Geodetic Observations for Baselines Calibration and Panoramic Photogrammetry Assessment on the UPV Campus

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Introduction

Geomonitoring of deformation and displacement and landslides is increasingly carried out by solutions that integrate different geomatics techniques to provide quickly 3D point clouds or models that are required to be rigorously in the same reference system. Methods based on remote sensing such as terrestrial laser scanning or photogrammetry need precise ground control, which is usually provided by means of geodetic surveys. Geodetic techniques cannot always grant accurate target points optimally distributed within the monitored object, but terrestrial photogrammetry shows clear advantages compared to terrestrial laser scanning. A possible alternative is the use of the panoramic photogrammetry method by using robotic devices like Gigapan along with a systematic collection procedure from stable stations of a reference frame whose coordinates are accurate and well-controlled. This contribution describes an experiment conducted on the Universitat Politècnica de València campus.

Objectives

The main goal of this experiment is to simulate geodetic and photogrammetric measurements to achieve a reliable and applicable method in a wide area and long baselines. In addition, the calibration of the geometric network of the pillars of the UPV campus for carrying out detailed experiments and training in the field of geomatics. On the other hand, the first period of these observations was done in 2008, and keeping the pillar coordinates up to date will be very useful for various purposes.

Also, other goals such as the following are followed:

1) Utilizing of dedicated algorithms for panorama orientation and restitution.

2) Eliminating refraction error in accurately measuring the distance between control points and target points.

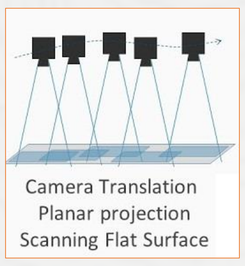
3) Integration of geodetic measurements with panoramic images to identify deformation and displacement.

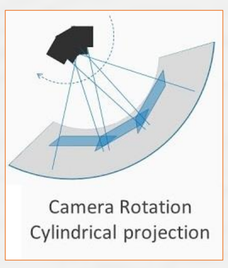
Materials and Methods

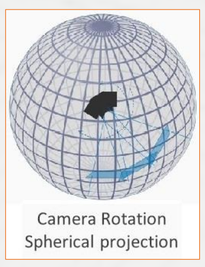
Panoramic Photogrammetry

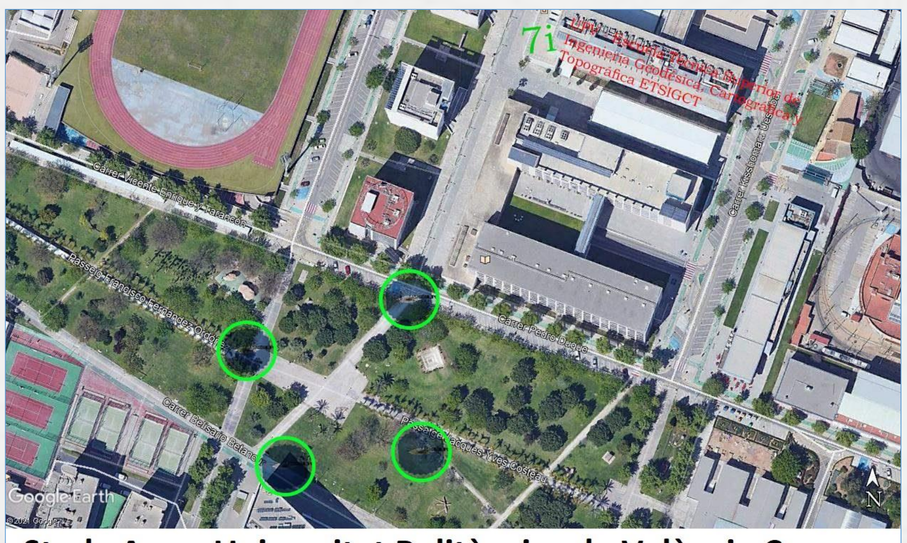
Panoramic Image

Panoramic photography, also known as wide format photography.
Stitches multiple images together to form a single image with wide view.







