BATHYMETRIC STUDY AT MALACCA RIVER USING COMPRESSED HIGH-INTENSITY RADIATED PULSE DEVICE

MUHAMMAD REDZUAN BIN ISMAIL
B091810450

BACHELOR OF MECHANICAL ENGINEERING TECHNOLOGY (AUTOMOTIVE TECHNOLOGY) WITH HONOURS

JUNE 2021

Faculty of Mechanical and Manufacturing Engineering Technology

BATHYMETRIC STUDY AT MALACCA RIVER USING COMPRESSED HIGH-INTENSITY RADIATED PULSE DEVICE

MUHAMMAD REDZUAN BIN ISMAIL

Bachelor of Mechanical and Manufacturing Engineering Technology (Automotive Technology) (BMMA) with Honours

June 2021

BATHYMETRIC STUDY AT MALACCA RIVER USING COMPRESSED HIGH-INTENSITY RADIATED PULSE DEVICE

MUHAMMAD REDZUAN BIN ISMAIL

A thesis submitted
in fulfillment of the requirements for the degree of
Bachelor of Mechanical and Manufacturing Engineering Technology (Automotive)
(BMMA) with Honours

Faculty of Mechanical and Manufacturing Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

June 2021

DECLARATION

I declare that this Choose an item. entitled "Bathymetric Study At Malacca River Using Compressed High-Intensity Radiated Pulse" is the result of my own research except as cited in the references. The Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name : Muhammad Redzuan Bin Ismail

Date : 16/01/2022

APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical and Manufacturing Engineering Technology (BMMA) with Honours.

Signature : Najiyah

Supervisor Name : Najiyah Safwa Binti Khashi'ie

Date : 27/1/2022

DEDICATION

Every difficult task necessitates both self-effort and the guidance of experts, especially those close to our hearts. First and foremost, I dedicate my endeavour to my dear and loving father and mother. A heartfelt thank you to my parents for their unwavering support and for being a pillar of strength during my ordeal. In addition, I would like to express my greates appreciation to my supervisor and co-supervisor for constantly guiding and advising me.

Thank you.

ABSTRACT

Bathymetry is the method can be used to conduct a hydrographic survey. The method itself already evolve from time to time. The traditional way of bathymetric survey is using a single rope and single point checked. Besides, it has a huge limitation where it only can check a single point at a time different from the modern method like using Light Detection and Ranging (LiDAR) or sonar. These kind of new method is more effective than the old method because there is no limitation of point checked. The new method produced wider data result and the resolution for the data also higher than the traditional way. Not only that, the modern method also easy to use and the data obtained more accurate. Hydrographic survey is very important to estimate or observe the underwater terrain for the specific survey area. Hydrographic survey also can be used to provide the underwater map where it allows us to determine what is and is not safe, seafloor mapping is an important technique for regulating underwater resource exploration, extraction, and equipment. Other than that, bathymetric survey assist in ensuring that ships can manoeuvre safely and that human-made structures on the ocean floor are secure. Every bathymetric survey need a tool to ensure the study is successfully done. As this research is using the Smart Deeper Sonar device where this device is using the Compressed High-Intensity Radiated Pulse to transmit the sonar frequency. This device also has a built-in Wi-fi where we can connect our smartphones or other device to tracke the data from the device. The study area is Malacca state. Thus, this study is focusing on producing the bathymetry maps for the Malacca River and the accuracy of Smart Deeper Sonar Device.

ABSTRAK

Batrimetri adalah satu kaeadah yang digunakan untuk menjalankan kajian hidrografi. Kaedah ini telahpun berkembang dari masa ke masa. Kaedah tradisional bagi menajalankan batimetri adalah dengan menggunakan satu tali dan satu titik kajian sahaja. Oleh itu, ia mempunyai suatu had kerana ia hanay boleh digunakan untuk memeriksa satu titik paada satu-satu masa sahaja. Berlainan dengan kaedah lama, kaedah moden seperti “Light Detection and Ranging” (LiDAR) atau sonar dapat memeriksa lebih daripada satu titik dalam satu masa. Bukan itu sahaja, data yang dihasilkan oleh kaedah moden adalah lebih meluas dan data yang dihasilkan juga beresolusi tinggi. Selain itu, data yang diperolehi melalui kaedah moden juga lebih tepat berbanding kaedah lama. Kajian hidrografi sangat penting untuk menganggar atau mengkaji bentuk muka bumi bawah air bagi sesuatu tempat. Kajian hidrografi juga digunakan untuk menghasilkan peta bawah air diamana peta ini boleh digunapakai untuk menentukan tempat tersebut selamat atau tidak. Pemetaan bawah air juga amat penting bagi menentukan keselamatan pergerakan keluar masuk kapal serta keselamatan pembinaan bawah air.setiap kajian batimetri memerlukan suatu alat bagi membolehkan kajian dapat dijalankan dengan jayanya. Dengan itu, kajian ini menggunakan alat “Smart Deeper Sonar” dimana alat ini menggunakan radar bagi menghantar frekuensi sonar ke dalam air. Tambahan pula, alat ini mempunya Wi-fi yang membolehkan pengguna untuk menyambungkan telefon pintar atau alatan pintar yang lain kepada alat ini untuk merekod data secara terus. Tempat kajian bagi projek ini adalah di negeri Melaka. Oleh itu, kajian ini memfokuskan untuk menghasilkan peta bawah air bagi sungai Melaka dan fungsi serta ketepatan alat “Smart Deeper Sonar”.

