TARGET STRENGTH OF FISH BASED ON ECHOGRAM

SYAZRINA BINTI AHMAD SAFAWI

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Faculty of Electrical & Electronics Engineering
Universiti Malaysia Pahang

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ABSTRAK

Tujuan dari projek ini adalah untuk mengenalpasti *target strength (TS)* ikan daripada gambar echogram yang ditunjukkan pada mesin Saintifik Echo Sounder Furuno FQ-80. Data yang diperolehi adalah nilai TS untuk *ikan kembung* dengan *ikan selar* pada frekuensi rendah iaitu 38 kHz. TS pada setiap ikan adalah berbeza mengikut jenis dan saiz. Dengan menggunakan perisian MATLAB, TS pada setiap ikan juga boleh ditentukan mengikut komponen warna. Dari nombor ping dan kedalaman air laut, posisi ikan dan nilai TS pada echogram boleh ditentukan. Nilai TS untuk *ikan selar* adalah -44.486 dan nilai TS untuk *ikan kembung* adalah -54.13. Ikan kembung mempunyai nilai TS yang lebih rendah berbanding ikan selar.

ABSTRACT

The purpose of this project is to determine the target strength (TS) of fish based on echogram using the Furuno FQ-80 analyzer. The data collected is the value of TS for *ikan kembung (restrelliger kanagurta)* and *ikan selar boops (ox-eye scad)* which is in low frequency data that is 38 kHz. TS value on fish is different according to their types and size. Using the MATLAB software, TS value for fish also can be determined according to its color component. From the ping numbers and the depth of the sea, the position and the TS value on echogram can be determined. The TS value for ikan *selar boops (ox-eye scad)* is -44.486 and the TS value for *ikan kembung (restrelliger Kanagurta)* is -54.13. *Ikan kembung* has the lower TS value than the *ikan selar boops.*

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOL

TS	-	Target strength
PSM	-	Projek Sarjana Muda
RGB	-	Red, Green, Blue

LIST OF GRAPH

GRAPH NO. **TITLE** **PAGE**

CHAPTER 1

INTRODUCTION

In this chapter introduction is made on some general information about sonar technique, target strength, echogram, image processing, problem statement, research objectives and the scope of the project.

1.1 Sonar Technique

Sonar techniques, especially echo sounders, have been used since the beginning of the twentieth century for the detection of fish at sea by professional fishermen and by fishery oceanographers. A scientific echo sounder is a device which uses sonar technology for the measurement of underwater physical and biological components. This device is also known as scientific sonar. Applications include bathymetry, substrate classification, studies of aquatic vegetation, fish, and plankton, and differentiation of water masses. Distance is measured by multiplying half the time from the signal's outgoing pulse to its return by the speed of sound in the water, which is approximately 1.5 kilometers per second. Figure 1.1 shows the transmission of echo sounders.

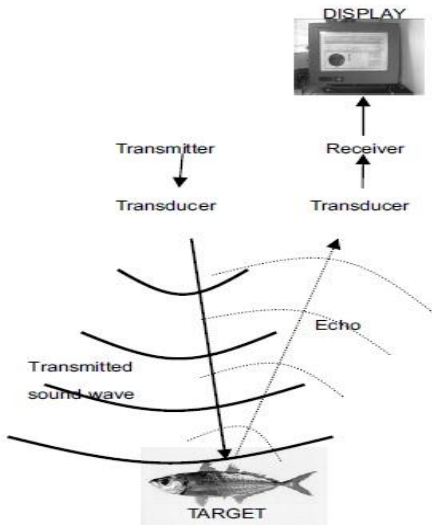

Figure 1.1: Transmission of Echo Sounders

It has been noted since the 1950s that the acoustic signature of fish can carry information on their species. In particular, the physical backscattering properties of small pelagic fish, such as their target strength or spectral response, are related to their species. Size and reflectivity of sound by object are combined into a parameter called the backscattering cross section, which is essentially the acoustic size of the object. This parameter usually expressed in logarithmic and called the target strength (TS) in dB unit.

1.2 Target Strength

The term target strength originates from naval acoustics and the simplest object to consider as an acoustic 'target' is the sphere because it radiates its echo equally in all directions. In order to convert data collected on acoustic survey into population estimates it is essential to have precise estimates of fish target strength. The methods used to obtain these are by having single fish or numbers of live fish in a cage, stunned individuals.

