Automated detection of reef fishes on underwater videos

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Monitoring biodiversity of reef fishes requires efficient data gathering over large areas and high frequency. Remote underwater videos are a cost-effective alternative to diver-based visual censuses, but videos are time-consuming to process by humans. Recent advances in computer vision have shown the efficiency of Deep Learning algorithms to detect objects on pictures. However, development of an AI algorithm able to efficiently detect all the fishes in an image whatever is the reef environment remains an intense research topic.

To tackle this challenge, we first built a database of 14,231 images from high-definition videos recorded in five regions (Mediterranean Sea, Western Indian Ocean, Pacific Ocean, Red Sea and Caribbean Sea), representing a total of 81,552 fishes covering 230 species. We then trained several fish detectors based on different AI architectures such as Faster R-CNN and YOLO for a comprehensive comparison. We also proposed a method to tune the confidence threshold on the validation set for two purposes: maximizing the recall while keeping precision above 0.75, and excluding fishes not identifiable at the species level. We evaluated the performance of all these models on an independant set of 56 underwater videos and assessed the impacts of fish taxonomy and apparent size on detection performances.

Our best model achieved an overall recall greater than 0.85. We found that apparently small fishes (body covering an area less than 2500 pixels, that is < 0.12% of the frame resolution) had a recall three times lower than those with more than 10.000 pixels. Moreover, species does not influence the performance of detection. Less than 5% of the objects detected by the best model were background elements.

Our detection algorithm can thus efficiently help to automate detection of fishes in order to count and classify their species with another AI algorithm. This opens the way to automatic biodiversity monitoring.

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