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Topic: Marine biology and ecology

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ABSTRACT Subject :

Autonomous and Intelligent Long-Term Video Monitoring of Antarctic Fauna

Abstract 13/02/2023 11:46:09

In situ long-term monitoring of aquatic organisms is one of the major challenging goals in ocean studies, particularly difficult in polar areas due to the extreme environmental conditions and the complicated logistic. Nevertheless, biological in situ observations extended in time allow to generate big data which are crucial to understand the marine ecosystem functioning and their modifications due to climate change. For this purpose, the intelligent and autonomous imaging device GUARD1, for non-invasive and autonomous underwater monitoring, was used for acquiring a high-resolution long-term image dataset of the Antarctic macrozoobenthos. The imaging device was deployed in Tethys bay, near Mario Zucchelli Station (Terranova Bay, Ross Sea), from January to November 2017 (11 months) collecting time-lapse images every nine hours. After the recovery of the instrument, the acquired images were visually inspected in order to recognize the local species and to determine their temporal distribution along the monitoring period. Subsequently, the image dataset was analyzed through computer vision and machine learning techniques in order to capture the long-term cross-seasonal dynamics of the macrozoobenthos. The results of the monitoring experiment demonstrate the effectiveness of such an autonomous imaging device for acquiring relevant long-term visual data and the effectiveness of the proposed image analysis algorithms for extracting relevant scientific knowledge. The changes in the dynamics of the observed ecosystems can only be detected through in situ continuous observation systems, hardly accessible with the current state-of-the-art monitoring approaches often implemented in polar studies. Such a long-term monitoring experiment is a step toward the automated collection of continuous environmental data in the coastal Antarctic areas and in general in all the remote and extreme underwater habitats. In addition, the stand-alone and autonomous imaging device GUARD1 can be used for increasing the number of the autonomous monitoring sites in remote environments and, when combined with multi-proxy probes for physical and chemical data acquisitions, will make a major contribution to increasing the collection of ocean big data. A summary of the past monitoring experiences performed with the autonomous intelligent imaging device GUARD1 will be provided and the new device architecture, together with the ongoing and forthcoming applications will be presented. We will focus on the autonomous onboard detection and classification of the underwater organisms and on the capability to transmit image-content relevant data to a land station.