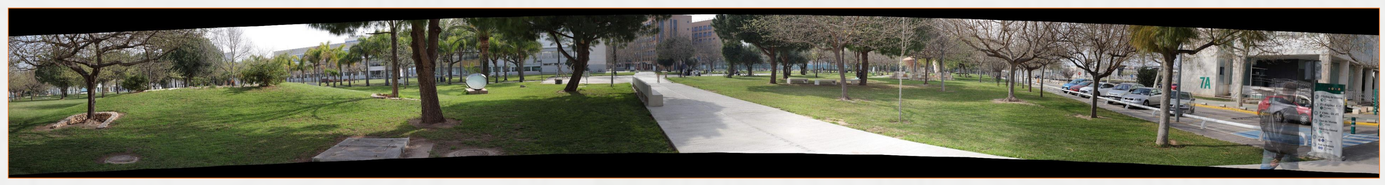


Study Area: Universitat Politècnica de València Campus

Panoramic Photogrammetry

Image Stitching

The biggest challenge with panoramic photography is the proper stitching of images, image correspondence, or possible parallax errors.



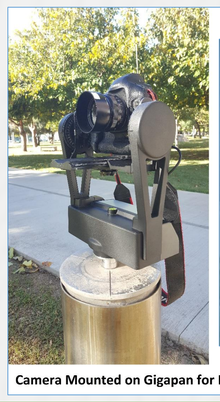
Measurement Setup

Geodetic Surveying

Robotic Total Station for Geodetic Surveying of Pillars

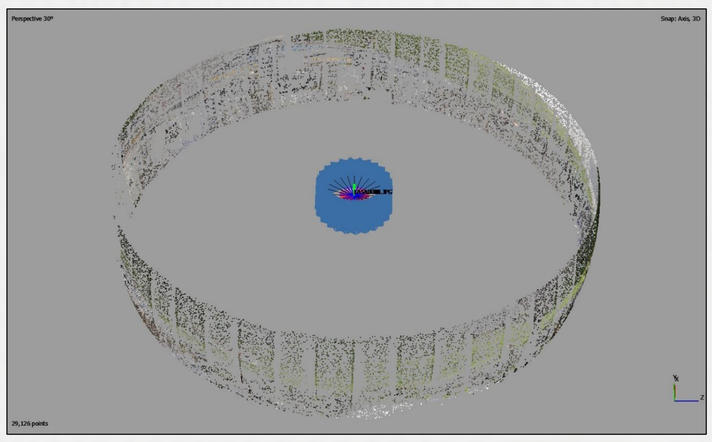
Measurement Setup

Panorama Photogrammetry



Camera Mounted on Gigapan for Panoramic Image Shooting

Results



A panorama made from one of the Pillars of the campus

Table 1: Data about the orientation of four panoramic images in one horizontal strip in the campus

	Number
Camera	**96**
Control Points	**7**
Check Points	**21**
Tie Points	**104526**

Table 2: Accuracy obtained in the orientation of the four panoramic images in one horizontal strip in the campus

	Error (m)	Error (pix)
Control Points	**0.039**	**5.33**
Check Points	**0.067**	**0.86**

Table 3: Showing the difference of the coordinates between the last epoch of baseline calibration of Pillars in UPV campus with the first epoch in 2008. These results were achieved by the Geodetic Surveying method.

	Differences (m)			*Errors (m)*		
Point	**dX**	**dY**	**dZ**	**eX**	**eY**	**eZ**
9001	-0.0060	-0.0038	-0.0103	0.0006	0.0006	0.0018
9002	0.0008	0.0001	0.0010	0.0007	0.0028	0.0017
9003	0.0030	-0.0021	0.0051	0.0006	0.0020	0.0016
9004	0.0030	-0.0002	-0.0015	0.0006	0.0022	0.0016
9005	-0.0003	0.0093	0.0113	0.0008	0.0033	0.0021
9006	0.0072	0.0065	0.0124	0.0008	0.0008	0.0019
9007	-0.0104	-0.0081	-0.0207	0.0008	0.0019	0.0018
9008	0.0024	-0.0020	-0.0013	0.0012	0.0012	0.0022

Conclusion

Experience using panoramic images to monitor displacement can be an optimal solution for detecting instability long distances, that requires a network with the correct geometry. In close-range photogrammetry, it is important to select reference CPs to orient the images. In this research, the baseline of pillars of the UPV campus were calibrated using geodetic surveying, the displacement of the pillars were calculated and their coordinates were updated. Also, the panoramic photogrammetry method was tested, and an accuracy of this method was 3.9 cm for CP and about 6.7 cm for ChP.