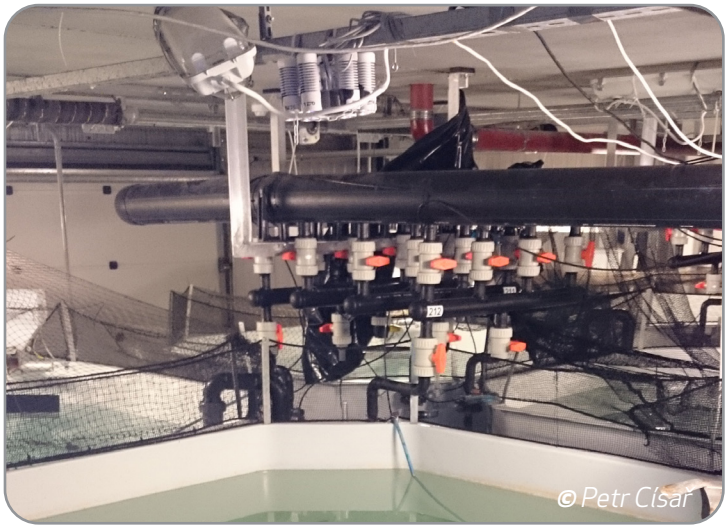
3DFISH – 3D FISH MONITORING SYSTEM FOR AQUACULTURE

SUMMARY

A novel infrared (IR) reflection system was developed for use as a suitable real-time 3D fish monitoring and measuring technique. The 3DFISH system is an inexpensive solution for real-time fish behaviour monitoring at indoor aquaculture facilities, and can also estimate fish weight. This will be of interest to aquaculture facilities looking to implement new 3D fish monitoring and measuring techniques or to improve upon existing techniques.

KNOWLEDGE NEED

Fish behaviour analysis can be used to address many questions related to nutrition, welfare, health and pathology, environmental interaction and aquaculture systems design. The basis of fish behaviour analysis is determining fish position and orientation at a particular time (called tracking). The automated analysis of fish tracks can provide information about individual fish behaviour, interaction and school behaviour, which can be used to monitor fish feeding activity and water quality, as well as enabling continuous contactless fish sampling. Existing technologies like 2D, single camera setups and stereo vision require either manual data analysis or are computationally intensive, causing problems with automated data processing.



POTENTIAL IMPACT

- 3DFISH enables non-invasive monitoring of fish behaviour and welfare indicators in real-time which allows for an efficient and cost-effective detection of behavioural abnormalities.
- Users of 3DFISH can detect potential problems in aquaculture facilities such as poor water quality and early disease signs earlier than in conventional systems, which will help reduce financial losses.
- The automated 3DFISH monitoring system requires less human labour, resulting in less human errors and higher profits.
- 3DFISH supports improved fish welfare because the fish do not need to be handled manually.

EATiP – Strategic Research and Innovation Agenda (SRIA) Thematic Area 2 - Technology & Systems; Goal 4, Thematic Area 7 - Aquatic Animal Health & Welfare; Goal 4. To see the full list and descriptions of the thematic areas and goals, please visit: **eatip.eu/?page_id=46**

UNDERLYING SCIENCE

Several approaches exist for fish detection and tracking. In this study, three systems for the monitoring of fish behaviour in 3D have been compared and evaluated: stereo vision, structured light and the novel 3DFISH infrared (IR) reflection.

Each fish monitoring technique was tested with the following parameters:

- Octahedron shape fish tank with fresh water (0.83m x 2m)
- All cameras and light sources were placed in a horizontal plane 1.21m above the water level near the central axis of the tank
- The experiments were conducted using Atlantic salmon with lengths 29.5±2.5cm and weight 295±73g

RESULTS

- All three systems reviewed have approximately the same horizontal plane accuracy of 0.5cm which depends on camera resolution and image segmentation algorithms.
- The stereo vision based system showed the best accuracy, but it requires two cameras and high computational power for detection of the stereo pairs in both views.
- The maximum obtained monitoring depth for the IR reflection system was ~75cm at 10 frames per second.

The **IR reflection system is recommended in circumstances where high accuracy of 3D coordinates calculation is not required, as is the case for fish tracking**. It uses an external light source with a wavelength which is highly absorbed by water. The advantages of this system include the low price of the components and relatively low required computation power. Increase of the monitored water volume can be obtained by using a more powerful external illuminator.

END-USERS & POTENTIAL APPLICATIONS

END-USER 1: Aquaculture fish farmers
APPLICATION: Non-invasive monitoring of fish behaviour and various welfare indicators. If changes are seen, conditions can be reviewed and a veterinarian can be notified at an early stage of a problem. Furthermore, this real-time monitoring can aid in optimising feeding conditions, and allow for targeted fish sampling.

END-USER 2: Aquaculture veterinarians
APPLICATION: If an abnormal change in behaviour has been detected, veterinarians can investigate recordings and begin treatment much earlier if needed.

END-USER 3: Water treatment stations
APPLICATION: Water quality can be monitored indirectly through fish behaviour.

END-USER 4: Scientific community
APPLICATION: Researchers studying fish behaviour will be able to monitor any behavioural changes in real-time, for example in response to introduced stressors or alternative feeds.

STATUS

Technology Readiness Level (TRL) 6 - with respect to the fish weight estimation.

Next steps include:

- Redesigning the prototype for 24/7 usage
- Reimplementing the software to improve user interface

AT A GLANCE

TITLE: 3DFISH Monitoring System for Aquaculture
KNOWLEDGE TYPE: Peer-reviewed publication
WHERE TO FIND IT: Pausina *et al.* 2015. Aquacultural Engineering 69, 7–17
STATUS: Published, constant improvements and extensions of applications
TNA FACILITY USED: Nofima Centre for Recirculation in Aquaculture (Nofirma NCRA), Sunndalsøra, Norway
CONTACT DETAILS: Dr Petr Císař, University of South Bohemia, Czech Republic, cisar@frov.jcu.cz
PATENTS OR OTHER IPR EXPLOITATIONS: Software: protected by copyright; Hardware: a license for selling the system is planned

Designed and developed by AquaTT

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 652831. This output reflects the views only of the author(s), and the European Commission cannot be held responsible for any use which may be made of the information contained therein.