CHAPTER 1

INTRODUCTION

1.0 Introducing Wood Scanning

The forest industry is one of the base industries in Malaysia and it covers all parts of the process from planting small trees to the refined end-products such as paper and lumber that will be used for various purposes. This proposal focus on the timber logs when they enter the saw mill, especially on the part of the process when solid wood is to be refined into lumber. This process involves a number of grading tasks where some kind of aid for the grading decision is of large interest. In addition to the grading the utilisation of the logs can be remarkably improved by deciding an optimal cutting strategy of the logs already at the line where they enter the sawmill. The optimisation strategy needs information about the dimensions as well as the inner structure of the logs in order to make the optimal cutting or grading decision. The optimisation criteria depend on the type of wood (Anders Kaestners 1999).

The simplest aid is the visual inspection by a human operator using his eyes as the only information source to base the decision on. This inspection can be considered to be a surface scanning and can also be carried out with the help of cameras and laser-scanners. The direct human has some drawbacks that affect the results, varying experience and varying degrees of awareness of the information passing by and the

judgments will therefore be subjective and varying with time. An automated scanning system performing the same task is always making the same decision when presented with identical information.

Scanning systems can be subdivided into two classes: namely surface and tomographic scanners. The surface scanner is only capable of gathering information from the surface of the log such as surface patterns and geometric dimensions, which is sufficient information for some purposes. If on the other hand, one is interested in the inner structure of the material, then the only possibility is to use a tomographic scanner that reveal the inner structure of the log in terms of variations in various physical properties. These two classes also have some what varying purposes; the surface scanners are more suited for grading sawn boards while the tomographic scanner is more suitable as provider of information to an optimisation system before the log is cut into lumber.

Another application in the sawmill is also related to optimisation, but does not involve a rotation of the log. The task in this application is to detect the presence of and determine the defection inside the wood using microwave signal.

1.1 Project Background

Scanning wood for internal defects has been large interest in the research nowadays. Today there are varieties of scanning technologies available and from those the most interesting alternatives for an industrial application in a sawmill are:

- X-ray computed tomography

- Ultra sound tomography

The X-ray based system is the most commonly used scanning device for this type of applications delivers images and shows the variations in density within the material. The images are of high resolution and directly corresponding to the visible images if the log was entering at the selected position. This technology has some drawbacks though, the X-ray scanners are expensive and that the X-rays are high energy electromagnetic waves which are harmful for human beings.

The ultra sound system produces images that are based on the reflections of the sound waves in the material. Since ultra sound are mechanical waves working in the same frequency range as the harmonics of the mechanical vibration in the system the result is corrupted by a lot of noise. As a way to avoid the noise it has been suggested to immerse the logs in a fluid. However, this approach has some drawbacks such as the undesirable soaking of the log as well as the large amount of bubbles in the fluid that also interferes with the measurements (Anders Kaestners 1999). As a conclusion, this type of imaging system is not recommendable for log scanning purposes in an industrial environment even though it is inexpensive and harmless to human beings.

As alternative to the previously mentioned two methods we purpose to use a scanning device based on attenuation of microwave signal. The microwaves are low energy electromagnetic waves that are emitted at very low intensity and are thus virtually harmless to human beings. Microwave tomography is a new technology which has enormous potential advantages in medicine, especially in areas of so called "physiologist imaging", such as in cardiology (Ruser and V. Magon, 1997). Nowadays the development of microwave tomography in industry increased recent years especially fluids or level measurement in large tank and vessels (Viktor S. Arefiev et al, 1997). This because the microwaves capable to penetrate non-metallic materials. Thus, its

possible to penetrate the wall of pipes made of concrete, stoneware or plastics to inspect the state of the pipe surrounding. The Microwave signal also is applied to measure moisture content, density, weight, and grain angle of wood depends on the attenuation, phase shift and depolarization (A Plaskowski et al).

The aim of this proposal is to study the possibility of microwave in order to determine the internal characteristic of wood especially on defection inside the wood

1.2 Objective of Project

1) To understand the basic concept of tomography/ scanning process and microwave signal propagation.

2) To understand the basic concept of measurement of microwave attenuation when passed through the wood.

3) To select proper wood type for studied purpose.

4) To select the proper width size of wood for experiment purposed.

5) To locate the internal defection inside wood for experiment purposed

6) To determine the effect of microwave attenuation for undefective, defective, wood and undefective wood with moisture contains based on experiment results.

7) Analysis of data experiment based on extrapolation analysis.

8) Determine the preliminary results for possibility using microwave attenuation in wood scanning.

9) Use artificial neural network (ANN) that applied in Visual Basic to recognize the pattern voltage based on experiment data to develop 2D image and determine the internal characteristic of wood.

10) Purpose the solution from previous problem to be used in the future development and improvement.

1.3 Scope of Work

1 Use the propagation of microwaves 14.5 GHz in wood tomography base on the attenuation of the microwave signal.

2 The experiment only focus on rubber wood as material under test (MUT)

3 To implement / set up simple hardware for testing/experiments in order to find the need amount of data for analysis.

4 Analysis of experiment data in order to determine the possibility to use microwave attenuation for wood tomography.

5 All of the results are based on analysis of experiment results.

6 Off-line 2D image reconstruction using Visual Basic based on experiment data. The image only constructed based on data measurement for wood without moisture content.

1.4 Thesis Outline

The thesis is divided into 6 chapters, which the first chapter is introduction of the project. The introduction is followed by chapter 2 that explained on literature review of the project. The basic properties of microwave include the basic theory of measurement of microwave signal are explained in chapter 3. The basic wood properties also discussed in this chapter. Chapter 4 provide explanation on project methodology include background on instrument used, experiment set-up, sample and software used for 2D off-line image reconstruction. The methodology chapter is followed by chapter 5, which describe the results of experiment results and analysis of results. Thesis conclusion and future recommendations is described in chapter 6