Change Detection in underwater time laps videos from stationary observatory

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Stationary observatories are more and more often equipped with digital cameras taking images of a fixed region of interest at equidistant time intervals. The time intervals between the shots are typically too large to apply video analysis proposed by the image processing community in the context of video surveillance. Therefore new methods and algorithms are needed that are able to deal with arbitrary low temporal resolutions in video data.

The aim of this study was a) to develop a new algorithmic approach to the problem of (semi-)automatic annotation in image time series / video and b) testing it with data from two stationary observatories at different chosen benthic ecosystems. One of them is the LoVe Observatory, located near Hovden in the Norwegian Sea about 260 meters below sea level. Each 60 minutes an image is taken. The other observatory takes one image every 111 minutes and is located 180 meter below sea level in the Peregrino Field in South Atlantic Ocean about 85km off the coast of Rio de Janeiro, Brazil.

To achieve a) a new algorithm was designed integrating two concepts, a generalization of the SLIC superpixel algorithm (Achanta 2011) and a new cluster fusing method for cluster obtained from image data. The new algorithm is able to spatially segment a visual field based on the temporal dynamics in the feature space. This allows a flexible and adaptive detection even of novel i.e. unseen objects, i.e. taxa.

Our results show, that the segmentation result divides the image into different categories (each category marked with a different color) representing different biologically / ecologically relevant semantics. A good example is the starfish, which is represented as a red region (see Fig 1) or the moving see cucumber represented as blue a region (see Fig 2). The figures below show the result of the algorithmic analysis as a pseudocolor map of the visual field. This map is computed for a temporal image sequence and summarizes the changes / movements in this sequence.

We believe that our approach has the potential to be used to build an incremental visual memory of a benthic site contributing to a first descriptive ecological model of a habitat. Such a model would also integrate other sensor data such as turbidity, temperature, current etc. However, if image / video surveillance data shall be integrated in such a modelling step, annotation of the data is a prerequisite. In this context, our method shall be considered as a contribution to the technological development.

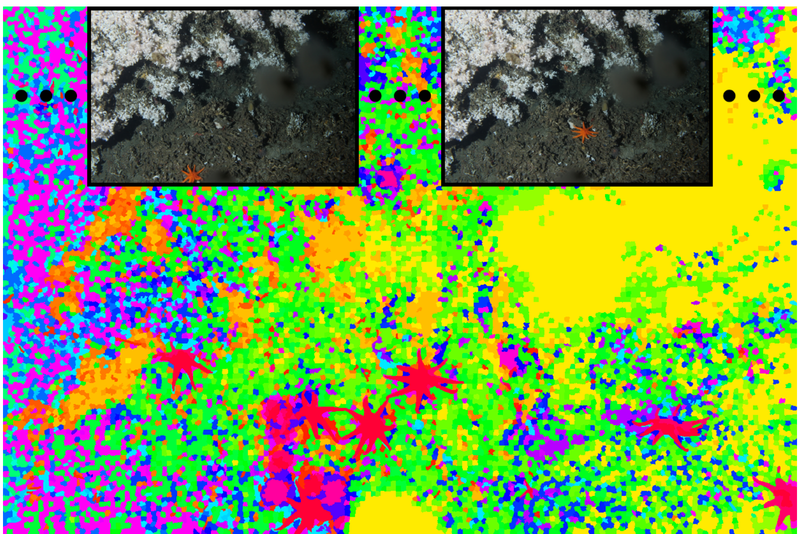

Figure 1: Segmentation result of a temporal image sequence from LoVe Observatory with two example images

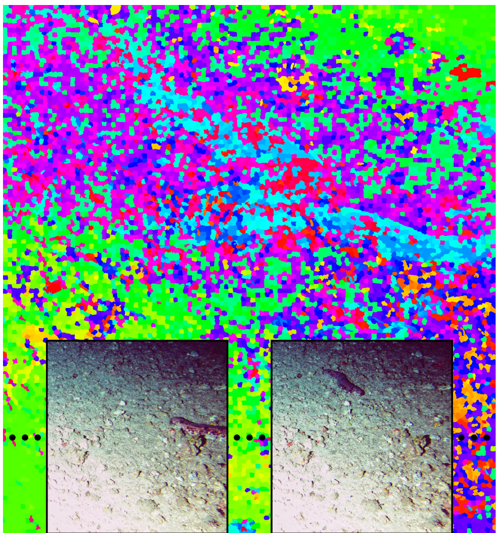

Figure2: Segmentation result of a temporal image sequence from Pemca Observatory with two example images