Accessible remote sensing techniques for geo-archaeological research

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1. Introduction

The Roman theater in Tiberias is a well-preserved relic of the Hellenistic Period and in itself is a unique venue for archaeological research. A geological fault runs through the theater, offsetting the structure in a number of locations, thus making the theater an unusual site for geo-archaeology studies as well. Ferrario et al. 2020 show impressive results using airborne and satellite based remote sensing coupled with shallow geophysical techniques.

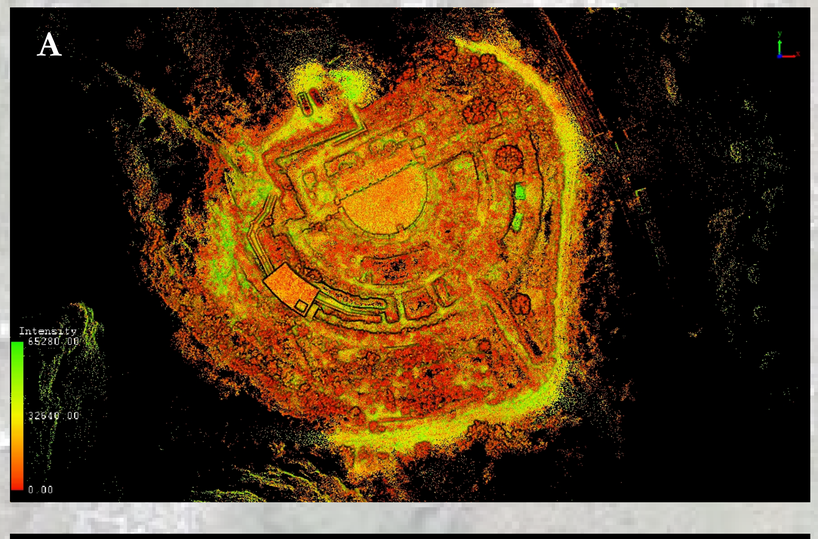
The present research was conducted by the Neev Center for Geoinfomatics at the Hebrew University of Jerusalem in collaboration with Enso – a small company founded by two geologists, to test the use of accessible and fast remote sensing techniques for mapping and measuring the offset at the site.

