Image segmentation of breakwater blocks by edge-base Hough transformation

Fernando Soares, Vinicius Barbon

Faculty of Sciences of the University of Lisbon, 1749-016 Lisboa, Portugal, (fjsoares@fc.ul.pt; vbarbon99@gmail.com)

Key words: *image segmentation; breakwaters; point clouds; Hough transformation*

ABSTRACT

A rubble mound breakwater (BW) is a coastal engineering structure built for purposes of harbor protection in areas with severe wave regimes. Block displacements can lead to a weakening of the protection, making the harbor more vulnerable to waving hazard. During the phase of BW design/rehabilitation the effectiveness evaluation of both the shape and the protective elements is made throughout 3D scale models, built inside wave basins or wave flumes. The experiment consists of simulating the impact of the swell on the physical model of the BW. During the process, 3D point cloud (PC) data is recorded with time-of-flight sensors, or later generated by photogrammetry from recorded RGB images. Surface changes can be obtained by comparing the PCs, identifying common points and estimating differences in their positions. However, inaccurate identification of points on the PC may lead to inconclusive results on the location and movement of the blocks. In this study, the authors propose to use both synchronized and registered RGB and PC data to estimate the displacement/motion of breakwater blocks. An edge-based image segmentation method, based on the Hough transformation algorithm is proposed, in order to obtain the straight edges of block's faces that are mostly seen from above. For each extracted polygonal region, the 3D points on the PC are selected and used to determine a plane surface model by least squares. After, the 3D spatial coordinates of the block's center point can be obtained from the ones of the given polygonal face model. For this study RGB and PC data regions were selected from a scanned BW model, built with small cubic concrete blocks. The results obtained reinforce the positive contribution that the proposed image segmentation methodology can provide, regarding the improvement of displacement accuracy and spending time analysis, in BW monitoring work.

This contribution was selected by the Scientific Committee for publication as an extended paper in the Journal of Applied Geodesy https://www.degruyter.com/journal/key/jag/html