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Automatic total catch data collection with deep learning analysis for fishing activity monitoring

Juan Carlos Ovalle[1], Carlos Vilas[1], Julio Valeiras[2], Esther Abad[2], Eva Velasco[2] and Luís T. Antelo[1,*]

[1]Biosystems and Bioprocess Engineering (Bio2Eng) Group. IIM-CSIC.
C/ Eduardo Cabello,6. 36208 Vigo, Spain
[2] Centro Nacional Instituto Español de Oceanografía-CSIC, Centro Oceanográfico de Vigo, Subida a Radio Faro 50-52, 36390 Vigo, Spain

Email: ltaboada@iim.csic.es

The development and effective compliance of fishing policies that guarantee both the sustainability of marine resources and fishing activity is one of the main challenges that policymakers nowadays face. At EU level, successful implementation of the Common Fisheries Policy (CFP) depends, at a large extent, on the capacity to quantify catches on board commercial vessels. So, the digital revolution has to contribute to ensure accurate registration of these data not only for control purposes by administrations but also for scientific evaluation of stocks/populations and self-monitoring of fleets. Unfortunately, this is neither easy nor cheap. However, electronic monitoring (EM) and reporting technology are demonstrating effective and cost-effective new ways to collect these critical data.

In this work, we present a complete re-design of the EM system iObserver, a device able to automatically register total catch by identifying and quantifying fish specimens present in fishing hauls. As a result, two more compact and lighter EM devices, with better implementation capabilities at real fleet scale, were developed: a) the *Linear iObserver2.0*, based on the use of line scan cameras and; b) the *Matrix iObserver2.0*, based on area scan cameras that work in linear mode aided by an optical flow analysis algorithm created ad hoc.

To obtain accurate total catch data from newly acquired, high quality, more complex images (i.e. with fish conglomerates and specimen overlap), the recognition and fish size regression algorithms were improved. So, a specific MOTS (Multi-Object Tracking and Segmentation) algorithm was developed to provide a solution for the continuous identification and quantification of the fishing hauls. These powerful algorithms allow to differentiate more than twice as many species as for the EM iObserver (31 instead of 15) and they work interchangeably with iObserver and iObservers2.0 images. Achieved results are very good, with a total **precision** (percentage of correct predictions) of **96%** and a **recall** (percentage of correctly identified samples) of **92%** for the test set. Regarding the size regression algorithm (from which weight is estimated), the **mean absolute percentage error** obtained is **3.1%** (**mean absolute error 9 mm**), calculated on the fraction of correct identifications of the target species.

iObservers2.0 were tested during the research survey DESCARSEL 0921, led by IEO-Vigo. Fishing was carried out emulating a commercial vessel. Obtained results are very promising in terms of providing accurate total catch estimates: the average **WAPE** (Weighted Average Percentage Error) of catch weight per haul was **16%** (with values ranging 6%-36%).

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Fishing catch data, fisheries management, remote electronic monitoring, landing obligation, species identification and length estimation, deep learning.