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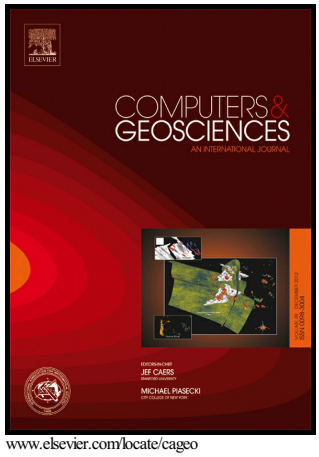

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WASS: an Open-Source Pipeline for 3D Stereo Reconstruction of Ocean Waves

Filippo Bergamasco[a,*], Andrea Torsello[a], Mauro Sclavo[b], Francesco Barbariol[b], Alvise Benetazzo[b]

[a] *DAIS, Università Ca'Foscari, Venice, Italy*
[b] *Institute of Marine Sciences, Italian National Research Council (ISMAR-CNR), Venice 30122, Italy*

Abstract

Stereo 3D reconstruction of ocean waves is gaining more and more popularity in the oceanographic community and industry. Indeed, recent advances of both computer vision algorithms and computer processing power now allow the study of the spatio-temporal wave field with unprecedented accuracy, especially at small scales. Even if simple in theory, multiple details are difficult to be mastered for a practitioner, so that the implementation of a sea-waves 3D reconstruction pipeline is in general considered a complex task. For instance, camera calibration, reliable stereo feature matching and mean sea-plane estimation are all factors for which a well designed implementation can make the difference to obtain valuable results. For this reason, we believe that the open availability of a well tested software package that automates the reconstruction process from stereo images to a 3D point cloud would be a valuable addition for future researches in this area.

We present WASS (`http://www.dais.unive.it/wass`), an Open-Source stereo processing pipeline for sea waves 3D reconstruction. Our tool completely automates all the steps required to estimate dense point clouds from stereo images. Namely, it computes the extrinsic parameters of the stereo rig so that no delicate calibration has to be performed on the field. It implements a fast 3D dense stereo reconstruction procedure based on the consolidated OpenCV library and, lastly, it includes set of filtering techniques both on the disparity map and the produced point cloud to remove the vast majority of erroneous points that can naturally arise while analyzing the optically complex nature of the water surface.

In this paper, we describe the architecture of WASS and the internal algorithms involved. The pipeline workflow is shown step-by-step and demonstrated on real datasets acquired at sea.

Keywords: Sea Surface Stereo Reconstruction, Stereo Reconstruction, 3D wave field, Camera Calibration, Open-source software

*Corresponding author
Email address: `filippo.bergamasco@unive.it` (Filippo Bergamasco)

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