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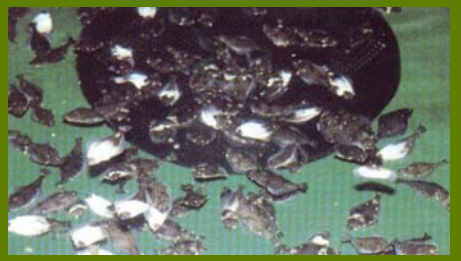
Image Analysis in Aquaculture

Project:
Development of a
Fish In Line Monitoringsystem (FILM)
for Flatfish



AquaLife 2010

1st – 2nd June

Kiel

ZUKUNFTSprogramm Schleswig-Holstein
Investition in Ihre Zukunft

Aquaculture

Definition

•Culture of aquatic organism (fish, shellfish, shrimp, algea)
•Population is owned by the company

Versions

•Fish farming in pond or raceway (carp, trout) in Freshwater
•Nearshore sea cages (salmon, tuna), ponds in mangrove (shrimp) in saltwater
•Onshore recirculating systems with filters (sturgeon, turbot)

•For the company it is important to know the biomass of their stock

Motivation

High manual effort in recirculation systems

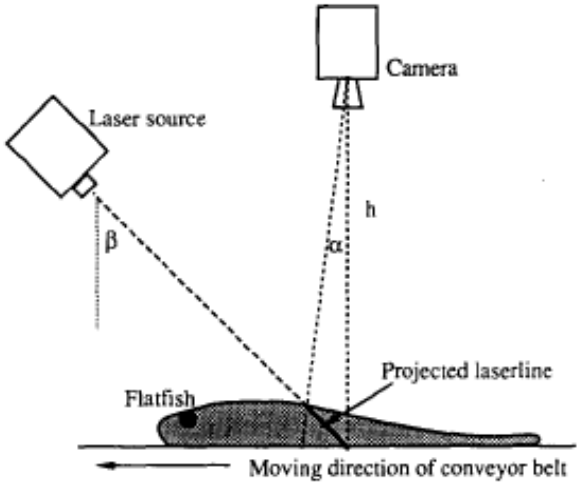
Fish sorting every few weeks due to different growing of fish

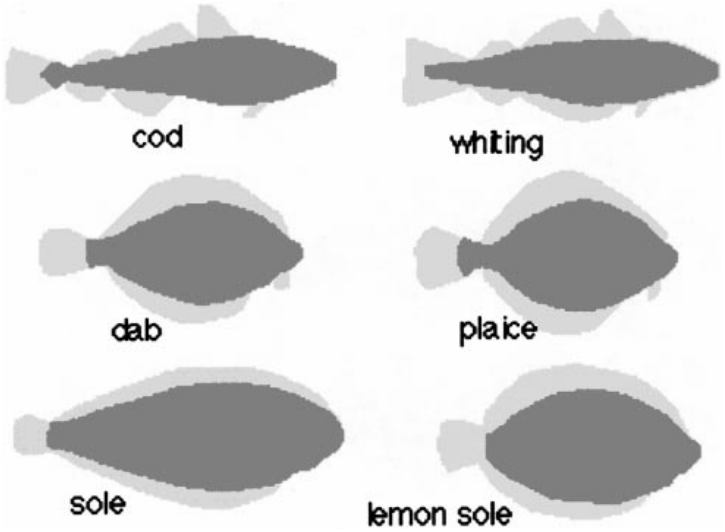
Problem: Size-distribution is unknown before sorting, can be too early or too late

Therefore: Monitoring of the size distribution with a camera system

Examples: Measuring on convoyer

- Laser line perpendicular to movement of convoyer
- Deformed by fish intersection
- Volume is calculated
- Recognition of 6 species via Neural Network

