FAKULTÄT FÜR INFORMATIK

DER TECHNISCHEN UNIVERSITÄT MÜNCHEN

Mater's Thesis in Biomedical Computing

The Big Work - Deformable object detection in underwater imaging

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The Big Work - Deformable object detection in underwater imaging

Deformierbare Objekterkennung in Unterwasser-Bilder

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Date:	November 27, 2013

I hereby declare that this thesis is enterely the result of my own work except where otherwise indicated. I have only used the resources given in the list of references.

München, den 30. Juni 2014 Andrés Sánchez

Acknowledgments

If someone contributed to the thesis... might be good to thank them here.

Abstract

An abstracts abstracts the thesis!

The monitoring of fish for stock assessment in aquaculture, commercial fisheries and in the assessment of the effectiveness of biodiversity management strategies such as marine protected Areas and closed area management has been thriving since the 1980s. as does area constinuously grows, it becomes important to develop a remote monitoring system to estimate the biomass of the large number of fishes bred in cages, since around 80% of all sales of farmed fish ara arranged pre-harves, that mean, the profit on the sale directly depends on correct estimations of weight, size distribution and total biomass. Therefore automated and relatively affordable tools for biomass estimation have to be developed.

Here, we will rely on complex stereo camera system, compose of time of flight range camera and CCD grayscale camera, that film fishes in the cage for sertain period of time. in order to estimate the biomass, the volume of the fish has to be estimated. this can be achieved by first detecting and segmenting the fish in every grayscale image of the incoming video stream and then translate this found fish contour to the range image obtaining a estimation of the volume. to find the algorithm that is in line with our problem, we need to understand the challenge in detecting fishes. they include the motion of the fish which makes the object of interest deformable, the location of the fish respect to the camera and occlussion caused by having multiple fishes in every available frame.

In this project, we concentrate on the first step that is detection of the fish that undergo deformation in grayscales images. Inspired by recent works in we develop a similar approach for fish detection. we use a

define recent work

define algorithm

We evaluate the proposes method by computing difference between tha label dataset with the predicted result, in addition, we cluster the results from different camera locations and found that when the sagittal plane is parallel to the image plane, the tracking algorithm provide the best result. Finally, we show that .

show improvement

Therefore, this thesis accomplished the following:

define accomplish, if there are somethings

Contents

Outline of the Thesis

Part I: Overview

CHAPTER 1: INTRODUCTION

This chapter presents an overview of the thesis and it purpose. Furthermore, it will discuss the sense of life in a very general approach.

CHAPTER 2: RELATED WORKS

No thesis without theory.

Part II: Methods

CHAPTER 3: THEORICAL BACKGROUND

This chapter presents the requirements for the process.

CHAPTER 4: IMPLEMENTATION

This chapter presents the requirements for the process.

Part III: Results and Conclusion

CHAPTER 5: RESULTS AND DISCUSSION

This chapter presents the requirements for the process.

CHAPTER 6: CONCLUSION

This chapter presents the requirements for the process.

Part I.

Overview

1. Introduction

1.1. Motivation

As we progress from livelihood fisheries to aquaculture industries, the global production and demand of fishes has drastically increased over several decades. According to Asche and Bj??rndal [2011], the production increased from 16 M in the 1970s to 142 M in 2008. In these statistical figures, the amount if wild fishes has reached a threshold since 1980s while the farmed fishes picked up the difference in amount. For instance, LARSEN and ASCHE mention in [2011] that Norway alone increased their production of Salmons from a few thousand in the 1980s to approximately 1.4 M in 2009 which constitutes around 51% of the global supply. This amkes then the largest supplier of Salmons in the world [Asche and Bj??rndal, 2011; LARSEN and ASCHE, 2011; Liu et al., 2011].

Other than favorable geographical and enviromental features that made Norway viable for this industrym technological advancement also played an important role in the economical cycle between demand and supply. As production increase, they reduced cost and as a consequence, increased the demand Asche and Bj??rndal [2011]. Therefore, this cycle supported the growth of the industry over the years. Since around, 80 % of all sales of farmed fish are arranged pre-harvest, the porfit on the sale directly depends on the correct estimations of weight, size distribution and total biomass. Therefore, our project deals with remote monitoring of fishes size and weight distribution in aquaculture environments. Considering a large amount of fish, it becomes essential to develop an automated biomass estimator to constantly monitor the changes or growth of fishes. This system involves cameras that would detect the fish in a video sequence and compute the biomass distribution over a specified period of time.

Add description of hardware setup

Underwater stereo-video measurement systems are used widely for counting and measuring fish in aquaculture, fisheries and conservation management. To determine population counts, aptial or temporal frequecies, most commonly using a point and click process by human operator. Current research aims to use stereo 3d depth vision system. A fully automated process will requiere the detection and identification of candidates for measerument, followed by the SNOUT to fork length measurement, as well as the counting and tracking of fish. This Thesis present a review and implementation of techniques uses for the detection, Identification, measurement, counting and tracking of fish in underwater image sequences, including consideration of the changing in body shape. The review will analyse the most commonly used approaches, leading to an evaluation of techniques most likely to be a general solution to the complete process of detection, measurement, counting and tracking

check this praragraph

1.2. Problem Statement

This work is part of the project call fishscan, where the main goal is design a system for remote monitoring of fishes size and weight distribution in aquaculture environments. during this project was develop a camera rig system consist in a underwater housing with a time of flight camera with LED light source and a 2D CCD grayscale camera as is shown in the fig 1.1.