Size and reflectivity of sound are combined into a parameter called the backscattering cross section (*σbs*), which is essentially the acoustic size of the object. The backscattering cross section can be expressed as the amount of reflected sound intensity measured one meter away from the target, relative to the amount of energy incident upon the target, as shown in Figure 1.2 and the calculations in figure 1.3.

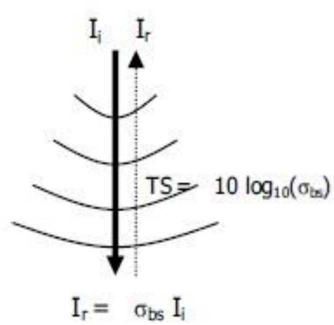

Figure 1.2: Reflected Echo Sounders

$$TS = 10 \log \left(\frac{I_r}{I_i} \right)$$

$$TS = 10 \log \left(\frac{\sigma_{bs}}{4\pi} \right)$$

$$TS = 10 \log (\sigma_{bs})$$

Where

I_r = Intensity reflected from target

I_i = Intensity incident on target

σ_{bs} = Backscattering cross section

Figure 1.3: Calculations of Target Strength

1.3 Echogram

An echogram is perhaps the most commonly encountered way of displaying the pattern of echoes received during a hydro acoustic sounding or survey. Especially in the field of fisheries acoustics these will be seen on the displays of echo sounder hardware and it will typically be one of the first things to see when using echo view.

Structurally most echograms will present a series of vertical lines; one for each ping an echo sounder transmits and listens for echoes from. The echo sounder will keep listening until it is next ready to ping and repeats this cycle. While listening it will sample the incoming sound (at the frequency of the transmitted ping) and record the echo trace. Such an echo trace is in figure 1.4.

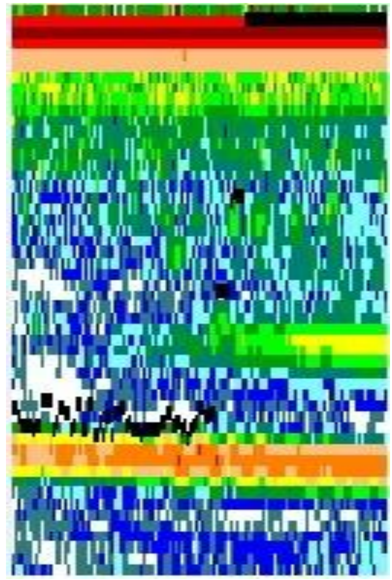

Figure 1.4: Echogram

Echogram is a recording of ultrasound echo pattern. It is made up of several different frequency waves. The very high frequency range is inaudible to the human ear is known as ultrasound. Ultrasound is used to detect a school of fish by fisherman. With the help of a microphone-shaped device known as transducer, ultrasound waves are created and beamed through water. When the beam encounters a boundary or interface between water and fish with a different density or compactness, part of the beam is reflected back to the transducer. The reflected ultrasound waves are collected and analyzed by the machine. It can detect a fish, and then the data recorded and calculate to determine the target strength of the fish.

1.4 Image Processing

In electrical engineering and computer science, image processing is any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it.

Image processing usually refers to digital image processing, but optical and analog image processing also are possible. This article is about general techniques that apply to all of them. The acquisition of images (producing the input image in the first place) is referred to as imaging.

1.5 Problem Statement

It is difficult to record the data from ping numbers from top view of TS in the echogram. The process will took a long time. From echogram, find the position of the fish using image processing software which is MATLAB. Need image processing approach to identify TS from echogram in a short time.

1.6 Objectives

1. To collect the low frequency data of TS in Furuno software for two different type of fish.
2. To identify the color component of ping numbers with specific TS using MATLAB.
3. To compare the color component between two types of fish.

1.7 Project Scope

1. Observe the TS of the fish using top of view TS from FQ-80 Analysers.
2. Determine TS using image processing approach.
3. Compare the result from the top view of TS.

1.8 Expected Results

The expected result of this project is the value of color component obtained from echogram. The coding in MATLAB will determined the color component and identified the TS value from the echogram.

CHAPTER 2

LITERATURE REVIEW

Target strength of fish based on echogram is improving through research. This is driven by the needs for data collection, determined the target strength based on image processing which several method have been developed to create the coding. In this chapter, some works have been done and the result of these works studied and taken as background in this project.

