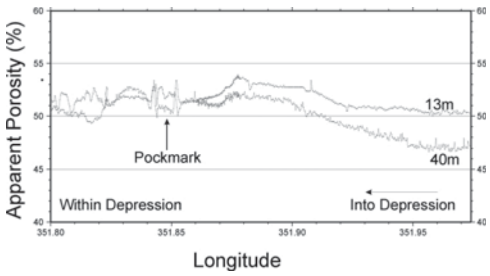

Figure 1. A profile entering the basin depression and crossing a small pock mark. Data are shown as apparent resistivities for the 13m and 40m receivers. The pockmark has complex structure, with a drop in porosity on the 40m receiver and an increase on the 13m receiver. Interpretation of this signal will depend on results from coring

3. Conclusions

Electrical resistivity measurement has proven to be a useful complement to other geophysical and sampling techniques. In some cases the EM system provides data where seismic surveys suffer from wipe-out. The density of data provided in a typical survey is substantially greater than can be provided by coring and allows tighter estimates of sediment variability.

The use of EM methods in the Malin sea has increased our knowledge of the sediment layer in this area. From EM data we have extracted a regional map of porosities, showing higher porosities in deep of the basin, probably due to more unconsolidated sediments. The anomalies observed when crossing pockmarks can be used with acoustic data and ground-truthing to trace the path of gas seepage and map gas accumulations.

The use of controlled source EM techniques for deeper-probing industrial applications has not yet translated into interest in shallow studies, but the applications discussed in the example in this paper and the references therein, may stimulate such interest.

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IDENTIFICATION OF GEOMETRICALLY CONSISTENT INTEREST POINTS FOR 3D SCENE RECONSTRUCTION

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1. Introduction

Many applications in mobile and underwater robotics employ 3D vision techniques for navigation and mapping. These techniques usually involve the extraction and 3D reconstruction of scene interest points. Nevertheless, in large environments the huge volume of acquired information could pose serious problems to real-time data processing. Moreover, in order to minimize the drift, these techniques use data association to close trajectory loops, decreasing the uncertainties in estimating the position of the robot and increasing the precision of the resulting 3D models. When faced to large amounts of features the efficiency of data association decreases drastically, affecting the global performance.

We propose an algorithm that extracts image features that are consistent with the 3D structure of the scene. The features can be robustly tracked over multiple views and serve as vertices of planar patches that suitably represent scene surfaces, while reducing the redundancy in the description of 3D shapes. In other words, the extracted features will offer good tracking properties while providing the basis for 3D reconstruction with minimum model complexity.
In order to better understand the concept, consider the simple example in Fig. 1a, which illustrates a 2-D profile as the cross section of a 3-D relief. By extracting features around the edges of the slopes (marked in dark grey) and applying linear interpolation (dotted lines), a good initial approximation of the shape is obtained.
The algorithm consists in 2 parallel pipelines (see Fig. 2): photometric features extraction & tracking [1] [2] and geometric features extraction. In order to extract the geometric features, the algorithm computes an approximation of the scene shape (depth map) [4] by analyzing the pixel disparities between frames (optical flow) [3] (see Fig. 3a).

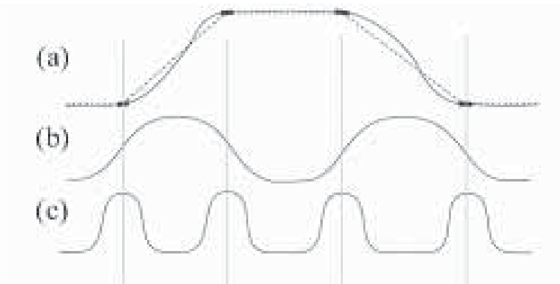


Figure 1. Simple 2D example of ideal features geometric extraction: (a) 4 feature points provide a good initial approx of the shape; (b) first derivative; (c) the 4 features correspond to the maxima of the second derivative.

By segmenting out high responses on the absolute value of the second derivative of the depth map (see Fig. 1c), we can extract the regions of interest corresponding to the edges of the objects present in the scene. On these regions we define 3 types of geometric features (Fig. 3b): line ends, line junctions and high curvature points.