ACKNOWLEDGEMENTS

In the Name of Allah, the Most Gracious, the Most Merciful

Above all, I want to thank and praise Allah the Almighty, my Creator and Sustainer, for everything that has been given to me since I began my studies. I would like to thank Universiti Teknikal Malaysia, Melaka (UTeM) for providing me with a good research platform. Thank you to the Malacca Department of Irrigation and Drainage for assisting me in locating the survey area for my analysis. Also, special thanks to Malaysian Ministry of Higher Education (MOHE) for the financial assistance.

Mrs. Najiyah Safwa of the Faculty of Engineering Technology at Universiti Teknikal Malaysia Melaka (UTeM) is my primary supervisor, and I am grateful for all her assistance, advice, and inspiration. Her unswerving patience in mentoring and imparting invaluable knowledge will be remembered forever. And all, to my co-supervisor, Mr. Shikh Ismail, Universiti Teknikal Malaysia Melaka (UTeM) who constantly supported my execution plan for this project. My special thanks go to Dr. Munir for all the help and support I received from him.

Finally, Thank you from the bottom of my heart to my PA, Ts. Mohd Faez Bin Zainol, for his words of encouragement and advises during my research. I would also like to thank my beloved sister for her endless support, love, and guidance to complete this project. Lastly, thank you to all the individual(s) who had provided me the assistance, support, and inspiration to embark on my study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

FIGURE **TITLE** **PAGE**

LIST OF SYMBOLS AND ABBREVIATIONS

™	-	Trademark
CHIRP+	-	Compressed High-Intensity Radiated Pulse
LiDAR	-	Light Detection and Ranging
LADAR	-	Laser Detection and Ranging
3D	-	Three Dimensional
SLS	-	Selective Laser Sintering
2D	-	Two Dimensional
m	-	Meter
mm	-	Milimeter
GPS	-	Global Positioning Sensor

CHAPTER 1

INTRODUCTION

1.1 Background

An overview of the river, its use, and how to preserve it are all covered in this chapter. Besides, this report will generally discuss bathymetric analysis, including the project's core concept, the problem statement, objective, scope, and the expected result.

1.2 Project Overview

The river is a natural water supply for a human ever since, and it is God's creation. Therefore, the water supply becomes an essential component of life for most creatures. If there is a shortage of water, the most creature will die. Moreover, water plays a crucial role in humans. For instance, water is needed to deliver nutrients. Not only that, but it also assists in converting food to energy. As a result, water supply has the potential to sustain human life quality.

Throughout this project, there will be an analysis of underwater depth or known as bathymetry. This analysis helps to create an underwater map by using the data obtained through the research. Meanwhile, a bathymetry chart is generally designed to assist in the protection of surface or subsurface navigation. It typically displays seafloor relief or terrain as contour lines and selected depths and surface navigational detail.

Initially, bathymetry only uses depth sounding to determine the ocean's depth (Gao, 2009). The earlier technique of bathymetry is using a rope or cable over the side of a ship. Nonetheless, this method is inefficient since it only tests the depth of one point at a time, besides the ship movements and winds, which cause the rope to drift out of the line and inaccurate. Today, a bathymetric survey usually used an echo sounder mounted to the boat (Kapoor, 1981). The echo sounder sends a signal of sound downward to the seafloor, and when it reaches the bottom of the seafloor, the signal will be sent back to the transponder. Ecologists use remote sensing Light Detection and Ranging (LIDAR) or Laser Detection and Ranging (LADAR) system in bathymetric study. This type of system is more advanced than the echo sounder system. It uses sound or light speed transmission travel through the water.

