CONSIGLIO NAZIONALE DELLE RICERCHE

ISTITUTO PER LE TECNOLOGIE APPLICATE AI BENI CULTURALI

TESTS FOR INNOVATIVE TECHNOLOGY AND TRAINING ACTIVITIES FOR THE CONSERVATION AND DEVELOPMENT THE ARCHAEOLOGICAL SITE UMM er-RASAS

Report of the activities 2013

This project is the result of an interdisciplinary partnership effort which involves several researchers and technicians of the Italian National Research Council (CNR) and the Pontifical Institute of Christian Archaeology (PIAC). This first stage of the work was mainly aimed to a careful documentation and a systematic mapping of the site, with a particular focus on the main visible structures of the complex. This preliminary work represents an essential base for any further activity addressed to the restoration and the conservation of the site. The mission was carried out under the scientific direction of Dr. Roberto Gabrielli (Researcher, Institute of the Technologie for the Cultural Heritage – CNR) in cooperation with Dr. Antonio Salvatori (Archaeologist, CNR) and Dr. Carmelo Pappalardo (Christian Archaeologist, PIAC). Moreover Dr. Laura Mattioli (Architect), Dr. Francesca Verri (graduated in Science and technique for the Preservation of the Cultural Heritage), Dr. Silvia Saviani (graduated in Science and technique for the Preservation of the Cultural Heritage) and Dr. Damiano Portarena (Archaeologist), were part of the team.
Although of a short duration (6-10 October 2013), the mission was addressed to some experimental tests to design effective and performing procedures for measuring and data processing to be used in the future missions.

Dy-by-day activities (Fig. 1, Fig. 2):

- day 1: general topography by D-GPS
- day 2: survey of the Complex of Bishop Sergius
- day 3: survey of the Complex of St.Stephen
- day 4: photogrammetry of the mosaic floor of the apse of the complex of St. Stephen and micro-photogrammetry

The fieldwork was firstly implemented by using total station, GPS, laser scanner and terrestrial photogrammetry to carry out topographical survey and the 3D survey of the site structures.
A particular processing technique was used in Umm er-Rasas through which the 3D model of the structure was realized from the remote sensing data obtained by the laser scanner, which created point clouds. 45 scans have been made, with a resolution of a point every 4 mm at a 10 meters distance. We then colored the clouds using the RGB data recorded by the photographic sensor of the instrument.
The point clouds have been aligned thanks to targets properly positioned on the site and, afterwards, the results have been refined by using a specific software and reducing the alignment error to a maximum of 2-3 mm for each pair of point coluds.
Thanks to the high point density, the point clouds generated an extremely detailed three-dimensional render/model of the artifact with a millimetric accuracy even in reconstructing large building surfaces.
Once recorded and measured structures, elevations and floors, the quality of the acquired data were day-by-day verified by using software (Reconstructor, Scene) installed on a mobile

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workstation. These software are needed for recording and visualizing the preliminary and low resolution data.
Non-invasive diagnostic techniques (laser scanner and photogrammetry) combined with computer technology, were chosen as part of the study and of the documentation of the famous mosaic floor of the main building of the site the church of St. Stephen.
The "Structure from Motion" technique has been used for the photogrammetry of the floor of the apse, thus obtaining millimetric precision in determining the position (xyz) of each mosaic's tile.
The work resulted in the collection and storing of a large amount of relevant and reliable data concerning the erosion and disarray of the floor, with the aim to plan further interventions finalized not only to the conservation of the artifact but also to its reconstruction representation presentation for touristic didactic purposes. Due to the considerable size of the mosaic floor of the St. Stephen's Complex, during this first mission, the combination of the two techniques –photogrammetry and laser scanner– was addressed only to a part of the surface. The test was performed on the floor of the apse and its outcome was a metric representation of a very high quality image obtained by applying the photographs on the point clouds originated from the laser scanner (Fig. 3).
Our intention is to use an integrated method in next missions, using the Laser Scanner to achieve an optimal metric control of the whole monument and using photogrammetry for the detail survey of the mosaic and of the walls' building typologies.

Fig.1: Survey operations on the site.

Fig.2: The laser scanner and photogrammetric survey's activity.

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- High resolution virtual models of the complexes of SantoStefano (Fig. 4) and Bishop Sergius (Fig. 5);
- Plans and sections of the structures;
- DEM (Digital Elevation Model) of parts of the mosaic in the apse of the complex of St. Stephen;
- Meshes: the points connected by a grid are transformed in a series of polygons that describe the surface
- Photogrammetry of the apse of the complex of Santo Stefano and of the walls of the complex of Bishop Sergius.

We also started to check bibliographic sources about mosaics' representations in order to study and compare the different representations.
We are also examining the data which can possibly be obtained from the virtual model of the single mosaic's tiles (distance, position, orientation) to analyze and understand intentional and accidental gaps occurred over the centuries.

Fig.3: Apse Mosaic - images from photogrammetric data applied on the points cloud..