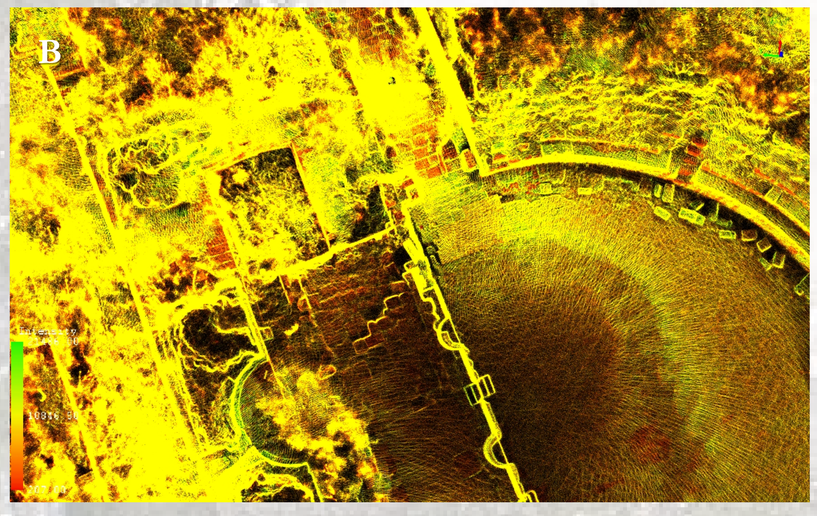
2. Methods

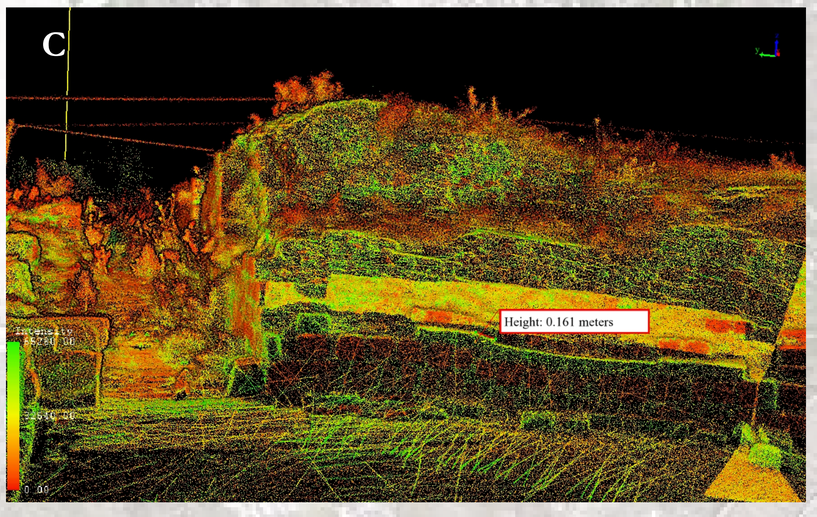
Two different technologies are used jointly, each with its own advantages and drawbacks. A handheld LiDAR (Light Detection and Ranging) system was used to scan the site and produce a 3D point cloud, while a UAV (drone) was used to create a colored 3D model of the site. Both datasets were georeferenced using the same Ground Control Points (GCP) and the same GPS RTK system.

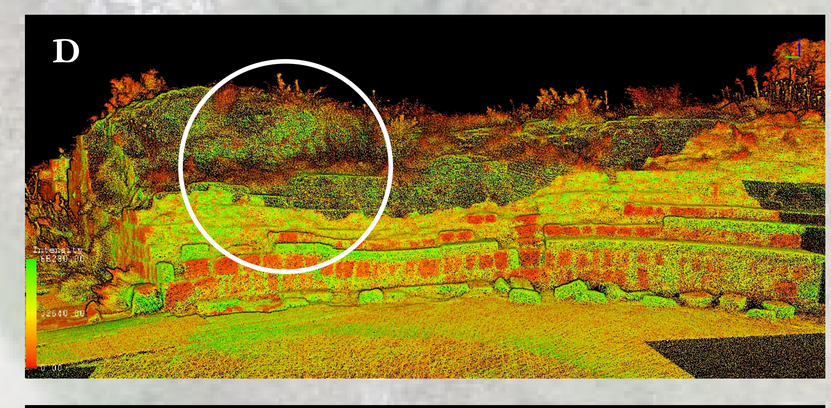
We used a GeoSLAM zeb horizon LiDAR system together with the DJI phantom 4 drone system. The precision of the LiDAR point cloud is between 1-3 cm in every axis, as verified by measuring elements of a known size within the point cloud as well as measurements on flat surfaces.

