

PHOTOGRAMMETRIC PROFILE SURVEY IN THREE-DIMENSIONAL SCALE MODEL TESTS OF RUBBLE-MOUND BREAKWATERS

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Paper topic: Laboratory and field observations and techniques

1. Introduction

In Portugal, rubble-mound breakwaters are a very common harbour protection structure and scale model tests are still a valuable tool in their design and lay-out.

During stability scale model tests, the eroded volume from the armour layer can be determined from consecutive surveys of the breakwater envelope and the damage of the structure can be inferred from it.

Alternatively to the mechanical profiler, the measurement of the eroded volume can be carried out using a technique based upon the reconstruction of stereo pairs, in which, refraction due to the air-water interface, is corrected (Ferreira, 2006). This means that it is not necessary to empty the flume or tank in order to get a good coverage of the whole armour layer with one of such pairs.

This survey technique was already tested intensively in long-term scale models for two-dimensional scale models, where rock elements were used (Lemos, 2010). Several tests were also carried out, aiming to measure the breakwater armour layer erosion, in which both natural and artificial units were used (Lemos et al, 2012).

The goal of the present work is to extend this survey technique to three-dimensional scale models.

2. Three-Dimensional Physical Model

In order to perform photogrammetric survey of the breakwater's head, several tests were carried out in one of LNEC's irregular wave basins. The studied section armour layer has a regular arrangement of Antifer units. An overview of the model is shown in Figure 1.

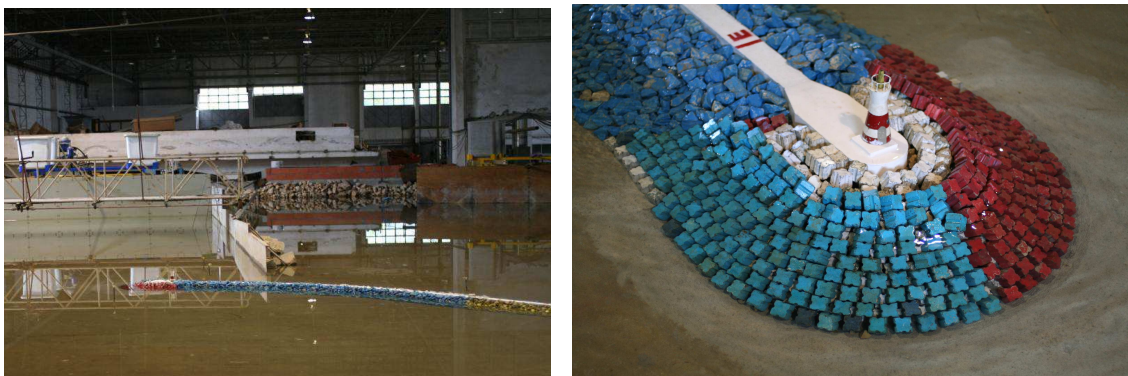


Figure 1. Three-Dimensional model overview.

3. Preliminary Results

The available software package allows a complete 3D reconstruction environment, using stereo image pairs as input. Using the reconstruction application, which consists of identifying depth from two different views of the scenery, it is possible to reconstruct both above water and/or submerged armour slope.

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The output of the package consists of a (x,y,z) file describing the cloud of reconstructed points. This is a standard file format which can be imported by various modeling tools. Using the Golden Software Surfer™, it was possible to create regular grids, enabling profile definition as well as the armour slope envelope (Figure 2).

