A Deep Learning algorithm for accurate and fast identification of coral reef fishes in underwater videos

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Abstract

Identifying and counting individual fish on videos is a crucial task to cost-effectively monitor marine biodiversity, but it remains a difficult and time-consuming task. In this paper, we present a method to assist the automated identification of fish species on underwater images, and we compare our algorithm performances to human ability in terms of speed and accuracy. We first tested the performance of a convolutional neural network trained with different photographic databases while accounting for different post-processing decision rules to identify 20 fish species. Finally, we compared the performance in species identification of our best model with human performances on a test database of 1197 pictures representing nine species. The best network was the one trained with 900 000 pictures of whole fish and of their parts and environment (e.g. reef bottom or water). The rate of correct identification of fish was 94.9%, greater than the rate of correct identifications by humans (89.3%). The network was also able to identify fish individuals partially hidden behind corals or behind other fish and was more effective than humans identification on smallest or blurry pictures while humans were better to recognize fish individuals in unusual positions (e.g. twisted body). On average, each identification by our best algorithm using a common hardware took 0.06 seconds. Deep Learning methods can thus perform efficient fish identification on underwater pictures which pave the way to new video-based protocols for monitoring fish biodiversity cheaply and effectively.