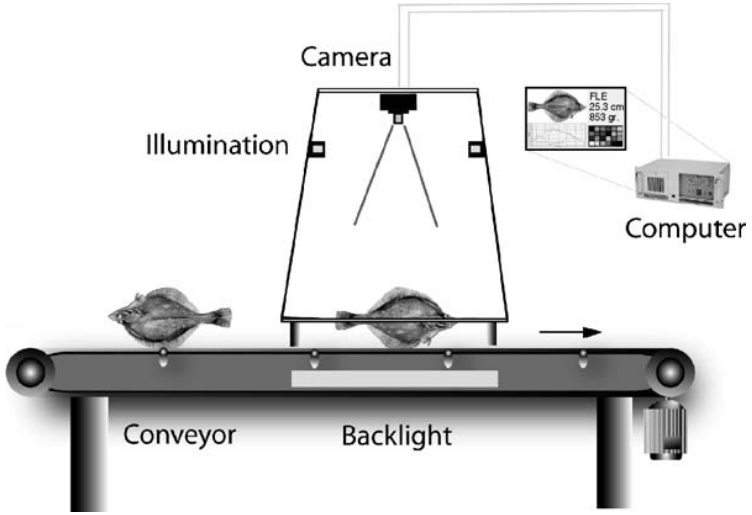


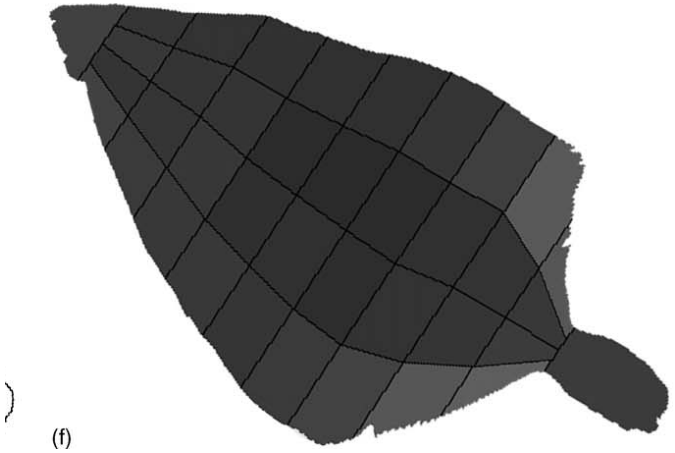


Fish species recognition using computer vision and a neural network - Frank Storbeck and Berent Daan 2001

Examples: Measuring on convoyer 2

- Scan for beginning of fish
- Image of the whole fish
- Extract outline, determine head and tail and calculate length
- Separated in grid for color information
- Recognition of 7 species of round-/flatfish via statistical procedures

