Coral reef fish detection and recognition in underwater videos by supervised machine learning: Comparison between Deep Learning and HOG+SVM methods

Sébastien Villon [1], Marc Chaumont[1] [3], Gérard Subsol [1]
Sébastien Villéger [2], Thomas Claverie [2], David Mouillot [2]
[1] LIRMM, CNRS, University of Montpellier, France
[2] MARBEC, IRD, Ifremer, CNRS, University of Montpellier, France
[3] University of Nîmes, France

Summary: we compare two different approaches to automatically detect and recognize coral reef fishes in underwater HD videos. The first method relies on a traditional two-step approach: extraction of HOG features and use of a SVM classifier. The second method is based on Deep Learning.

Ecological key-points:

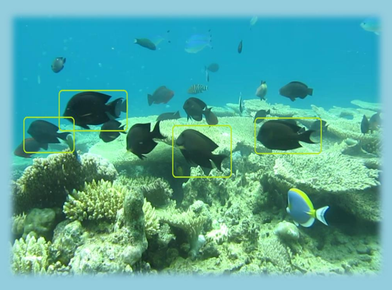
- To follow the benefits of Marine Protected Areas
- To assess the Impact of Global Change

→ We need to monitor fish biodiversity

The goal of our work is :

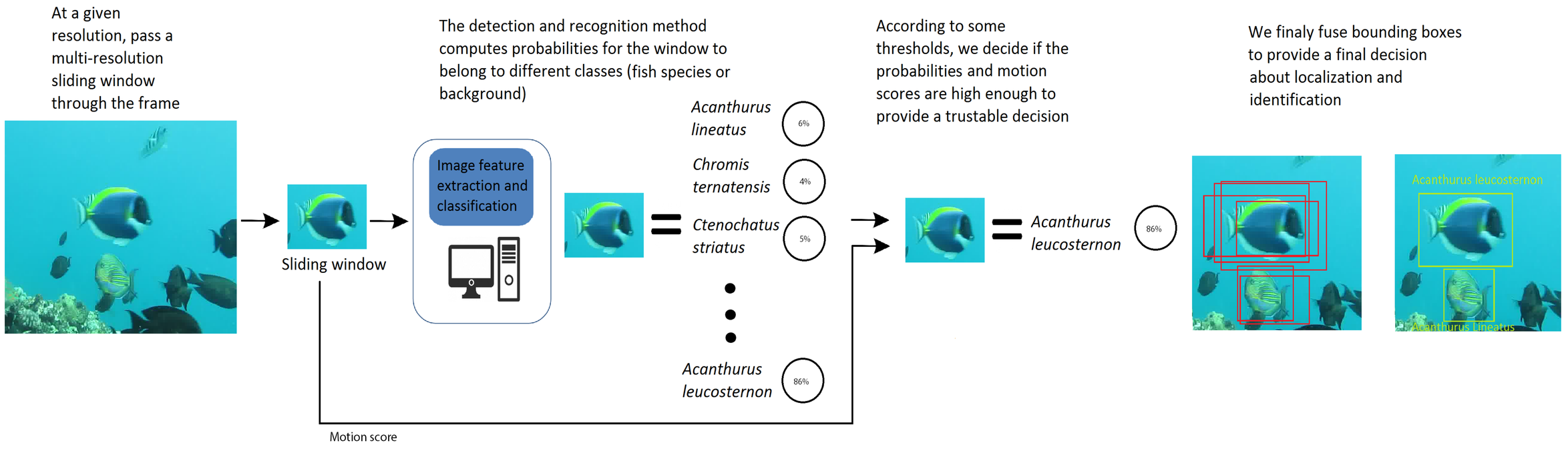
To improve the performance of video analysis

From HD underwater video recorded by divers…



… to fully analyzed frames with all fishes detected and recognized.

Detection and Recognition Pipeline



What is the best detection and recognition method? → Compare HOG+SVM vs Deep Learning

Methods :

- HOG+SVM: non linear SVR, Gaussian radial basis function kernel [1]
- Deep Learning : based on GoogLeNet's architecture, we use 27 layers with 9 inception layers, and a soft max classifier. [2]

Learning database

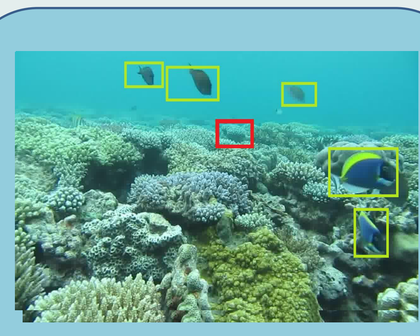
Species	Thumbnails
Acanthurus lineatus	2465
Acanthurus nigrofuscus	3923
Chromis ternatensis	4755
Chromis viridis/Chromis atripectoralis	2619
Pomacentrus sulfureus	3830
Pseudanthias squamipinnis	5900
Zebrasoma scopas	2400
Ctenochatus striatus	4000

Performance of algorithms

Video	HOG+SVM	Deep Learning
1655	0.28	0.62
1654	0.24	0.65
1547	0.49	0.64
1546	0.14	0.55

F-measure of the two methods with identical fusion parameters and probability thresholds on 4 test videos (250 frames).

Deep Learning has an higher performance than the HOG+SVM method.



Some imperfections remain. Here a rock is misclassified as "fish".

Following these promising results, we plan to scale up the training database to be able to recognize more than 100 species using Deep Learning.

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[1] Hearst, M. (Ed.), Dumais, S.T., Osuna, E. Platt, J. Scholkopf, B., Support Vector Machines, IEEE Intelligent Systems, Trends & Controversies feature, 13 (4), July-August 1998.
[2] Schmidhuber, J. Deep Learning in Neural Networks: an overview. Neural Networks, 2015, vol. 61, p. 85-117.