1.3 Problem Statement

Malacca river, which flows through the middle of Malacca City, is well known for its river cruise. The length of the Malacca River is about 40 kilometres, originated from the Tampin river and Batang Melaka river. Back then, the European seafarers once called the Malacca River the "Venice of the East". These days, the Malacca River has been a popular tourist attraction because of the river cruise. The river cruise is a 45-minute round trip and covers 9 kilometres. It will be a main attraction of Malacca if the river is well maintained.

The problem statement that will be mainly focused on here are:

a) There is no bathymetry study done that maps the depths and shapes of underwater terrain to illustrate the land below for Malacca River.

b) The shallow river depth points that could present significant risks of boat accidents are unknown (Fowler and Sørgård, 2000).

1.4 Project Objective

The main objective of this project is to estimate the depth and the riverbed of the Malacca River. In detail, the project objectives are as follows:

a) To perform a hydrographic survey on the riverbed of the Malacca River by using a Compressed High-Intensity Radiated Pulse (CHIRP) device.

b) To study the functionality of CHIRP+ whether it is helping to conduct a bathymetric study

1.5 Project Scope

This project scope was shown below:

a) The accuracy of the CHIRP+ device.

b) Only focusing on the Malacca River

1.6 Expected Result

The expected result for this project is to produce an underwater map for the Malacca River and observe the significant risk and point where boat accidents could occur. Below is an example of the expected result for this project.

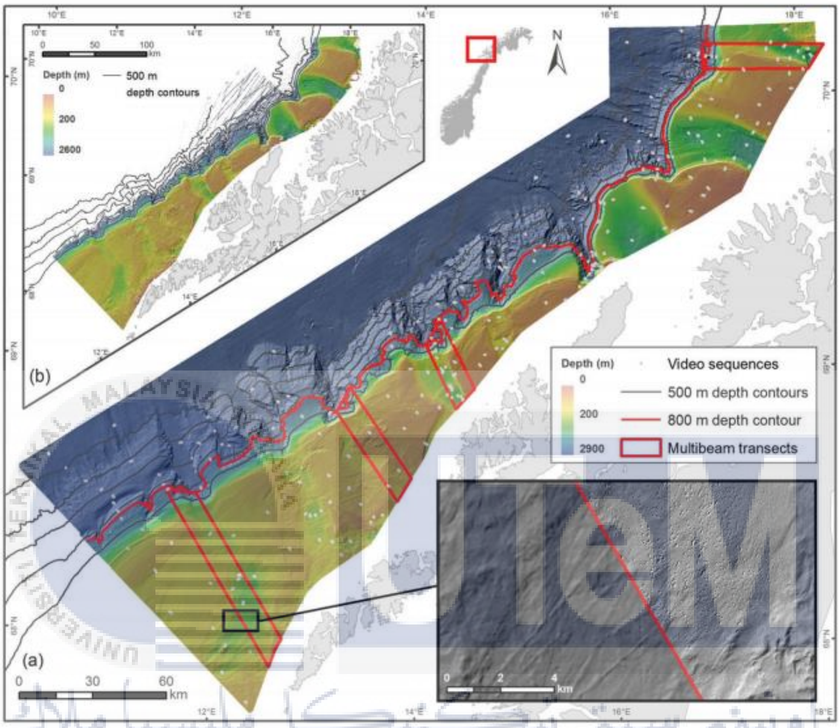

Figure 1. 1 (a) Colour shaded relief image of the composite multi-beam and Olex bathymetry dataset (Olex–MB). The dataset comprises Olex data across all shelf areas except within the multi-beam transects indicated. Data below 800 m depth are multi-beam data only, as Olex data coverage is very poor. The position of MAREANO video lines (each ca. 700 m long) is also indicated. The inset map shows one example of the difference in resolution/quality between shaded relief bathymetry generated from Olex data at 50 m (left) and multi-beam data at 5 m (right) resolution. (b) Colour shaded relief image of Olex bathymetry data only, illustrating the extent and density of coverage. Note that the colour range of the bathymetry in (a) and (b) has been adjusted to emphasize features on the continental shelf (Bowers, 1979).

CHAPTER 2

LITERATURE REVIEW

2.1 Background

In this chapter, the gathering information related to this bathymetric survey from the previous articles or sources will be presented based on Figure 2.1. This project literature review will begin with a study on the Malacca River.

