# Chapter 1 INTRODUCTION

## 1.1 Background

In 3D radar systems, antenna arrays are used to process beamforming to define the elevation degree, which aims to determine height of target. On the conventional transmitter radar, the cosecant beam pattern is produced by parabolic antenna. In 3D radar, the antennas is an arrays antenna, so to get cosecant beam we must use phase shifter.

To determine the height of a target, the receiver uses Direction of Arrival (DoA) technique. DoA is processed in software. With the DoA process, the target height can be estimated. There are three types of classical DoA algorithm, there are: Minimum Variance Distortionless Response (MVDR) [1], Multiple Signal Classification (MUSIC) [1], and Estimation of Signal Parameters Via Rotational Invariant Techniques (ESPRIT) [1].

MUSIC algorithm is one of the breakthrough algorithms in the field of DoA with eigen analysis techniques on covariance matrix. This algorithm is often called as an eigen based algorithm. The success of this algorithm in detecting several sources at once with very high resolution be the main attraction of this algorithm. Some problems with the MUSIC algorithm are the number of samples for calculating the covariance matrix must be large enough to obtain a statistic stable, and high calculation complexity [1].

ESPRIT algorithm exploits the symmetry structure of the ULA arrangement with the exploitation of this symmetry structure, then the ESPRIT algorithm doesn't do corner-by-corner scanning. However, analytically obtained DoA estimates from received and exploited signals from antenna symmetry structure. The weakness of the ESPRIT algorithm is ability the detection is only half the signal compared to the algorithm MUSIC. The computational process in ESPRIT is quite heavy on the other hand requires high computing resources. Some of these reasons lead to algorithms ESPRIT is less popular in the field of implementation [1].

The MVDR algorithm was proposed by Capon in 1969. The MVDR algorithm was processed by correlating the received signal. The advantage of MVDR algorithm is that this algorithm is robust against noise, and has relatively low complexity. While the drawback of this algorithm is that it has a low detection resolution. Low detection resolution means that it usually cannot distinguished two objects with a small angle of arrival difference. In the term of implementation, MVDR is favourable to MUSIC and ESPRIT. For examples in continuous wave (CW) radar system used MVDR to detect the elevation angle. Simplicity and robustness are the main reason that MVDR is used in these researches.

In this thesis we proposed the modified of MVDR algorithm, with adding matched filter and phase detector before MVDR processing.

## 1.2 Problem Identification

MVDR algorithm is usually applied to continuous signals, where continuous signals radiate all the time with a fixed frequency value. The MVDR algorithm applied to a continuous signal, the higher the SNR, the better the result.

While the signal emitted on the radar, is a pulse compression signal, where the signal is only emitted at a certain time and has a frequency that changes linearly. Based on the simulation, MVDR is applied to pulse compression signals, resulting in mismatched output.

## 1.3 Objective

The objective of this research is to modify the conventional MVDR so that it can work on chirp signal. The capability of the new algorithm is expected to improve the conventional algorithm in the case of very high noise environment. The modification will include the pre-processing scheme that consist of matched filtering and phase detecting.

## 1.4 Proposed Solution

The MVDR algorithm will be modified by adding a process between the input signal and the MVDR algorithm process. Before the MVDR algorithm, in the future a matched filter and phase detector will be added.

## 1.5 Expected Results

With the addition of a process in front of the MVDR algorithm, it is expected that the results of the MVDR algorithm process applied to the pulse compression signal will produce the same results as the MVDR applied to the continuous signal.