CHAPTER 1
INTRODUCTION

1.1 Background

Soil moisture is difficult to determine because it has different things in different disciplines, including in agriculture [1]. Soil is very supportive of plant life that provides nutrients and water on earth, but not all soils in Indonesia have soil types with good and stable water content. Sub-surface water content to the root zone is very important for the development of crops, which affects the quality and quantity. Generally, the problem that occurs is the determination of physical and mechanical properties of the soil, not all soils are suitable for plants because the texture of the soil is different, this is very important because the water content in the soil serves as a medium for nutrient transport to plant roots, water content in excessive soils can limit the movement of air in the soil resulting in dead plants [2] .

Spatial knowledge of groundwater content is also important for precision agriculture programs, and the costs of crop irrigation can be very large, especially in arid and semi-arid regions [3]. There are several methods to identify soil moisture, including the gravimetric method [4]. For wide area observations, the gravimetric method will certainly require a lot of time and money to detect. Remote sensing method for estimating characteristics Soil has also been studied in soil mapping, such as satellite imaging [5], Radiometrics [6], Synthetic Aperture Radar (SAR) [7] and Ground Penetrating Radar (GPR) [3], but that this measurement must be done in a laboratory so it requires a lot of time and effort to get a moisture content value. Therefore a Ground Penetrating Radar (GPR) tool was developed which can be used to find out information on the water content under the surface in a short and easy time.

Ground Penetrating Radar (GPR) is a geophysical method that uses electromagnetic radar pulses to image subsurface structures[4]. This non-destructive approach uses electromagnetic waves in microwaves in the radio spectrum to detect signals reflected from underground structures [8]. GPR can be used in a variety of media, including rock, earth, ice, snow, water and construction. It can detect things underground, variations in material, and cracks and holes. The advantages of the GPR method include safety, portability, low cost, and does not damage the soil.

The GPR system consists of a transmitter, an antenna connected to a signal gen-

erator and a receiver, an antenna connected to a VNA (Vector Network Analyzer) then connected to a survey data processing unit and then the output of a display for aids get an information on the state of objects under the surface of the ground. The sending antenna sends electromagnetic pulses into the ground. then the electromagnetic waves that are sent will experience a reflection when exposed to the object, then the reflected signal will be captured by the receiving antenna (receiver) and then processed to obtain an underground condition that can be easily concluded by the user of the tool.

This thesis is a further development of Raymond's previous thesis. There are several additions to this thesis such as the method and principle of processing the output data signal. In this thesis use MATLAB to design a post-processing tool for GPR data to obtain information on water content on the subgrade. Therefore, image processing is a very important main part of the GPR device, because it requires a received signal in order to obtain accurate information to obtain the condition of objects under the surface of the ground[4].

Signal processing consists of several stages, namely A-Scan includes one-dimensional GPR Scanning data in the form of repair and detection of one-dimensional objects, B-Scan a collection of data from A-Scan for two-dimensional data processing, and C-Scan a collection of data from B- Scan for three-dimensional data processing. The method used in this thesis is the processing of B-Scan images, GPR device survey data will be processed to obtain information and mapping of water content on the ground so that it makes it easier for users to define the content on the ground. In this thesis, GPR with the antenna placed above the ground is used as a method to map groundwater content, especially in the upper layer.

1.2 Problem Formulation

Mapping and detection of water content at top soil in large areas using GPR, process the measurement data from the measurement survey with the GPR device in order to obtain information on water content on soil top level on the B-Scan image. The B-scan method is expected to be able to increase the time, easy to identify the state of the soil, and the cost efficiency in mapping top soil content over a large area.

1.3 Purpose

The purpose of writing this thesis is to develop research that has been done previously by applying the B-scan processing on the GPR system to determine

mapping of the water content on the ground, which then performs the test of the implementation of detection with actual measurement conditions. The method used is expected to improve time and cost efficiency in mapping groundwater content in large areas.

1.4 Scope of Research

The scope of the problem in the research is detection and mapping of water content in top soil. So in this final project is given some problem constraints.

1. The research focus on process process signal until B-scan.
2. Imaging of underground objects using a time domain GPR device with a frequency of 1 GHz.
3. Electromagnetic wave propagation media with unspecific sand.
4. Does not discuss the GPR device subsystem in depth.
5. Not analysing the detection of soil types.
6. Research used depth of the object are 3 cm and 10 cm from surface ground.

1.5 Research Methodology

The research methodology carried out on this thesis are:

1. Study of Literature

   The purposes of this step are to collecting and identify some journals, paper, books, and the previous research about Ground Penetrating Radar (GPR) system, signal processing in GPR, the method to mapping and determine the water conten on base soil using GPR to support the preparing this undergraduate thesis.

2. Experiment

   Collect data from experiments using VNA. Before that, preparations were made for tools used for the experiment, one of which was a sandbox with sand that was not specified specifically, VNA, bistatic antenna and water at the bottom of the soil. Then sand with water at the bottom of the soil will be mapped, by collecting data on the VNA which will then be analyzed.

3. Analysis

   The analysis process is the result of an experiment in the form of a GPR output signal that has been taken subsequently processed into an image or image using a matrix laboratory.

4. Conclusion

   This step is the final stage to be done as a report of the results and conclusions of the experiments and analyzes that have been carried out.