

Application of digital close range photogrammetry to monitor local deformations of architectural monuments: El Mirador de Inkaraqay (Machu Picchu) case study.

J. Kościuk*, M. Pakowska†

*Laboratory of 3D Laser Scanning and Modeling (LabScan3D)
Faculty of Architecture, Wrocław University of Science and Technology
Wyb. Wyspiańskiego 27, 50-371 Wrocław, Poland
e-mail: jacek.kosciuk@pwr.edu.pl

† Doctoral student at
Faculty of Architecture, Wrocław University of Science and Technology
Wyb. Wyspiańskiego 27, 50-371 Wrocław, Poland
e-mail: marta.pakowska@pwr.edu.pl

ABSTRACT

Monitoring of possible deformations is one of the essential elements of the conservation strategy. This applies both to observation on the scale of the entire building and its selected parts. The classic survey technics require placing permanent, stable markers around the object defining a fixed reference system, and then, at specified intervals, repeating measurements of characteristic points on the object. For such the measurements, usually, totalstations are used, and recently also TLS. However, the situation becomes complicated when we do not have the possibility to place such the markers around the object within the visibility range of the instrument, and at the same time the site is in a remote and difficult to access area, so sending the survey crew is difficult and expensive. This is exactly the case of El Mirador de Inkaraqay - the Inca astronomical observatory discovered in the dense jungle on the steep northern slopes of Huayna Picchu. The authors searched for a method of monitoring local deformations in such the situation.

For this experiment, the photogrammetry of a fragment of the wall made of irregular stone was made, and then it was repeated, this time with modelling clay layer attached to the face of the wall, simulating local deformations ranging from 1 mm to 8 mm in size. In the next step, tests of different ways of registering 3D clouds from two different survey eras into a common coordinate system were carried out. Several computer programs available on the market using different rules and registration algorithms were tested, and then the size of detected deformations was analysed. The experiment resulted in a low-cost method allowing the detection of local deformations already in the order of 2 mm in spite of the lack of permanent reference markers. The proposed method permits for successive monitoring of the monument only with the help of photographs taken in the field by the crew of the Machu Picchu Archaeological Park and then sent to our Laboratory for analysis. An additional factor that has been considered, was a possibility to use archive sets of photos from earlier seasons. Discussed limitations of the method define the field of its effective application and compare it with low-cost MEMS technology which might be the second choice in this case.

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