



**HAL**  
open science

## **Coupling underwater autonomous vehicles and automatic video analysis for efficient monitoring of coral reef ecosystems: promises and challenges**

Thomas Claverie, Marc Chaumont, Karen Godary-Dejean, Adrien Hereau, Lionel Lapierre, Silvain Louis, Mathilde Maslin, David Mouillot, Gérard Subsol, Sébastien Villéger, et al.

### ► To cite this version:

Thomas Claverie, Marc Chaumont, Karen Godary-Dejean, Adrien Hereau, Lionel Lapierre, et al.. Coupling underwater autonomous vehicles and automatic video analysis for efficient monitoring of coral reef ecosystems: promises and challenges. ICRS 2021 - 15th International Coral Reef Symposium, Jul 2021, Bremen (virtual), Germany. lirmm-03820865

**HAL Id: lirmm-03820865**

**<https://hal-lirmm.ccsd.cnrs.fr/lirmm-03820865>**

Submitted on 19 Oct 2022

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

**Coupling underwater autonomous vehicles and automatic video analysis for efficient monitoring of coral reef ecosystems: promises and challenges.**

Claverie T., Chaumont M., Godary Dejean K., Hereau A., Lapierre L., Louis S., Maslin M., Mouillot D., Subsol G., Villéger S., Villon S.

Coral reefs are facing increasing effects of global changes. Yet, diver-based surveys do not allow assessing the subsequent changes of reef fish assemblages over large areas and at high frequency. Development of Semi-Autonomous Underwater Vehicle (SAUV) and Deep Learning technologies could help to tackle this challenging task. To this end, we developed a small-size underwater vehicle carrying stereo cameras and environmental sensors, capable of automatically perform standardized trajectories in a complex environment. Our robot can, for example, dynamically verify mission-dependent properties (remaining to a constant depth or altitude, moving below a maximal speed, following a virtual transect line, etc.) and automatically transition among missions. We are actually working toward full autonomous functionalities in order to remove the umbilical cable presently necessary for human operators to visually detect dangerous obstacles. The umbilical cable limits drastically the operational range of the system, increases the logistical burden and induces huge disturbances on the system (it can cling on coral, creates overwhelming drag, limits the action range of the robot, etc.). But, removing the umbilical cable implies to improve autonomous system reaction to specific troubling events (obstacle detection and avoidance, energy management, essential sensors failure, etc.). In parallel, we developed Deep Learning based computer vision algorithms capable of automatically, locating and identifying fishes in videos for post treatment of recordings.

Tests of these novel tools revealed that diver and SAUV -operated video recordings showed little differences in describing overall structure of fish assemblages (both set of video were treated manually by the same operator). SAUV even appeared to be more appropriate to survey commercial species, which are probably more scared by the potential “human predators”. Similarly, Deep Learning algorithms were as good as humans to identify fish species but at a higher rate.

Full autonomy is still a hard point to reach for mobile robotics in harsh environment such as oceans, but combined with automatic video analysis, such tools are now necessary to succeed in ecosystems monitoring. While necessary hardware are now becoming available, greater effort needs to be made in algorithmics.