

3-D Photo-Mosaicking of Benthic Environments

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Abstract: 2-D mosaicking of a sequence of scene images is an active research area [3,6,7], and of particular interest for underwater mapping applications [1,2]. The scene structure is irrelevant in many common terrestrial applications where the images are obtained by the camera panning motion, e.g., to construct a panoramic view. For any motion that involves camera translation, topographical variations play a role in the quality of the mosaic. Even the most elaborate methods currently require the simplistic and restricting assumption that there is no significant height variations among different points of the scene. In such cases, the process consists of 1) finding the (planar) projective transformation between nearby images from the overlapping regions, 2) warping one of them to the coordinate system of the other one, and 3) align the images next to each other [6]. But, the situation is not the same if the above assumption about the scene structure is not satisfied. In this scenario the mosaicking of the image sequence is not a trivial task, because significant height differences between adjacent points results in projections of these points to have various inter-distances on overlapping images. On the other hand, height difference in the scene leads to a distortion in the image, which affects 2-D mosaicking [7]. To solve this problem the idea of Ortho-Photo in Photogrammetry [5] can be used, in which the height information (DTM/DEM) is used to remove the corresponding effect on the images and transform them from projective projection to orthogonal/orthographic projection.

In this paper we will apply the idea of Ortho-Photo mosaicking for underwater images of scenes with complex topography. Here the main challenge is to compute and consequently utilize a reasonably accurate

estimate of the 3-D scene structure, which may be determined from either the optical flow (up to a scale factor ambiguity, that is irrelevant for photo-mosaicking) or stereo disparity measurements when stereovision is available [4]. Lighting artifacts and water turbidity are among certain factors that add to the complexity of underwater image processing, and have to be addressed in the computation of optical flow/stereo disparity. Having determined the 3-D scene structure, the 3-D mosaicking is generated by transforming the images into a orthogonal projection and merging them together.

References:

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