2.1 Theory of Target Strength

Echogram is an image of a structure that is produced by echo sounder which the reflection of high frequency sound waves is. Echo sounder is an older instrumentation system for indirectly determining ocean floor depth. Echo sounding is based on the principle that water is an excellent medium for the transmission of sound waves and that a sound pulse will bounce off a reflecting layer, returning to its source as an echo. The time interval between the initiation of a sound pulse and echo returned from the bottom can be used to determine the depth of the bottom. An echo-sounding system consists of a transmitter, a receiver that picks up the reflected echo, electronic timing and amplification equipment, and an indicator or graphic recorder.

This study discusses to identify the TS for any fish species. Acoustic backscattering by fish depends on fish size, anatomical characteristics, morphology of the body, swim bladder, and location in the acoustic beam by Jech & Horne 2002; Sawada et al 2002 [1].*In situ* measurement is a method that used by researchers for any fish, location, and conditions, such as acoustic observation in the Bay of Biscay in 1996 [2]. The usefulness of in situ target strength measurements depends largely on the reliability of the accompanying biological data by Kenneth G. Foote, Asgeir Aglen, and Odd Nakken 1986 [3]. Foote showed that a theoretical calculation of TS is possible using the exact shape of the swimbladder [4].

Fish swimbladder volume will change according to Boyle's law [5], and Ona [6] reported the volume and area in three gadoids as a function of pressure. Indeed, the TS factor depends on several aspects, such as the physiological state of the fish, its behavior and the time of day by Ona, 1999 [7]. Richard klemm stated that the aim of image enhancement is to gain an echogram display that is easy to interpret [8].

Due to distortion, noise, segmentation errors, overlap, and occlusion of objects in color images. Recognition and classification as a technique gained a lot of attention in the last years wherever many scientists utilize these techniques in order to enhance the scientific fields. Digital image recognition has been extremely found and studied. Various approaches in image processing and pattern recognition have been developed by scientists and engineers to solve this problem [9].

Image recognition is a challenging problem researchers had been research into this area for so long especially in the recent years, due to distortion, noise, segmentation errors, overlap, and occlusion of objects in digital images [10].

2.2 MATLAB Software

The MATLAB® shows in figure 2.1 is a high-performance language for technical computing integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. It is a high-level technical computing language and interactive environment for algorithm development, data visualization, data analysis, and numeric computation. MATLAB is stands for matrix laboratory and is used in a wide range of applications.

It is was originally written to provide easy access to matrix software developed by the LINPACK and EISPACK projects, which together represent the state-of-the-art in software for matrix computation. It features a family of application-specific solutions called toolboxes. Very important to most users of MATLAB, toolboxes allow people to learn and apply specialized technology. Toolboxes are comprehensive collections of functions (M-files) that extend the environment to solve particular classes of problems. Areas in which toolboxes are available include signal processing, control systems, neural networks, fuzzy logic, wavelets, simulation, and many others [L. Ljung, 2008].