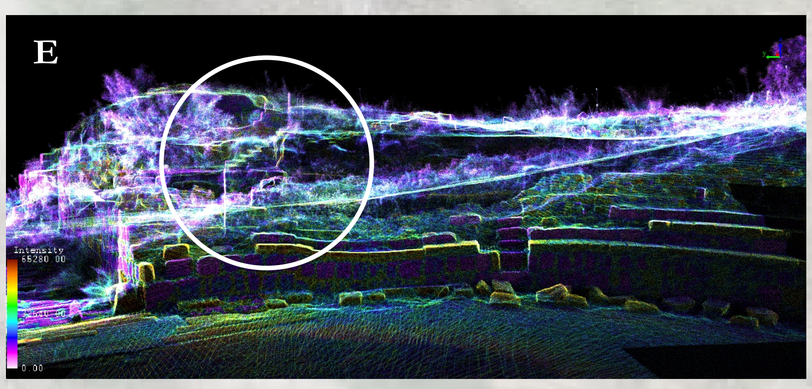
3. Results & Conclusions

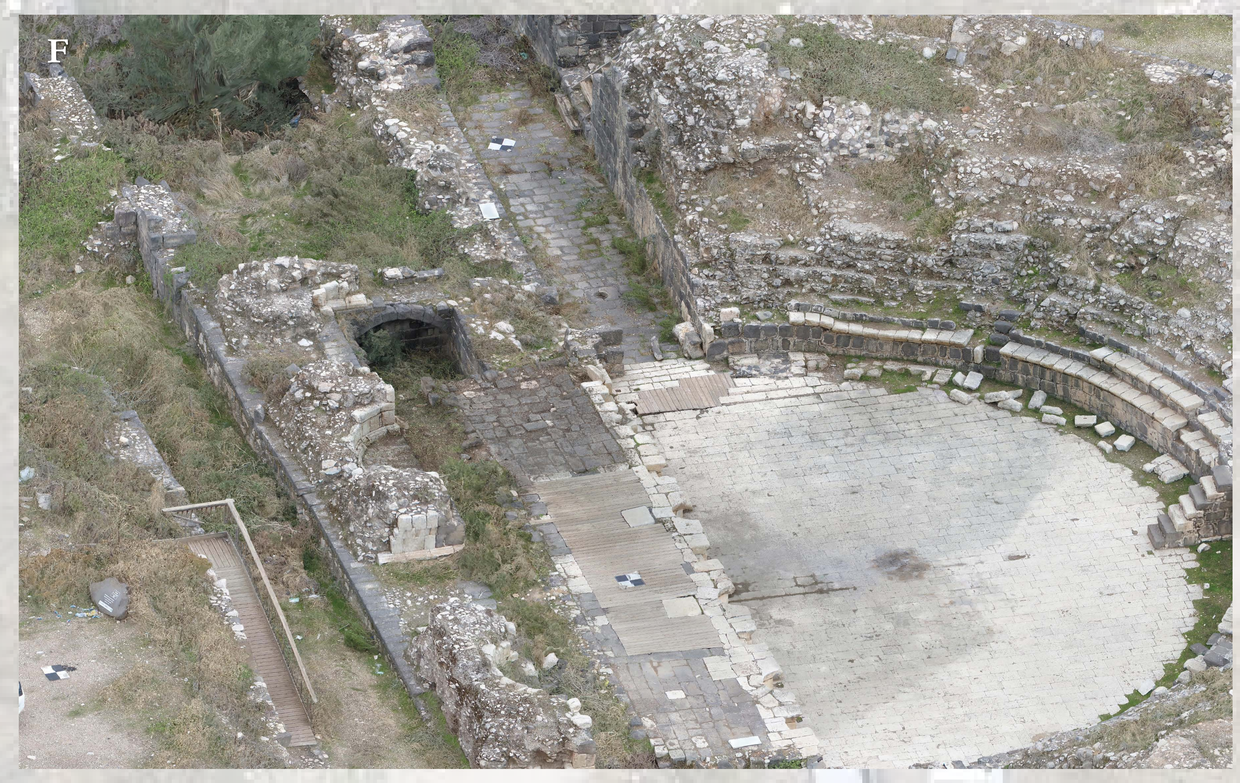












A,B,C,D,E – LiDAR scans and types of different processing. F – Snapshot from the 3D model. The checkers rectangles are the ground control points for the geo-referencing procedure. The white ellipse in figures D & E is where the glass algorithm emphasizes the stairs hidden under the vegetation.

The results show the ability to achieve <3cm precision and, along with correct "best practice" GPS workflow, similar absolute accuracy. The texture of the 3D photogrammetry model allows for comprehensive context and understanding of the site, while the LiDAR is able to obtain high precision measurements in areas of shade, subsurface voids, and under vegetation. Together, these two technologies with the correct workflow, allow for precise and accurate measuring and exploring of midsized areas even where accessibility is difficult by foot. Furthermore, the model and point cloud can be made available to a greater number of researchers, increasing the accessibility to the site in a remote way, and creating the opportunity for larger collaborations.