The UTOFIA Project

The aim of the UTOFIA H2020 project is to develop a **new underwater imaging system for turbid waters** based on **laser technology and range-gated imaging** that will **extend the camera range by 2-3 times** compared to current standards while improving the quality of images and at the same time providing the potential for **video rate 3D information**. Coordinated by SINTEF from Norway, the project is run by a consortium of marine scientists, technology providers and end-users.

This edition of the UTOFIA Newsletter reports on the **trials at DTU Aqua** (Denmark) which allowed investigating the **impact of the laser on fish behavior** as well as capturing **3D information** of dynamic scenes in near **real-time**.

The UTOFIA Project Team

Laser impact on fish behavior

The first UTOFIA trials of laser impact on marine fauna took place at Blue Planet, Copenhagen, last February. Engineers from SINTEF and expert scientists on fish behavior and physiology from DTU Aqua (Technical University of Denmark) tested the system on cod and crabs to see if it causes stress or changes in behavior. All experimental procedures were approved by the Danish animal welfare committee.

THE TRIALS SET-UP

A system of cameras, similar to those used to monitor traffic in cities and movement of football players during a game, was set up to track the swimming behavior of individual fish and their detailed response to exposure to the laser light. The setup was composed of 5 GoPros and one digital CMOS video camera with a stereoscopic system. The GoPro cameras were positioned to provide 2D top-view of the fish movements along the entire experimental tank. The stereoscopic system was then used to reconstruct the 3D trajectories for each fish detected by the cameras. (Figures A, B)
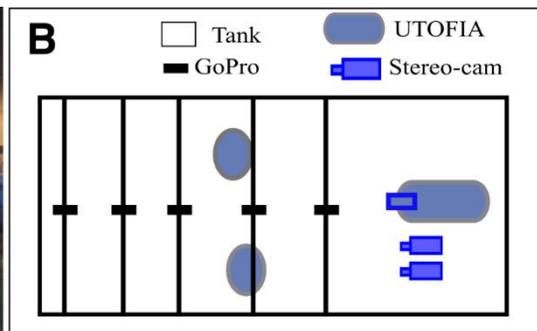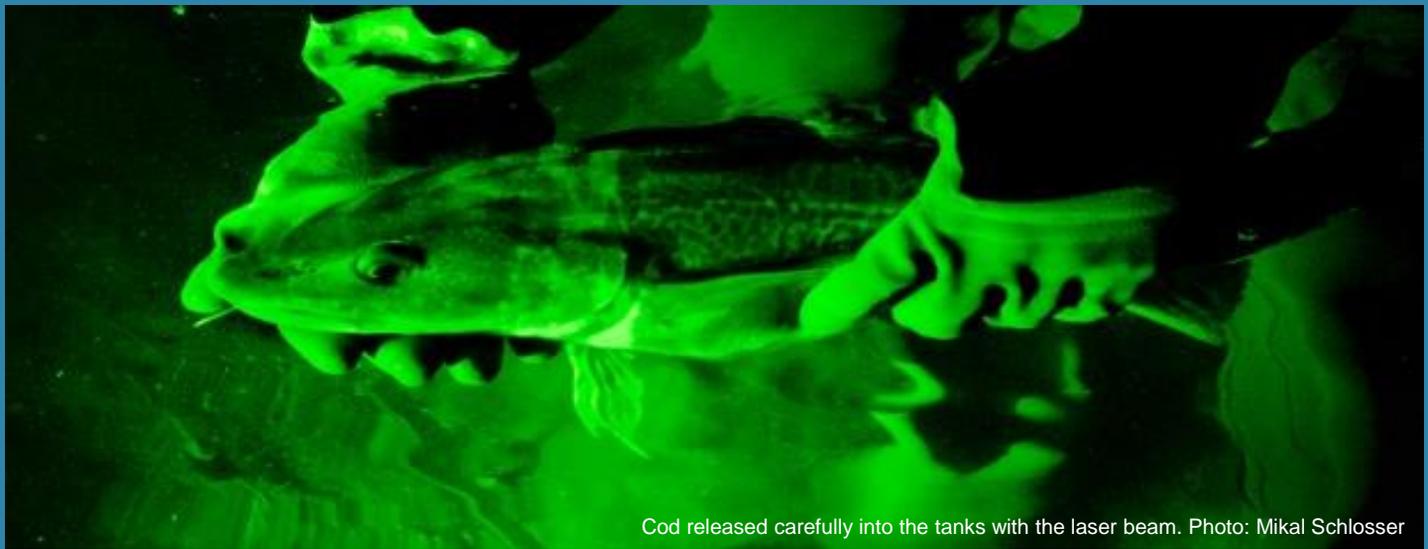
Cod released carefully into the tanks with the laser beam. Photo: Mikal Schlosser

FISH BEHAVIOR IN REACTION TO THE UTOFIA LASER

Senior Research Scientist Dr. Jane Behrens led a team of scientists to investigate the UTOFIA laser effect on the cod swimming in the tank. The cods were fitted with implanted heart monitors from StarOddi to constantly monitor their heart rate with the laser on and off, as well as with other stress stimuli (natural and implemented). Simultaneously, a tracking system, designed by Dr. Patrizio Mariani from DTU, allowed constant monitoring of the physical fish behavior thanks to the network of GoPro cameras.

