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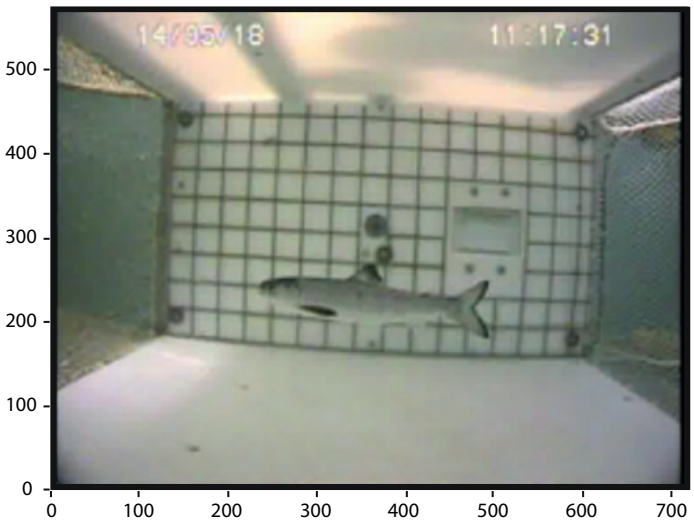
AUTOMATED IMAGE ANALYSIS OF UNDERWATER VIDEO



SALMON SMOLT (*SALMO SALAR*) WHICH HAS BEEN ENTRAINED BY A TRAWL NET

PHOSPHORESCENT SEA PENS (*PENNATULA PHOSPHOREA*) ON SOFT SEDIMENT IN THE NORTH SEA

Introduction

Understanding and estimating the potential impacts of marine renewables on the environment is an important consideration when making decisions on marine development applications. Underwater video is becoming more widely used as a method of data collection, as this non-invasive and often autonomous monitoring provides a cost-effective and efficient way of collecting continuous, long-term data to study the effects of marine developments and other activities on the marine environment.

In Marine Scotland, underwater camera footage is utilised for numerous projects, such as understanding the migration of salmon in relation to offshore wind farms and on assessing the impact of offshore wind farms on features of conservation interest on the seabed. These studies often yield comprehensive but large datasets. The time intensive nature of examining camera footage from such large datasets can be costly and result in only a proportion of the footage being used.

Marine Scotland tasked MarynSol, a software engineering company specialising in this field, to provide an overview of the current state of computer vision technologies for automated detection of aquatic life in underwater video, the objective being to provide a development route for a tool to analyse the large amount of video footage without the need for human supervision. This task was split into two parts: the first being a review of the literature of the current technologies and the second being a case study incorporating some of the more promising software platforms.

Key Findings

The project successfully demonstrated that image analysis techniques could be used to a) identify salmon smolts and distinguish them from sprats in underwater video of fish entrained by a trawl net, and b) identify the phosphorescent sea pen in video that was generated while towing a video camera along the seabed.

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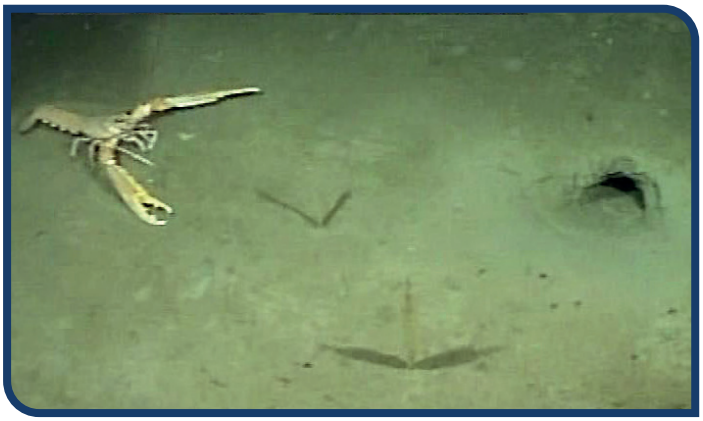
The freely available software platform, Google Object Detection API, appeared to be the best method utilised during this case study. The Convoluted Neural Network (CNN) models clearly outperformed the Bag of Visual Words (BoVW) models in terms of both speed and accuracy. The high levels of precision and recall observed with the CNN models indicate that these are potential solutions for automating the analysis of videos from aquatic environments. The Faster Region-based Convolutional Neural Network (FRCNN) model performed the best overall in the fish detection videos, but the Region-based Fully Convolutional Network (RFCN) model performed better on the fish classification and the detection of sea pens.



NEPHROPS (*NEPHROPS NORVEGICUS*) NEAR TO BURROW

Identification of Nephrops burrow complexes was too challenging for the applications that were trialled. When assessing stocks of the Norwegian lobster (Nephrops), a trained assessor would count the number of burrow complexes on the seabed, each complex being attributed to one animal. Identification of these burrow complexes proved too challenging for the applications that were trialled. It is suggested that a combination of programming and automated image analysis would be required in order to identify a complex of burrows that can be attributed in an individual Nephrops.

How will the deliverables will be used in practice?

The demonstrations that were carried out currently require a software specialist to train the software platform and run the analysis. Marine Scotland Science (MSS) are now planning to develop a user-friendly interface to successfully utilise the products that have been developed and for non-software specialists to be able to train the tools to identify features of interest. The application of such automated image analysis technology will ultimately enable automation of a large element of the detection and identification of fish in underwater video and a fast and accurate method of identifying features of conservation interest in benthic video.

Further information

The full version of the report can be downloaded here: Automated Identification of Fish and Other Aquatic Life in Underwater Video: Scottish Marine and Freshwater Science Vol 11 No 18 – https://doi.org/10.7489/12333-1

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