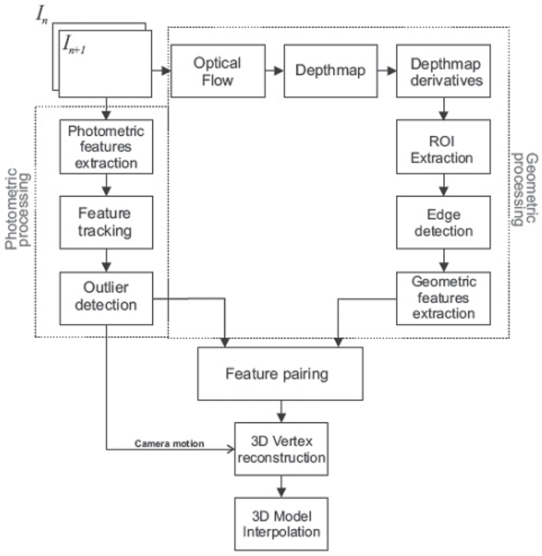
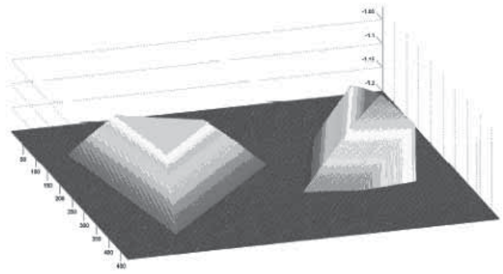
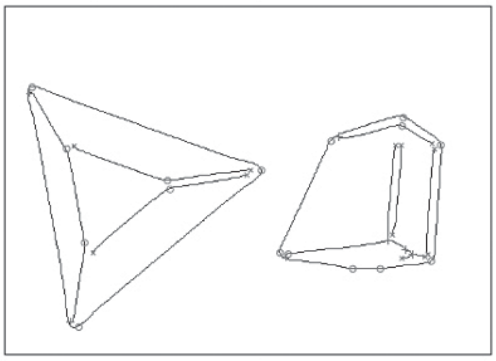


Figure 2. Flowchart of the feature extraction algorithm. Two parallel pipelines extract photometric and geometric features, the 2 types



(a)



(b)

Figure 3. Steps of the geometric feaure. extraction. (a) recovered depthmap of synthetic scene and (b) extracted geometric features

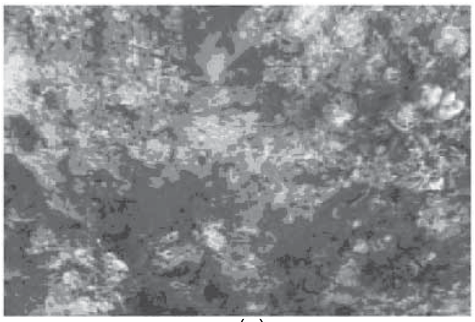
For each geometric feature, the Feature Piring module associates a photometric features that is much more reliable for tracking and 3D reconstruction.

2. Experimental results

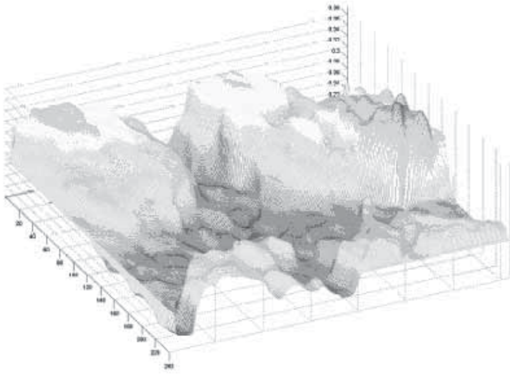
The data set represents a sequence of a coral reef in Bahamas. Applying the proposed method, we have obtained a reduction in the number of features from 343 to 51. The average volumetric error induced by the reduction is 4.5%. Fig. 4 illustrates the results after the main steps in the proposal.

3. Conclusions

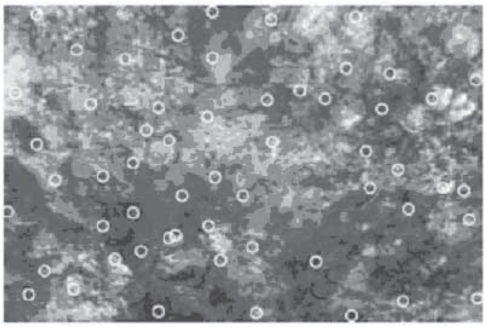
The presented technique is intended to reduce the computational costs for robot navigation and to improve data association efficiency in large scene reconstruction. The key aspect of the methodology is the extraction of geometrical representative regions and to associate them with image features that can be robustly tracked in multiple views. The experimental results have shown that this approach enables the reduction of 3D model complexity up to 90% with a precision cost of only 4-5%



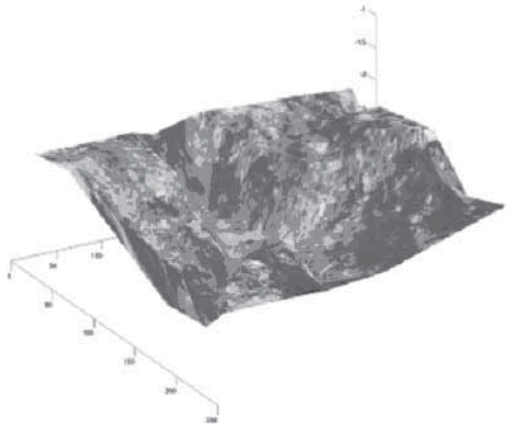
(a)



(b)



(c)



(d)

Figure 4. Proposal applied on an underwater scene: (a) sample image; (b) recovered depth map; (c) object contours; (d) geometrical features and (e) 3D reconstruction.

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