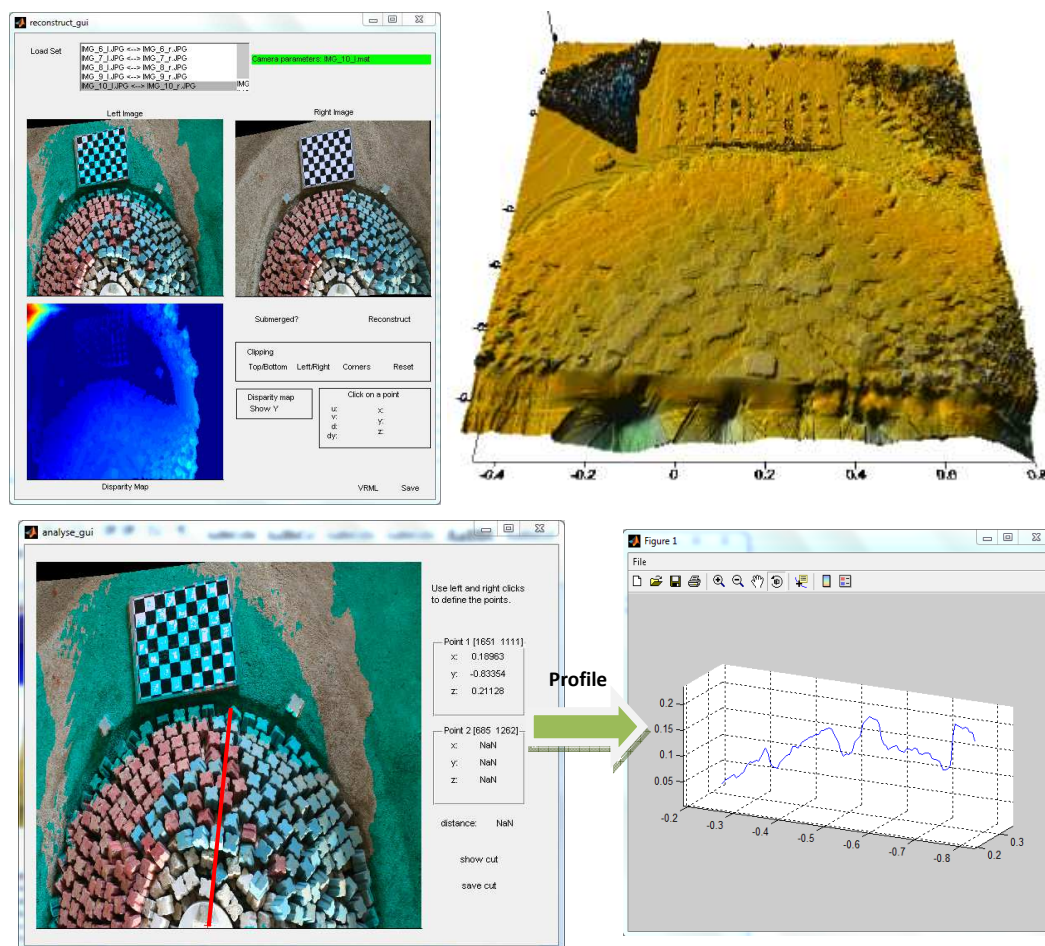


Figure 2. Reconstruction using stereo image pairs. Envelope and profile definition.

4. Conclusions

The present work is part of an on-going study at LNEC that comprises carrying out more experiments in order to test the use of the photogrammetric procedure in different sections of the 3D model of the breakwater using different water levels and light.

References

- Ferreira, R.; Costeira, J.P.; Silvestre, C.; Sousa, I. e Santos, J.A. (2006). Using stereo image reconstruction to survey scale models of rubble-mound structures. Proc. 1st CoastLab 2006 - International Conference on the application of physical modelling to port and coastal protection. Porto, Portugal, pp.107-116.
- Lemos, R. (2010). Verificação de fórmulas para a evolução da erosão em taludes de quebra-mares. Tese de Mestrado em Engenharia Civil. Instituto Superior de Engenharia de Lisboa.
- Lemos, R.;Contente, J. e Santos, J.A. (2012) -“Ensaios em Modelo Reduzido de Quebra-mares de Taludes. Aplicação da Fotogrametria no Levantamento de Perfis” - MEFTE 2012. IV Conferência Nacional em Mecânica dos Fluidos, Termodinâmica e Energia - Lisboa, Maio de 2012.