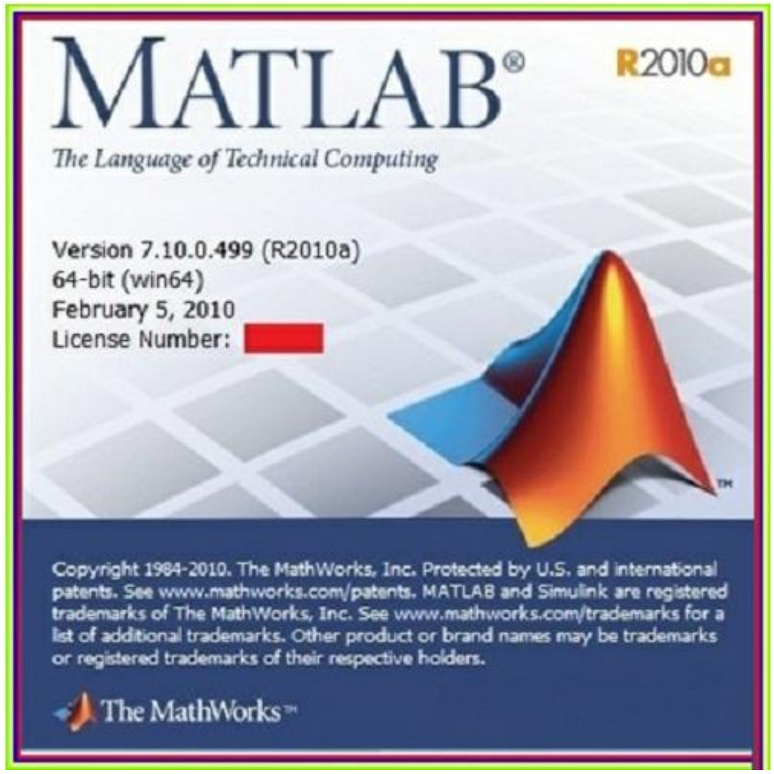

Figure 2.1: MATLAB R2010a version

2.3 Color Space

A color space is a means of uniquely specifying a color. There are a number of color spaces in common usage depending on the particular industry and/or application involved. For example as humans we normally determine color by parameters such as brightness, hue, and colorfulness. On computers it is more common to describe color by three components, normally red, green, and blue. These are related to the excitation of red, green, and blue phosphors on a computer monitor. Another similar system geared more towards the printing industry uses cyan, magenta, and yellow to specify color, they are related to the reflectance and absorbance of inks on paper. Figure 2.2, 2.3 and 2.4 shows the RGB color computations.

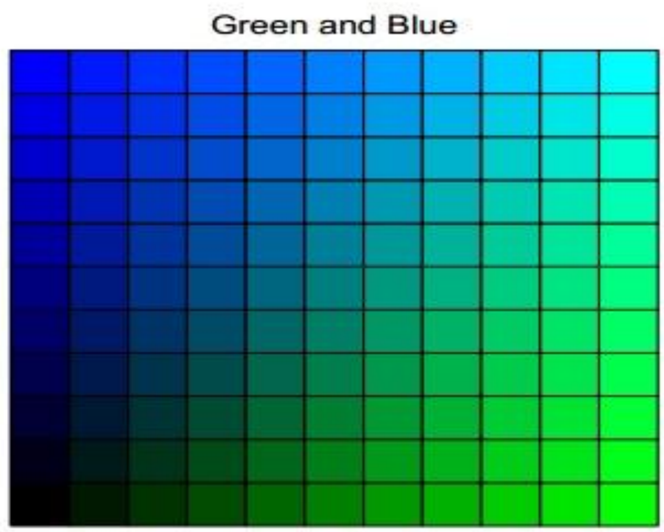

Figure 2.2: The Combination of Green And Blue Color

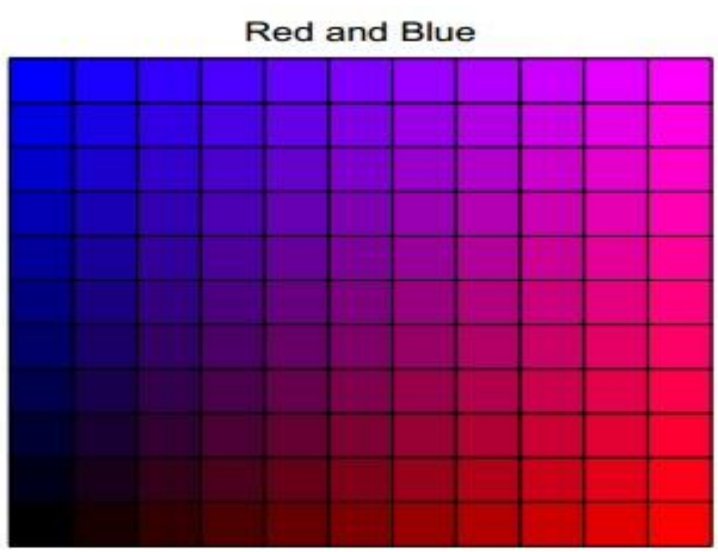

Figure 2.3: The Combination of Red And Blue Color

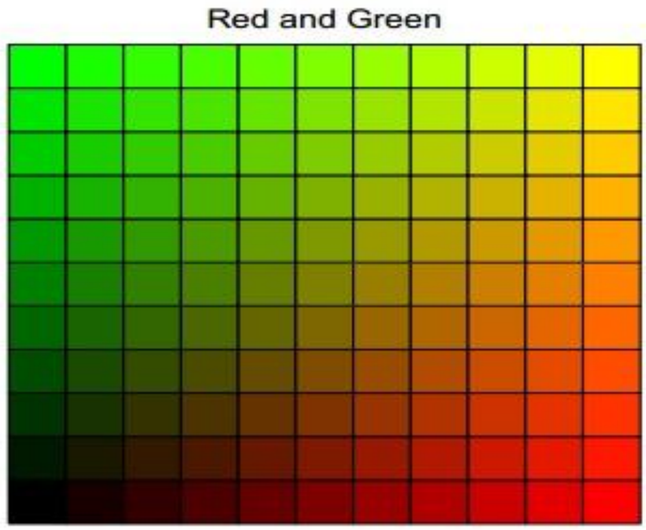

Figure 2.4: The Combination of Red And Green Color