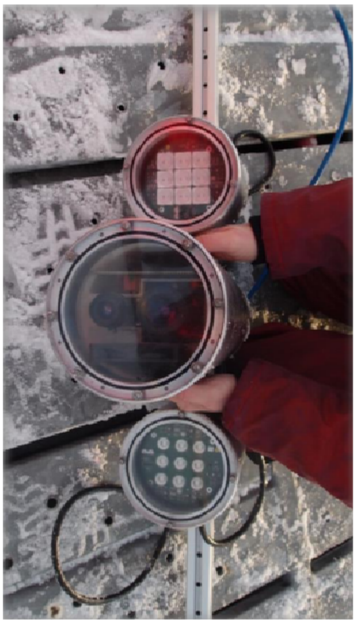


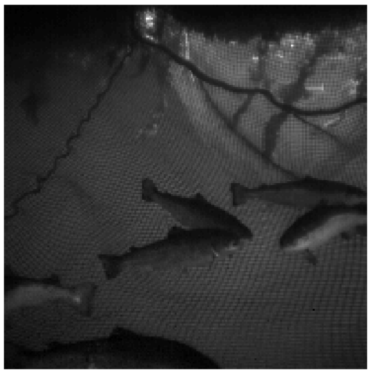
Figure 1.1.: Rig Camera System - TOF + CCD cameras

as the main goal of the project is compute the biomass of the fish by computing the volume of it, taken the concept of mass density from the physics, using the relation between biomass and volume. Then, this problem of biomass estimation can be formulated as a problem of volume estimation of the fish. to achieve this objective, the first step is the fish detection in an 2D grayscale image. followed by a backprojection into the TOF image where the is possible to fit a 3D model to the detected fish. it is important to mention that the approach assume in this work is due of highly noisy image acquire by the range imaging camera, which was adapted to work in a underwater environment, but as you can see in the 3D image shown in 1.2

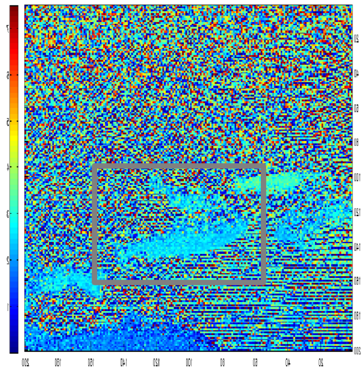
although, the detection using the 2D intensity image alone cannot compute the volume of the fish because it is not depth invariant and the size is up-to-scale; This work will may use of the 2D intensity image as a First step, detecting the fish contour. The pipeline depicted in consist of three major steps that are: fish detection, contour extraction, volume-biomass estimation. In this project, we concentrate on the first step that is fish detection and contour extraction.

add image ref ??

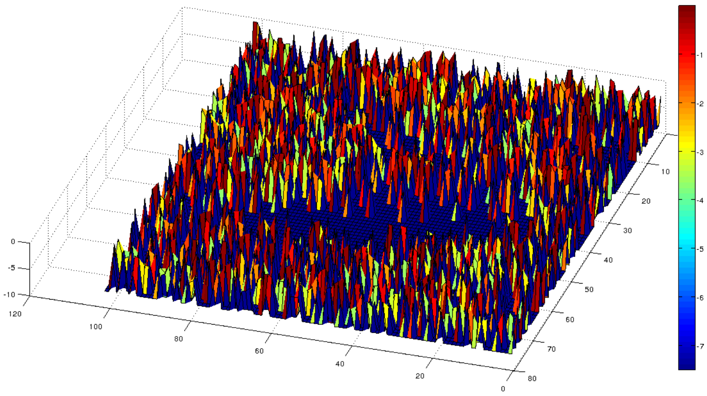
At this point we need to find a algorithm for fish detection and contour extraction that addresses the three major challenges of our problem, These are:



(a) Intensity Image TOF camera



(b) depth Image



(c) 3D represemtation depth image

Figure 1.2.: TOF camera images.

1. *Deformations*

2. *Different Viewpoints*

3. *Occlussions*

adding some text for structure this

The monitoring of fish for stock assessment in aquaculture, commercail fisheries and in the assessment of the effectiveness of biodiversity management strategies such as Marine Protected Areas and closed area management is essential for the economic and environmental management of fish population, Video based techniques for fishery independent and non-destructive sampling now widely accepted. The advantages od suing stereo-video for counting the numbers of fish. measuring their lenght and defining the sample area have been well demostrated. However, the time lag and cost of processing video imagery decreases the cost of miffectiveness and uptake of this technology. Current research aims t

2. Related Work

2.1. Related Work

This thesis focuses on detecting fishes; therefore, this chapter concentrates on works that deal with object detection, specifically in underwater application. In Shortis et al. [2013] review the current technique apply in this field,

2.2. Problem Statement

Part II.

Methods and Implemantation

3. Methods

Here starts the thesis with an introduction. Please use nice latex and bibtex entries Lamport [1994]. Do not spend time on formating your thesis, but on its content.

3.1. Theorical Background

There is no need for a latex introduction since there is plenty of literature out there.

3.2. Notation and Symbols

There is no need for a latex introduction since there is plenty of literature out there.

3.3. Camera Geometry

There is no need for a latex introduction since there is plenty of literature out there.

4. Implementation

Here starts the thesis with an introduction. Please use nice latex and bibtex entries Lamport [1994]. Do not spend time on formating your thesis, but on its content.

4.1. Fish Model

There is no need for a latex introduction since there is plenty of literature out there.

4.2. Linemod

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Part III.

Results and Conclusion

5. Results and Discussion

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5.1. Results and Discussion

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6. Conclusion

Here starts the thesis with an introduction. Please use nice latex and bibtex entries Lamport [1994]. Do not spend time on formating your thesis, but on its content.

6.1. Discussion

There is no need for a latex introduction since there is plenty of literature out there.

6.2. Conclusion

There is no need for a latex introduction since there is plenty of literature out there.

Appendix

A. Detailed Descriptions

Here come the details that are not supposed to be in the regular text.

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