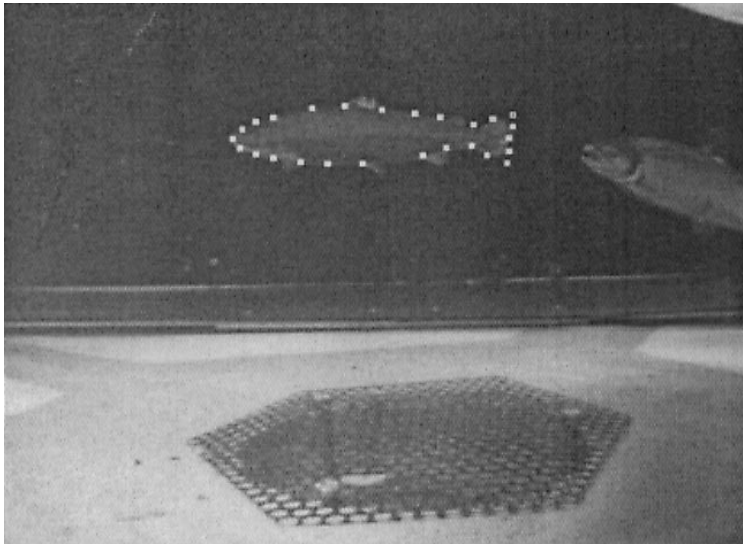


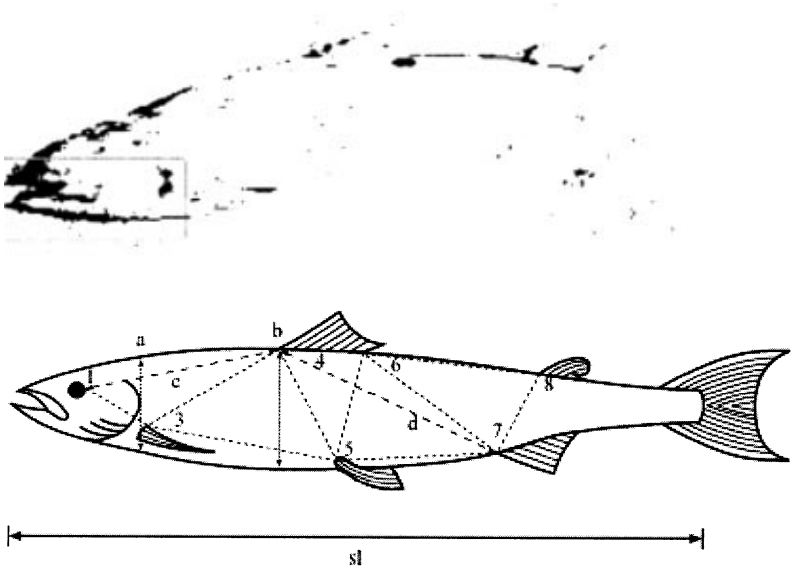


Automated measurement of species and length of fish by computer vision - D.J. White et al 2006

Examples: Swimming fish offshore

- Finding head of salmon via a binary shape
- Shape model consisting of 26 landmarks
- Fitting of model via point distribution model (PDM)
- Size estimation using a salmon truss network





An automatic image-based system for estimating the mass of free-swimming fish - J.A. Lines et al 2000

Examples: Swimming fish offshore 2

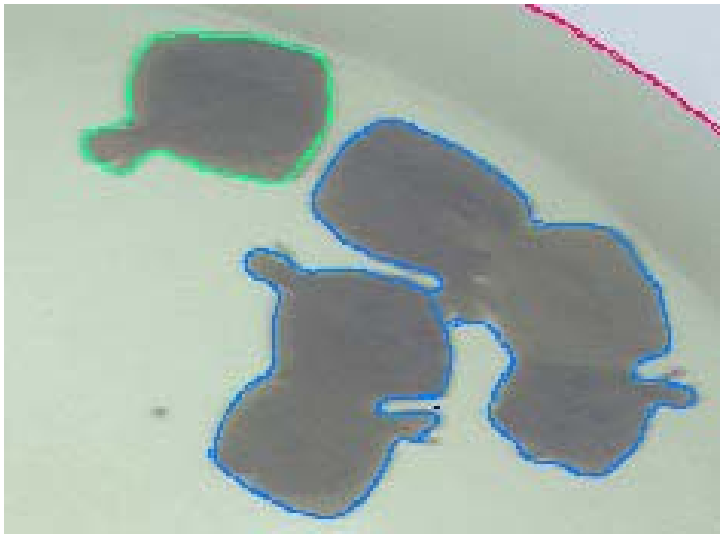
- While transfer to transport cages, divers film tuna with stereo camera system
- Filtering sequence to retrieve outline
- Check for fish form and finding landmarks
- Tracking of tuna to avoid doubled measurement
- Size measurement via an artificial neural network

Extracting fish size using dual underwater cameras - C. Costa et al 2006

Examples: Recirculation System

FIVOM-Project:

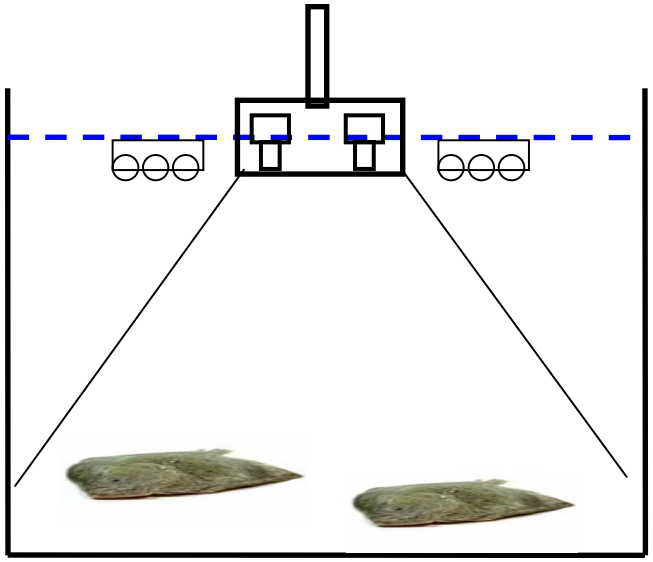
- 1 Camera system
- Calibration so the plane of ground is known
- Check for no movement
- Edge detection to find objects
- Rectification according to calibration
- Check if found objects fit turbot form
- Measuring



