UNDERWATER AND IN THE CLOUD: WEB-BASED MACHINE LEARNING FOR FISH VIDEO ANALYSIS

Jonas Jäger[1,3], Claudia Kruschel[2], Stewart T. Schultz[2], Dubravko Pejdo[2,] Viviane Wolff[1], Klaus-Fricke Neuderth[1], Joachim Denzler[3]

[1]Fulda University of Applied Sciences, Department of Electrical Engineering and Information Technology, Leipziger str. 123, 36037 Fulda, Germany
[2]University of Zadar, Department of Ecology, Agronomy and Aquaculture and CIMMAR, Center for Interdisciplinary Marine and Maritime Research, Trg kneza Višeslava 9, 23000 Zadar, Croatia
[3]Friedrich Schiller University Jena, Computer Vision Group, Ernst-Abbe-Platz 2, 07737 Jena, Germany

e-mail: jonas.jaeger@et.hs-fulda.de

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Fish stocks should be monitored with fisheries-independent and non-destructive methods. In Croatia, we are using baited, remote, underwater, stereo video (BRUV) and diver-operated video-visual census (DOV), potentially operated inexpensively by personnel untrained in fish biology but requiring lengthy and tedious office labor by experts to classify, count, and measure fish. Automated methods will potentially greatly reduce this labor cost and allow greater video data-processing per unit time, and increased statistical power for detecting spatio-temporal variation in fish populations and fish communities. We are currently developing computer-vision tools for automated processing of high resolution underwater videos from BRUV and DOV videos taken in the shallow Croatian Adriatic under varied fish assemblage, water, and habitat conditions. The method is based on deep machine learning and consists of three major steps: detection, classification, and movement tracking of fish. The current prototype achieves accuracies for fish-species classification of 69%, 94% and 98% on the Croatian dataset (794 images), the fish4knowledge 2012 dataset (27370 images) and the seaclef 2015 dataset (22443 images) respectively. The positive correlation between dataset volume and classification accuracy indicates that experts should annotate over 25000 images for the algorithm to be trained to achieve accuracies above 90%. In the near future we plan to embed our algorithms into a lifelong machine-learning framework that continuously improves through incremental learning from newly arriving annotated data. Human-machine collaboration is facilitated by the software tool L3P which allows for annotation within a web-based image-processing engine. This tool enables fish experts to improve analysis algorithms in the cloud without specialized computer-vision knowledge. Our core system achieved best results in a competition to estimate fish abundances within the seaclef 2016 dataset and is foreseen to accomplish several more specialized tasks. We present an innovative machine learning approach that will utilize human-machine collaboration and is suitable for the overall challenge of monitoring marine species and habitats. This work was partially supported by the Croatian Science Foundation, under the project COREBIO (3107).