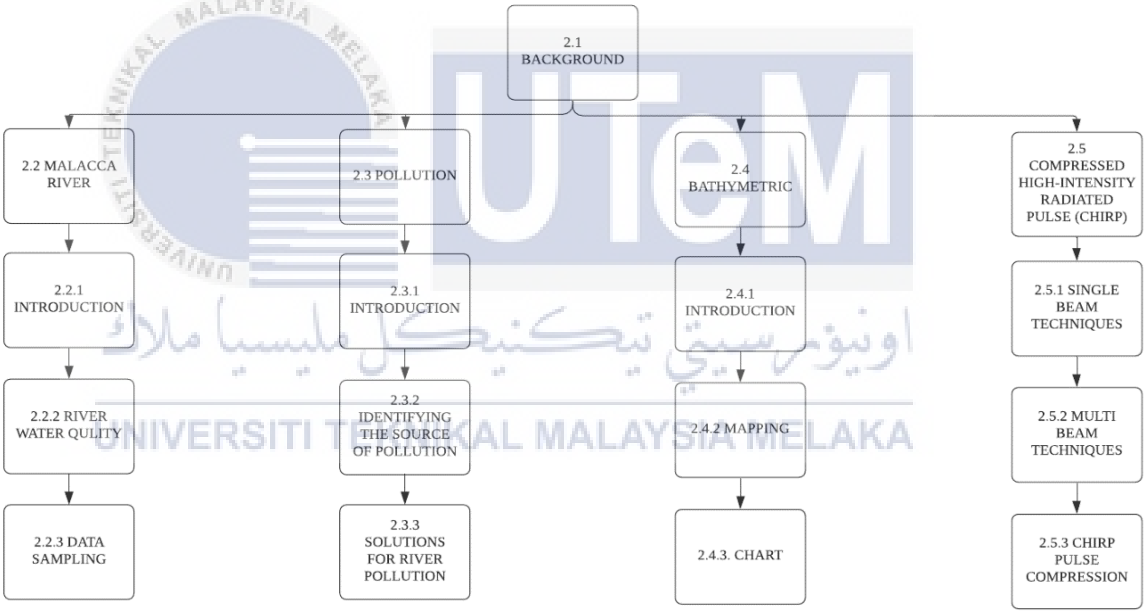

Figure 2. 1 Flowchart of Literature Review

2.2 Malacca River

2.2.1 Introduction

Malacca is the southernmost state in Peninsular Malaysia. Malacca is divided into three districts: Alor Gajah, Jasin, and Malacca Central. According to (Ang Kean Hua, 2017), the Malacca River is defined by the watershed's 13 subbasins.

Although Malacca has only three districts, it has one reservoir. Durian Tunggal Reservoir is a 20-kilometre-square reservoir located between Alor Gajah and Malacca Central. It serves as a water supply for Malacca's residents. When a community's population increases, public services such as transportation, housing, lodging, drainage, and water supply expand, resulting in economic development and political change. On the other hand, cultural and social ties were strengthened, which benefited the environment, particularly the Malacca River's water quality.

2.2.2 River Water Quality

The researcher has already studied Land Use Land Cover (LULC) changes in the Malacca River's water quality detection (Ang Kean Hua, 2017). The study determined the river water quality at nine different sampling stations, as shown in Figure 2.2; they stated that the data on river water quality were obtained from the Malaysian Department of Environment (DOE) (Ang Kean Hua, 2017).