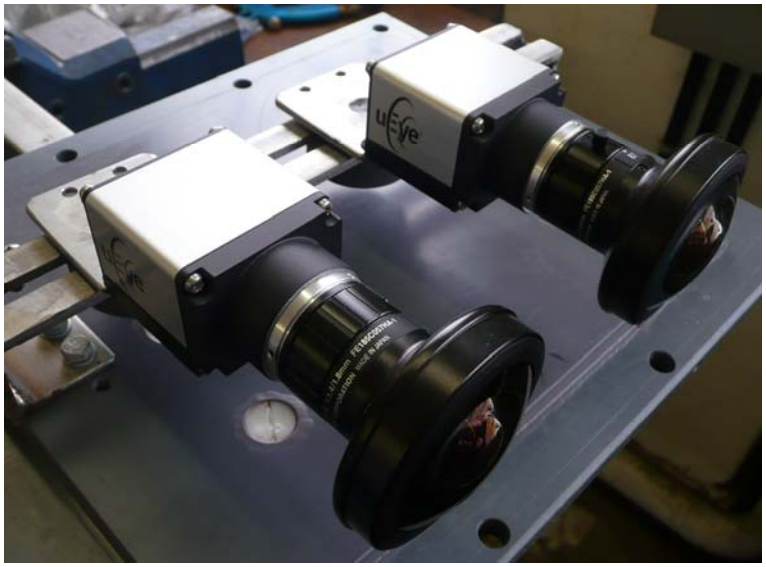
Thiessen E., Hartung E.: Bildanalyse in der Fischproduktion (2008) GIL Jahrestagung : 155-158

FILM: Fish In Line Monitoringsystem

1. System using stereo cameras and fish-eye optics
2. Working under realistic terms of condition in a fish tank
3. Full automatic object recognition of turbot and measuring



Stereo System



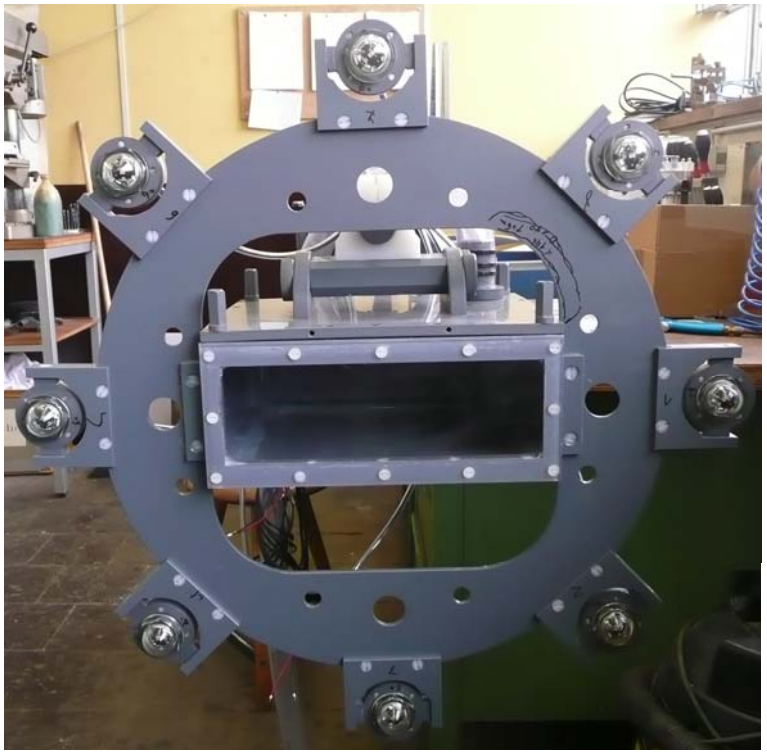
Camera system using:

