

UNIVERSITI TEKNOLOGI MARA

**INDIVIDUAL TREE PARAMETER
EXTRACTION AT THE PLOT
LEVEL IN TROPICAL FOREST
USING TERRESTRIAL LASER
SCANNING**

**NUR IRDINA ZULAIQA BINTI ABU BADRI
(2019814112)**

Thesis submitted in fulfillment
of the requirements for the degree of
**BACHELOR OF SURVEYING SCIENCE AND
GEOMATICS (HONOURS)**

Faculty of Architecture, Planning, and Surveying

August 2022

ACKNOWLEDGEMENT

Bismillahirrahmanirrahim. Alhamdulillah. Firstly, I wish to thank Allah SWT for giving me the mercy, guidance, and opportunity to embark on my degree to complete this long and challenging journey successfully. I was grateful so much for experiencing the process and managing to complete this thesis.

Then, my gratitude and thanks go to my thesis supervisor and co-supervisor, Dr. Nurul Ain Binti Mohd Zaki, and Sir Mohamad Azril Bin Che Aziz for their support, persistence, understanding, and encouragement in completing this thesis journey. It has been pleased and honored to have as my thesis supervisor.

Besides, I would like to show my deep and sincere gratitude to the crew members of the FRIM who provided the facilities and assistance during sampling. Special thanks to my colleagues and friends for helping me in collecting the data at the FRIM.

After that, this thesis is dedicated to my very dear father and mother for their prayers, support in financial, and determination to educate me. This piece of victory is dedicated to both of you. Alhamdulillah.

In addition, I offer my special thanks to all individuals who helped me directly or indirectly in completing this thesis. Then, I want to thank Dr. Roslina Idris, Madam Siti Nor Maziah Saad, Madam Nurhafiza Md Saad, and Madam Siti Aminah Anshah for commenting and correcting my thesis in a good way.

Last but not least, I would like to express my thanks and gratitude to me for believing in me doing all this work. I also want to thank myself for having no days off, never quitting, and giving up on just being me at all times. Lastly, thanks to Allah for giving me the stability of the mental and physical for doing this thesis.

ABSTRACT

Forests are essential among the resources because they provide a source of wood as well as a means of protecting the hills, regulating streamflow, and minimizing soil erosion, among other things. Forests can only provide maximum advantages and benefits if they are managed appropriately. The quantity and quality of data available about the forest are crucial to effective forest management. If a renewable natural resource like a forest is to be managed reasonably and sustainably, basic data and information are essential. Forest inventories are the source of this data. This study aims to assess individual tree parameter extraction at the plot level in Tropical Forest using Terrestrial Laser Scanning (TLS). In order to achieve this study, there are two objectives of this research which are to establish the data collection of tree attributes such as tree species, tree height, diameter at breast height (DBH) using conventional method and terrestrial laser scanning and to identify the performance of Vision Lidar software and Cloud Compare software in generating the individual tree quantification. The method involved in the data processing used Vision Lidar and Cloud Compare software to process digital data and do the processing. This study will help the data of the tree characteristic to be kept updated using advanced technology. As a result, in terms of equipment purchase costs, staff skills and qualifications, data collecting working time, data recording accuracy, post-processing time, and labor expenses, one can select the most cost-effective approach for gathering forestry reference data. Although the application of TLS in forest inventory is a promising technology.

CHAPTER ONE

INTRODUCTION

1.1 Research Background

Forests and trees are essential elements of life on Earth to support basic human needs and contribute to culture and recreation. Other than that, they have a crucial function in the environment, such as providing a habitat for biodiversity, controlling climate, and purifying the atmosphere. Furthermore, forests play an important role in mitigating global warming caused by increased carbon dioxide (CO²) levels in the atmosphere, and they hold 86% of all terrestrial plant carbon on the Earth (Wassihun et al., 2019).

However, forest inventory information has always been important to forest management. Forest inventory is a general characterization of the forest in terms of diameter at breast height (DBH) of trees, species, and their mean height. In other terms, a forest inventory is a systematic collection of data and information on forests for assessment and analysis (Khameneh, 2013).

Other than that, modern technologies such as Terrestrial Laser Scanner (TLS), which may determine the vertical and horizontal structure of a forest by scanning targets with laser pulses, are usually used nowadays (Jung et al., 2011). According to Liang et al. (2019), terrestrial laser scanning (TLS) has been proved to be an efficient technology for acquiring reliable information on tree inventories in forest sample plots over the previous two decades.

Since the last decade, the use of three-dimensional (3D) terrestrial laser scanning (TLS) data with the use of several algorithms for single tree extraction has been widely used in the field of forestry to reduce the time, manpower, and cost of conventional forest inventory method (Khameneh, 2013). In addition, the terrestrial laser scanner is a type of high-speed and high-precision data acquisition instrument that is increasingly being used in forest inventory studies.

TABLE OF CONTENT

	Page
CONFIRMATION BY PANEL OF EXAMINERS	ii
AUTHOR'S DECLARATION	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENT	vi
LIST OF TABLES	ix
LIST OF FIGURES	x
LIST OF PLATES	xii
LIST OF SYMBOLS	xiii
LIST OF ABBREVIATIONS	xiv
CHAPTER ONE INTRODUCTION	1
1.1 Research Background	1
1.2 Problem Statement	2
1.3 Research Question	3
1.4 Aim of Study	3
1.5 Objective of Study	3
1.6 Scope and Limitation of Study	3
1.7 Data Acquisition	4
1.8 Significant of Research	4
CHAPTER TWO LITERATURE REVIEW	5
2.1 Introduction	5
2.2 Tropical Forest	6
2.3 Forest Inventory	7
2.4 Tree Height Measurement	8
2.5 DBH Measurement	9
2.6 Terrestrial Laser Scanning (TLS) System	11
2.7 TLS System Calibration	12