Chapter 4
Comparison of Photogrammetric Reconstruction Methods: The Case of an Archaeological Site With Two Software and Geovisualization Modelling Techniques

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ABSTRACT

Digital photogrammetry is a passive contactless, easy, and low-cost 3D scanning technique, that provides effective and powerful tools for 3D realistic reconstruction, as well as precise and high-resolution models based on Structure from Motion (SfM). Photogrammetry leverages data obtained by Unmanned Aerial Vehicles

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(UAVs), which have reached significant maturity in the sense that they offer a fast, affordable, and effective method for the acquisition of high-resolution geospatial information and image block (nadir and oblique) with high geometric and temporal resolutions. Data are processed by different available commercial or open-source photogrammetric software aiming at 3D reconstruction modelling. Then, the 3D-generated models can be further processed for quantity assessment by applying geometrical measurements. In addition, models through various geovisualization techniques can be used for realistic representations of the physical world. The current research investigates 3D model reconstruction by applying two photogram-metric software, Agisoft Metashape and 3DF Zephyr, in an example of an archaeological site in Greece focusing on the performance of each approach. Moreover, different distance and noise metrics are applied to compare and geometrically assess the 3D dense point clouds, meshes and Digital Surface Models (DSMs). Furthermore, traditional, and modern geovisualization forms of 3D models are discussed towards approaching the 3D models' representation holistically, aiming to provide guidelines to researchers in this field through a comprehensive workflow from data acquisition to manipulation and capabilities combined with other fields such as Computer Vision. Finally, open issues and future research directions are highlighted as a stimulus to further investigations.

1. INTRODUCTION

In the last decades, 3D visualization representations have been increasingly applied to various fields. 2D data is completed by 3D and 4D, which enable improved approximations of reality. The latter opens new vistas (Haala & Cavegn, 2016; Kadobayashi, Kochi, Otani, & Furukawa, 2004). Nowadays, 3D representations are achieved by 3D reconstruction of surfaces (Ponto & Tredinnick, 2022; Tenze & Canessa, 2024). Photogrammetry has diverse applications in different scientific disciplines, such as in Archeology (Baltsavias, 1999; Gagliolo et al., 2018), providing powerful tools and techniques for accurate 3D reconstruction of photorealistic models (Hassani, 2015), allowing the exploration and navigation of virtual environments (Adami, Cerato, D'Annibale, Demetrescu, & Ferdani, 2014). Nevertheless, Photogrammetry has been utilized from the 19th century (Meydenbauer, 1867). The American Society for Photogrammetry and Remote Sensing (ASPRS), claimed that "Photogrammetry is the art, science and technology of obtaining reliable information about physical objects and the environment through processes of recording, measuring and interpreting images and patterns of electromagnetic radiant energy and other phenomena" (Grimm, 1980). It should be noted that the term derives