63. Accuracy and Repeatability of Smartphone Photogrammetry: A Comparison with TLS in a Cultural Heritage Case Study

Noemi Pagano, Ionut Sandric 2, Eufemia Tarantino

1 Department of Civil, Environmental, Land, Construction and Chemistry (DICATECh), Politecnico di Bari, Via Orabona 4, 70125 Bari, Italy, , 2 Faculty of Geography, University of Bucharest

The protection of cultural heritage and the documentation of its geometric and material details are extremely important, holding a deep value of both economic and social, nowadays particularly precious to Italy. Technology is undoubtedly a reliable source for data collection, and the widespread use of mobile devices serves as a pervasive and democratic tool for information, transforming millions of users into potential producers of three-dimensional data. The latest research frontiers have shifted the focus from the feasibility of three-dimensional object reproduction to the metric evaluation of data, as demonstrated by current publications in the fields of Digital Twins and data fusion. Thus, the evaluation of the precision and accuracy of data is therefore a topic of ongoing scientific interest. In this context, the work presented here analyses the variability associated with photogrammetric reconstruction performed using mobile devices, distinguishing the error components attributable to the acquisition phase from those introduced during data processing. To achieve this objective, a rigorously controlled experimental protocol was defined, based on the repeated acquisition of the same object by different devices while keeping the shooting geometry, distance from the object, and operating modes constant. The research subject is a statue placed on the campus of the Polytechnic University of Bari, characterized by a complex geometry and numerous surface irregularities. The devices considered in the study were Apple iPhone released between 2019 and 2023 and equipped with sensors that all have a camera resolution from 12MP to 48MP. For each device, a dual dataset is available, captured by different operators simultaneously. To rule out variability and subjective bias in the subsequent processing stage, all datasets were processed through a fully automated pipeline developed in Agisoft Metashape using Python scripts, thereby standardizing the alignment and reconstruction parameters. Alongside the data collection phase, a survey was conducted using a Terrestrial Laser Scanner (TLS), taken as the ground truth. The purpose of this study is to analyze the errors and statistical metrics by comparing each point cloud dataset generated by smartphones with the TLS, thereby providing an assessment of the final model’s metric reliability. 2