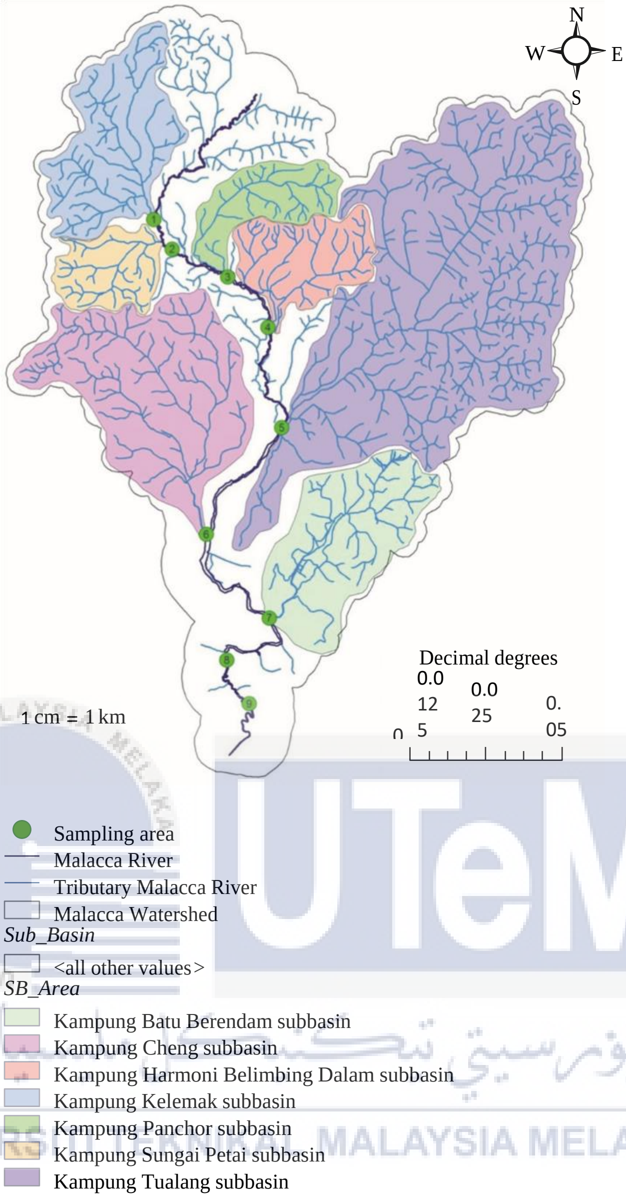

Figure 2. 2 Sampling station and subbasins (Ang Kean Hua, 2017).

They assess river water quality using pH, temperature, electrical conductivity (EC), salinity, turbidity, and total suspended solids (TSS). Additionally, they assessed river water quality using the dissolved solids (DS), dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), and ammoniacal nitrogen (NH3N) methods, as well as trace elements (i.e., mercury, lead, and zinc). The conclusion is drawn from the sampling data presented in Table 1. The study establishes a link between LULC and the quality of river water.

There are a few distinct land use classes, as illustrated in Table 1. In addition, the percentage of LULC varies over time, as shown in Table 2 (Ang Kean Hua, 2017).

Table 2. 1 Classification of LULC.

Class name	Description
Vegetation	Including all agricultural and forest lands.
Built-up area	All residential, commercial, industrial, and transportation area.
Water	All water bodies (rivers and lakes).
Open space	All land areas that exposed soil and barren area influenced by a human.

Table 2. 2 The changes of LULC based from 2005 to 2015 (Ang Kean Hua, 2017).

	Total area and percentage						Magnitude change			
Class name	2005		2009		2015		2001-2009		2009-2015	
	km^2	%	km^2	%	km^2	%	km^2	%	km^2	%
Built-up area	196	29.3	245	36.6	337	50.3	+49	+7.3	+92	+13.7
Vegetation	271	40.4	202	30.1	221	33	-69	-10.3	+19	+2.9
Water	138	20.6	97	14.5	30	4.5	-41	-6.1	-67	-10
Open space	65	9.7	126	18.8	82	12.2	+61	+9.1	-44	-6.6
Total	670	100	670	100	670	100	0	0	0	0

The Kappa test is used to ensure that classifications are accurate. The Kappa Test can account for all elements in the uncertainty matrix. This test was used to determine the calculation's accuracy using predefined producer and user-assigned ratings, which can be expressed as follows.:

$$\boldsymbol{K = \frac{P(A)-P(E)}{1-P(E)}} \quad \textbf{(1)}$$

where:

$$\boldsymbol{A = \frac{(F-1)}{I} \times 100} \quad \textbf{(2)}$$

where A is a percentage of changes, F is first data, and I is reference data.

To increase the number of accurate analyses, each of the established four categories should receive a minimum of 50 points. As a result, the average classification accuracy in 2001, 2009, and 2015 was 89.51%, 88.49%, and 92.21 %, respectively, based on kappa coefficients of 0.87, 0.85, and 0.90. According to 2001 findings, the built-up area was 196 kilometres square (29.3%), agriculture was 271 kilometres square (40.4%), water was 138 kilometres square (20.6%), and open space was 65 kilometres square (9.7%). Only the built-up area and open space increased in 2009 by approximately 49 km^2 (7.3%) and 61 km^2 (9.1%), respectively, to equal 245 km^2 (36.6%) and 126 km^2 (18.8%). On the other hand, agriculture and water were reduced by approximately 10% and 6%, respectively, resulting in total areas of 202 km2 and 97 km2, respectively. Finally, built-up areas increased by approximately 13.7%, totalling 337 km2. While rural land has increased by 2.9%, totalling 221 km^2. Despite this, open space areas have shrunk by 44 km2, totalling 82 km^2 (12.2%), and water coverage has decreased by 10%, or 67 km^2. As a result, a total area of 30 km2 is created (14.5%). As a result of the increasing LULC, the river water quality deteriorated. Numerous factors contributed to this issue.