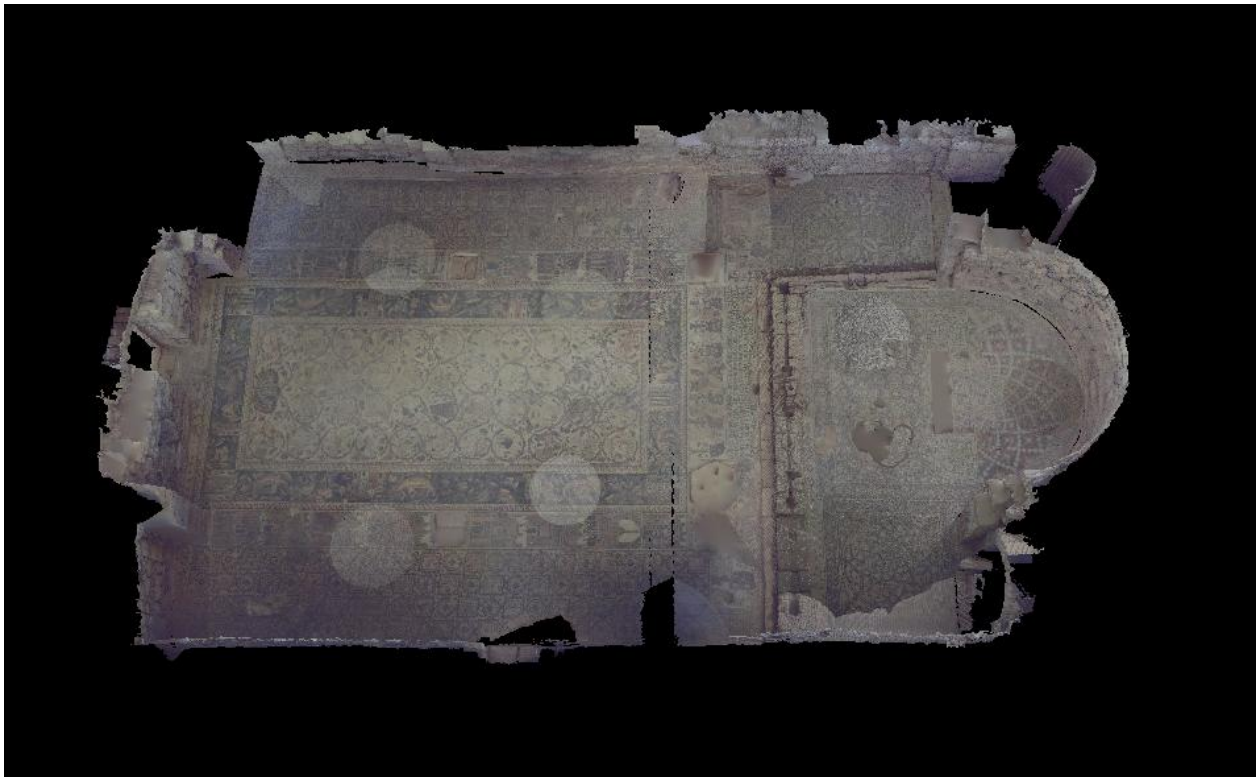

Fig.4: 3D Model from Laser Scanner of the Church of Santo Stefano.

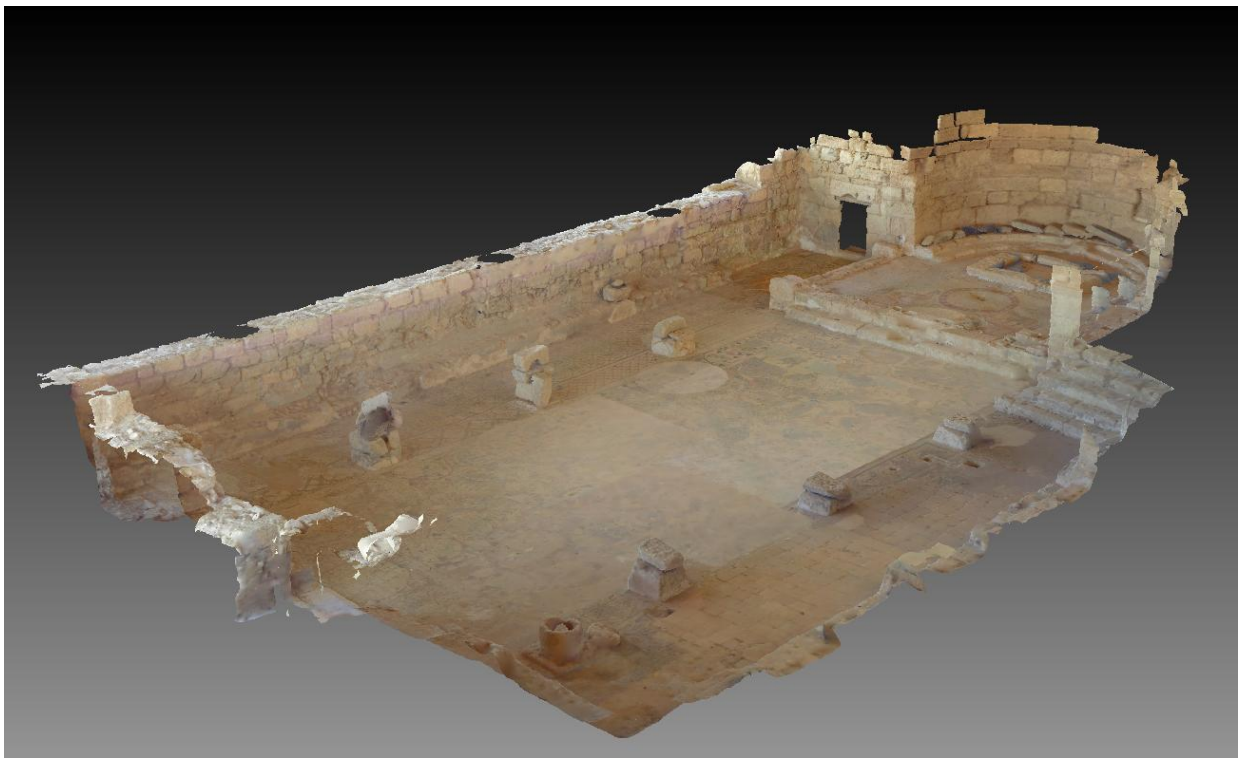

Fig.5: Laser Scanner 3D Model Complex Bishop Sergio.

Dott. Roberto Gabrielli