WASHTREET - Application of Structure from Motion (SfM) photogrammetric technique to determine surface elevations in an urban drainage physical model.

1. Experimental procedure

Experiments consist of measuring surface elevation in a 36 m^2 urban drainage physical model using Structure from Motion (SfM) technique. As input, 64 images were taken from different random positions around the surface with a Lumix GH4 camera (image resolution of 3264 × 2448 pixels and 28 mm focal length). SfM provides a 3D reconstruction from the triangulation of different points that appear in several images of the analysed object. The concrete surface of the facility is homogeneous and the SfM software was not able to correlate common points between images. Therefore, it was necessary to project a coloured texture over the model surface while the images were taken. The 64 images, such as those showed in Figure 1, are provided in '2_RawImages.zip'.

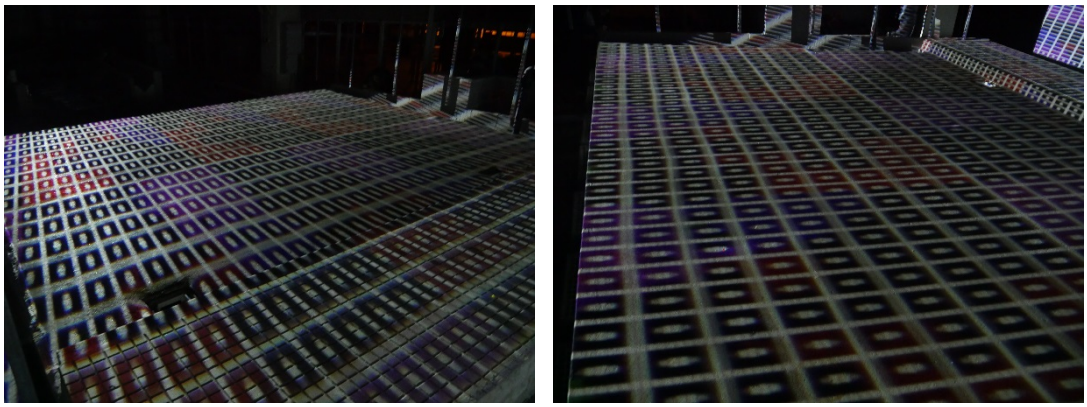

Figure 1. Examples of raw images taken as input for the SfM 3D reconstruction.

2. Data processing

Images were used as inputs for the open access software VisualSFM (Wu et al., 2011) and a point cloud of roughly 976,000 elements was obtained (available in '*3_SfM_RawPointCloud.dat*'). Then, the coordinates of five reference points were used to move and scale point cloud to a known reference system using Meshlab. The positions of the reference points over the model surface are showed in Figure 2. The real coordinates of these points and their corresponding coordinates in the raw point cloud are provided in Table 1. In addition, more details of the physical model geometry and coordinates of other elements, which could be also used as reference in further works, can be consulted in Naves et al. (2019a, 2019b).

Finally, the 'Screened Poisson Surface Reconstruction' Meshlab tool (Kazhdan and Hoppe, 2013) and a 40 × 60 elements two-dimensional median filter was applied in order to obtain a 5 mm squared despiked grid. The elevation map resulted is available in '*4_SfM_ElevationMap(m).xyz*'. Further details of the followed methodology and the application of the obtained elevation map to a shallow water model are included in Naves et al. (2019c).

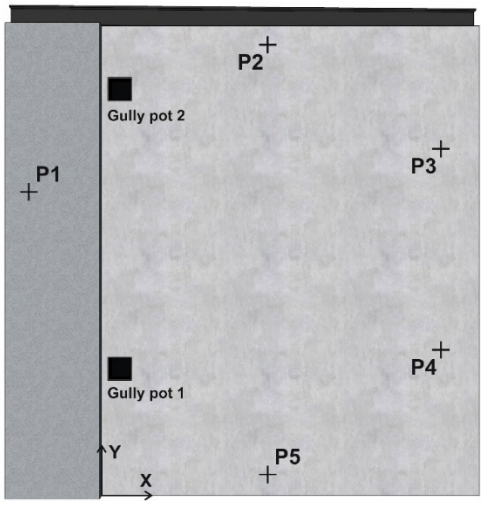

Figure 2. Scheme of the situation of reference points over the model surface.

Table 1. Reference points and corresponding SfM point cloud coordinates.

Reference point	Real coordinates			SfM coordinates		
	X(m)	Y(m)	Z(m)	X	Y	Z
P1	-1.0011	3.8086	0.9600	2.7834	0.7718	1.6434
P2	2.0029	5.7780	0.8355	2.9938	0.8693	-0.4967
P3	4.0019	4.2668	0.8850	1.6559	0.8141	-1.1556
P4	4.0032	1.7938	0.8935	0.3139	0.7768	-0.4495
P5	2.0062	0.2715	0.8560	0.0723	0.7821	1.0224

References

Kazhdan, M., & Hoppe, H. (2013). Screened poisson surface reconstruction. ACM Transactions on Graphics (ToG), 32(3), 29.

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