- 2* IDS GigE uEye UI-6210SE
- 2* Fujinon FJN FE185C057HA-1
- Attached on adjustable rig

- Waterproof diving box made of PVC
- Mount for fish tank and illumination
- Acrylic glas front

Stereo System 2

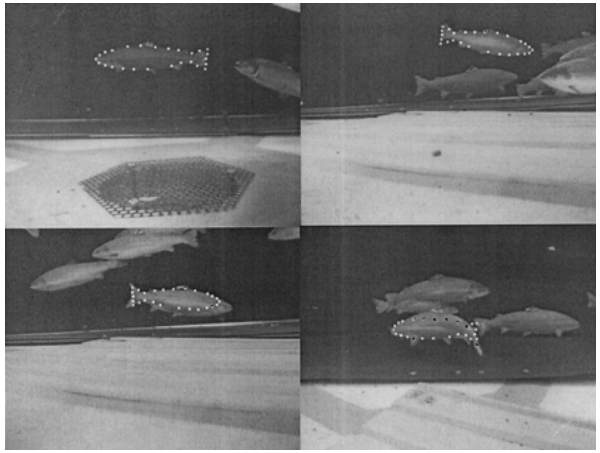
Fully assembled stereo camera system with illumination ring:
- 8 redlight LEDs
- Ring-shaped for consistent illumination of fish tank
- Can be triggered to reduce luminance

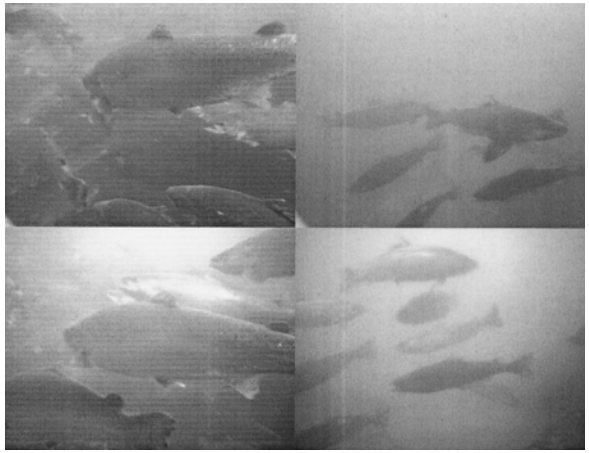


- LEDs in single casing
- Variable angle for optimizing illumination

Realistic Conditions

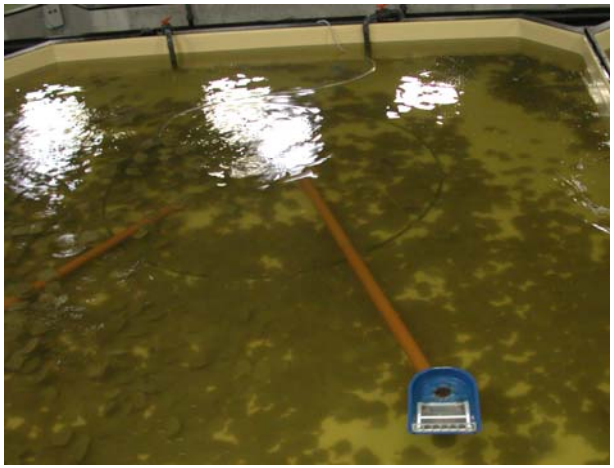
Methods often need low density of fishes for recognition





An automatic image-based system for estimating the mass of free-swimming fish
J.A. Lines et al 2000

