shoulder-width between the edges, where peripheral vision ends, and the area up to the rear of the car that is not visible in the side mirrors. The left side blind spot is smaller and should be checked as well.

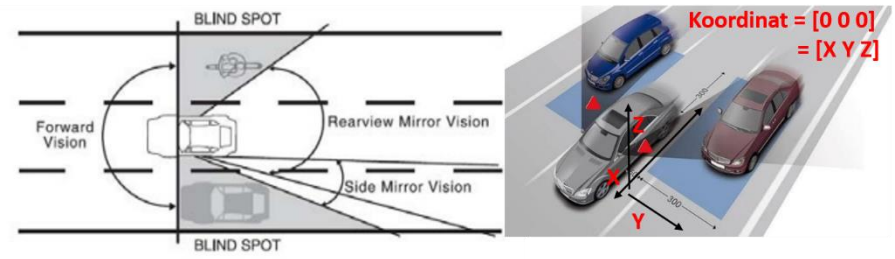

Figure 1.1 Blind Spot Definition [22]

Thus, automotive radar using FMCW is intended as a tool to detect objects around it in order to avoid traffic accidents that can harm the driver and the people around that location. The Blind Spot Detection (BSD) system requires a small detection area with a maximum range of 5 meters (up to 15m) at the car's blind spot location. The path change assistant system can be thought of as a logical extension of the BSD system. FMCW was chosen because of its good range, high and accurate estimation of signal transmission speed, and production of a simulation design as a mitigation for other vehicle detection objects located on the right and left sides of the car.

1.2 Problem Identification

FMCW radar is a radar system that has been widely used in various applications. However, to detect nearby vehicle objects at closer distances, it requires a very wide bandwidth. This study takes up the main discussion of automotive radar, which can provide early detection in the vehicle's blind spot area. The intended radar is a system for sending and receiving information from one vehicle to another around it so that potential traffic accidents can be avoided. Specifically, the automotive radar used in this study is an FMCW-based automotive radar. The formulation of the problem is as follows:

1. How does the FMCW radar work in the vehicle's blind spot area?
2. What technical advantages does the FMCW radar have that makes it feasible to be the choice for automotive safety detection?
3. What about the detection accuracy of the vehicle with objects around?

1.3 Research Objectives

The aims of this thesis are:

1. to design a blind spot area detection method that is applied to the car body using an FMCW radar with an antenna array.
2. to conduct a simulation to determine its detection ability.
3. to conduct performance analysis and measure the quality of object detection in the blind spot area with the FMCW radar antenna array.

1.4 Problem Limitations

The limitations of the problem in this thesis are:

1. The thesis focuses on detecting the blind spot area at a number of points without having to double the sensor to monitor a large area with a modification of the FMCW radar system using an antenna array at a scale of 5 cm – 150 cm, narrow bandwidth, and low power.
2. The simulation shows the blind spot area with the weakest object distance indicated by area dots.
3. The testing phase is carried out by computer simulation using software mathematical equations (Matlab).

1.5 Research Methodology

In this study, the FMCW radar system will be modified with an antenna array so that it can detect the blind spot area, which will be applied to the left and right sides of the car, and detect objects around the blind spot area, which will be pointed at the weakest point area. The parameters of the FMCW radar antenna array system will be examined as an object of study. The parameters of the FMCW radar system are frequency, bandwidth, and noise. These parameters are tested by simulation using Matlab software.

1.6 Hypothesis

This research can show the detection of the blind spot area using the FMCW radar antenna array method by modifying the radar system using Matlab software as an experimental stage to prove the FMCW radar concept so that it can provide more actual images, can fulfill wide bandwidth requirements, and has the ability to detect the blind spot area for motorized vehicles. This happens because the FMCW radar has the advantage of detecting objects precisely and accurately.

1.7 Thesis Structure

This research is divided into several topics of discussion, which are systematically arranged as follows:

CHAPTER 1 INTRODUCTION

This chapter contains background, problem identification, objectives, problem definition, research methodology, hypotheses, and thesis structure.

CHAPTER II LITERATURE REVIEW

This chapter contains the basic concepts and theories related to the thesis.

CHAPTER III RESEARCH METHODOLOGY

This chapter as a whole discusses the proposed method for the research and the planned structure of the method to be used in the research.

CHAPTER IV RESULTS AND ANALYSIS

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

CHAPTER V CONCLUSION

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