The experimental team was composed of Jostein Thorstensen (SINTEF), Simon Jarnit (DTU Aqua), Petter Risholm (SINTEF), Jane Behrens (DTU Aqua), Jacobo Bridda (DTU Aqua). Photo: Mikal Schlosser
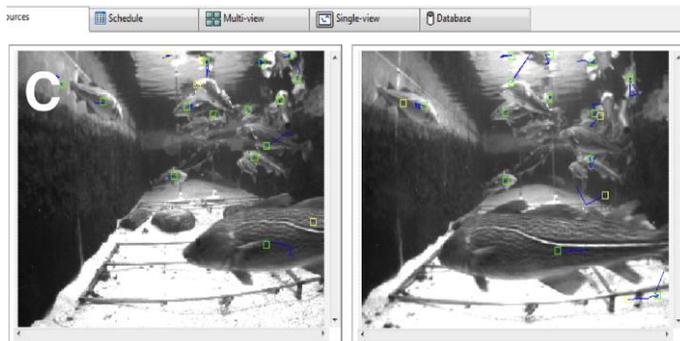
Fish tracking was performed using the LabTrack software developed by BIORAS, http://www.bioras.com, (C).
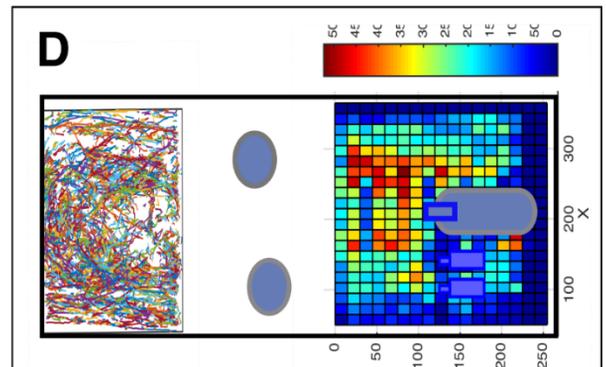
The statistics on fish distribution and motility are being analyzed, allowing tracks and frequency mapping within the tank (D).

PRELIMINARY CONCLUSIONS

The first visual observation showed that the cod did not care at all if the laser camera was on or off, the swimming behavior was not affected and no measurable stress responses were observed from the heart monitors which is very good news for the further use of the laser camera in the aquatic ecosystem. Data on other possible effects of the laser on the physical health of the cod are still to be analyzed.

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3D Acquisitions

The UTOFIA system has already shown its capability of capturing 3D information of static underwater targets (see Newsletter #1). Therefore, the next step of the project was to demonstrate that the UTOFIA system is also able to capture dynamic scenes. In preparation for this, algorithms have been developed in order to be able to interpret the sensors data in close to real-time and in February 2016, the experiment was conducted by DTU and SINTEF during the tank trials described above. Approximately 30 fish have therefore been released in the tank measuring 7m x 3m x 1,5m. The UTOFIA system then measured the distance to each fish which is shown in the color encoded image below.

2D image acquired with the camera.
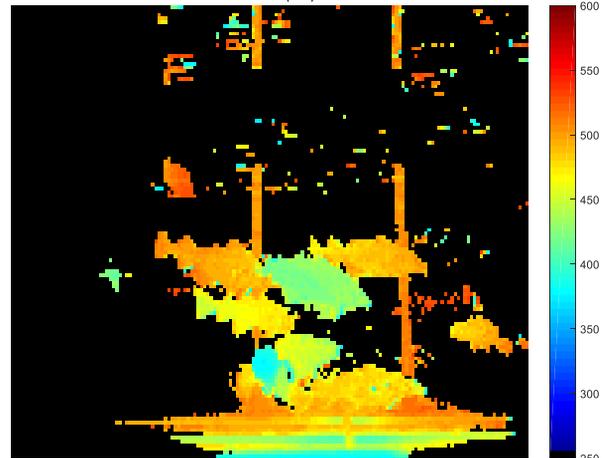
Depth map corresponding to the 2D image (left).

Videos of the results of the experiment are also available on the UTOFIA YouTube play list: https://www.youtube.com/playlist?list=PLph_pmk7hsCzN_uggTyOSf6USpaOI3tyC
The experiment was a full success and UTOFIA is on its way to being an enabling technology for precise size measurements of observed biomass, capturing length estimations (to avoid discards) and automatic shape recognition for automatic species differentiation.

UTOFIA Partners

UTOFIA brings together a unique group of technological, scientific and engineering expertise spanning from design and technology to characterization of environmental status and marketing. Coordination of the project is taken by SINTEF, one of the largest maritime research companies in Europe, with a long history in successful EU projects. The consortium is a world-class team comprising marine scientists (DTU, AZTI), technology providers (STF, BRI, ODOS, FHG) and end-users (SUBSEA) and therefore well placed to promote the technology to a range of end-users from public authorities, offshore industry, commercial fisheries and the marine science community.

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