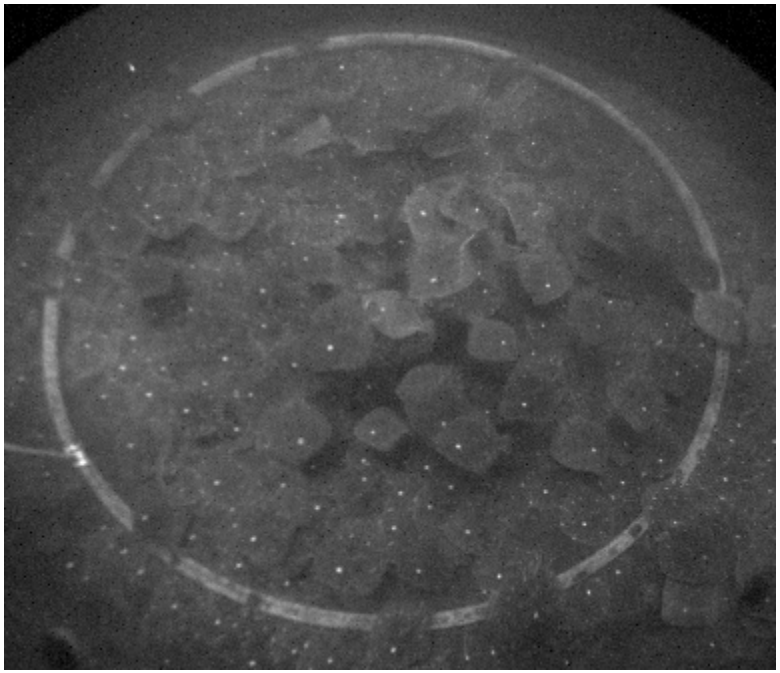
Picture of fish tank at ILV

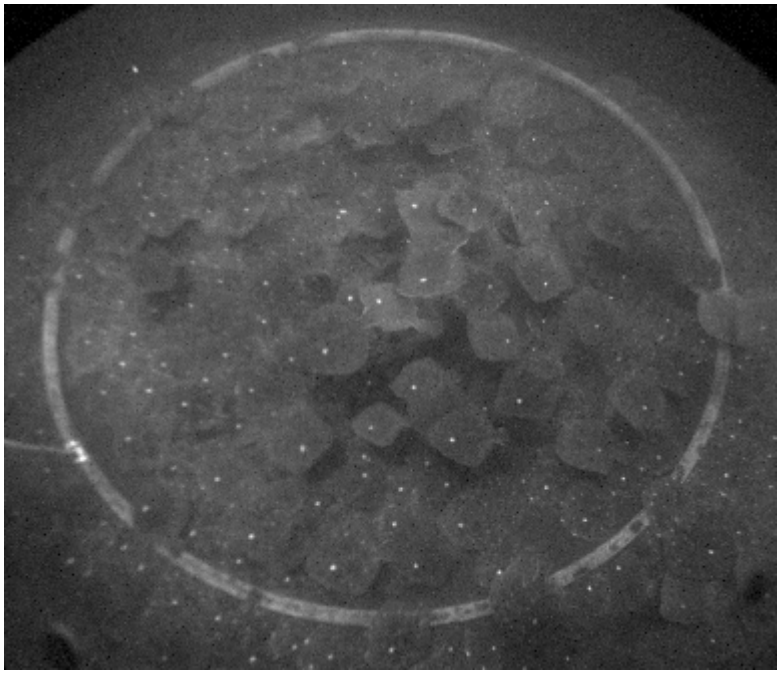


Picture of fish tank in aquaculture

Realistic Conditions

... in Büsum at GMA Gesellschaft für Marine Aquakultur mbH





- In the fish tank is a very high density of turbot
- Relative low light conditions
- In aquaculture, turbot prefer to lie on each other
- Their texture is camouflage and adopting to their surroundings

Object Recognition Concept

- Preprocessing
  - Improve image quality for optimized feature detection
- Feature detection
  - Edges, corners, circles, special patterns etc.
- Statistical Pattern Recognition
  - Find turbot in crowded picture
- Corresponding object in stereo image
  - Epipolar geometry for real world coordinates
- Tracking of found objects
  - Avoiding multiple measurements

Future

1. Due to tracking: Behavior analysis
2. Feeding control
3. Expanding the service to other species of fish

Thank you for your attention

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