



How we build reality

Z+F
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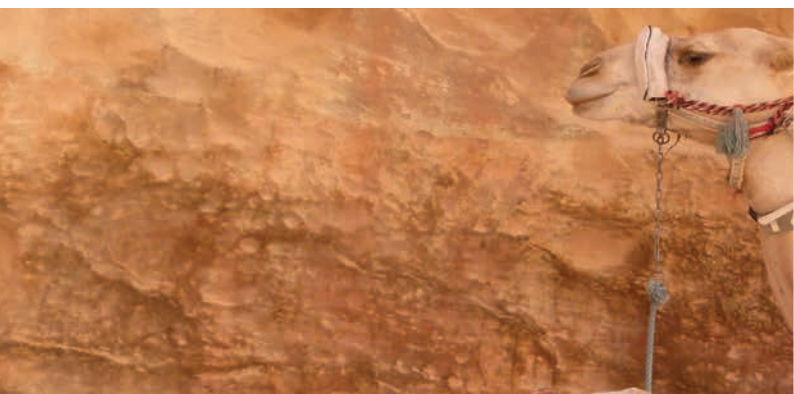
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Case Study

Petra, Jordan



Company Overview

Z+F is one of the world's leading manufacturers in the field of non-contact laser measurement technology. Due to years of research, development and numerous successful engineering projects, Z+F is the forerunner in this field with a wealth of knowledge, experience and success.

When it comes to implementing future developments Z+F has always encouraged innovative thinking and open-minds. Our loyal and long-standing customers appreciate our continual innovations, support and the services we provide.

In cooperation with the Zamani Project





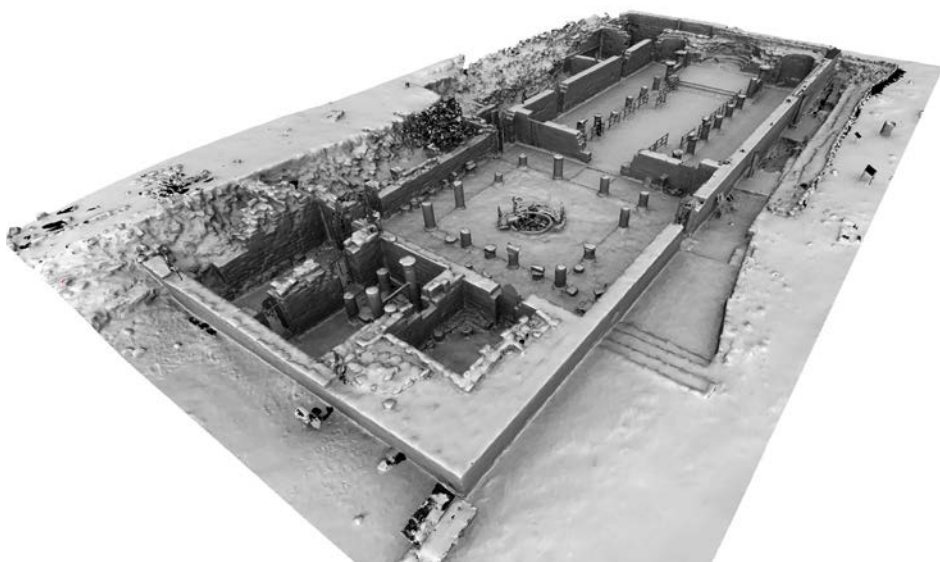
Laser scanning down the 100m high valley of the Siq (Pic.: Giorgia Cesaro)

Introduction

The ancient city of Petra in Jordan is one of the most popular and best-known cultural heritage sites in the world, not only since its short appearance in the Hollywood movie Indiana Jones III. It is especially famous for its unique facades which are carved out of the rock. The location is very mountainous and the entire Archaeological Park of Petra (PAP) covers an area of about 5km².

The tombs and structures are now in danger of erosion due to earthquakes, floods and natural weathering and are thus in need of monitoring and documentation.

Petra was originally built by the Nabataeans around 300 B.C. who were famous for their complex water drainage systems, collecting big amounts of water during the rainy season. The city was an important trading point of great wealth and conquered by the Romans around 300 A.D. The Romans added decorations to the caves and built temples and other structures throughout the valley.



3D Model of the Byzantine Church



Zamani Project

The *Zamani Project* is an initiative of the University of Cape Town. The team members are experts in digital High Density Documentation (HDD) projects. Also known as the “African Cultural Heritage and Landscapes Project”, the non-profit initiative started in 2004 under the leadership of Prof. Heinz Rüther with the objective to document cultural heritage sites all over the African continent with laser scanning, photogrammetry, conventional survey techniques, panorama and casual photography, videos and remote sensing. For each site, 3D models are created, from which highly accurate plans and maps are derived, as well as a GIS, incorporating various data from different sources. Within nine years the project completed the documentation of about 40 sites in thirteen African countries.

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The valleys of Petra were documented by the Zamani Project with 1,750 scans

Methodology

A large portion of the main valleys and its structures was now laser-scanned by the *Zamani Project* as part of the *Siq Stability Project*, which is a *Funds In Trust* initiative of the Italian Ministry of Foreign Affairs for UNESCO.

The *Zamani Project* was contracted to create a highly accurate 3D computer model of the Siq, a large but very narrow gorge, which is used as the main entrance for tourists to the site. In addition, the project will create 3D models of all major structures and the landscape of Petra, based on laser-scanning and aerial photography.

The models, together with several hundred 360° all-round panoramas, will be combined in a virtual tour of Petra. Also a site information system (SIS/GIS) will be created for storage, analysis and management of data relevant for the PAP area.

Why the Z+F IMAGER® was chosen

High density documentation (HDD) of cultural heritage with laser-scanning technology means to record as much surface of the structures as possible with a minimum of blank spots, due to occlusion.

Every documented data point can be of significance. Thus it is important to rather use a high speed scanner, which can be often repositioned to fill-in missing data. During the course of the Petra-project, the team collected 1,750 scans of which more than 1,200 were done with a Z+F IMAGER® 5010. This scanner offers great flexibility, speed, range and ease-of-use. It proved to be of great value to the project, as not only structures but also landscape had to be scanned, thus reducing the need for special close range and long range scanners.



Local transport system

The Z+F IMAGER® 5010, which is able to record reliable, complete data more than 150m, and allows to acquire data at a rate of 1 million points per second was perfect to be used for fine detail as well as large areas.

With this scanner the team managed to scan more than 160 scans in one day. Besides that, the IMAGER® 5010 is the only phase-based laser scanner with laser class 1, which means it is completely eye-safe and thus usable even in crowded, public areas. This was an important aspect, regarding the fact that between 3,000 and 5,000 tourists are visiting Petra every day.



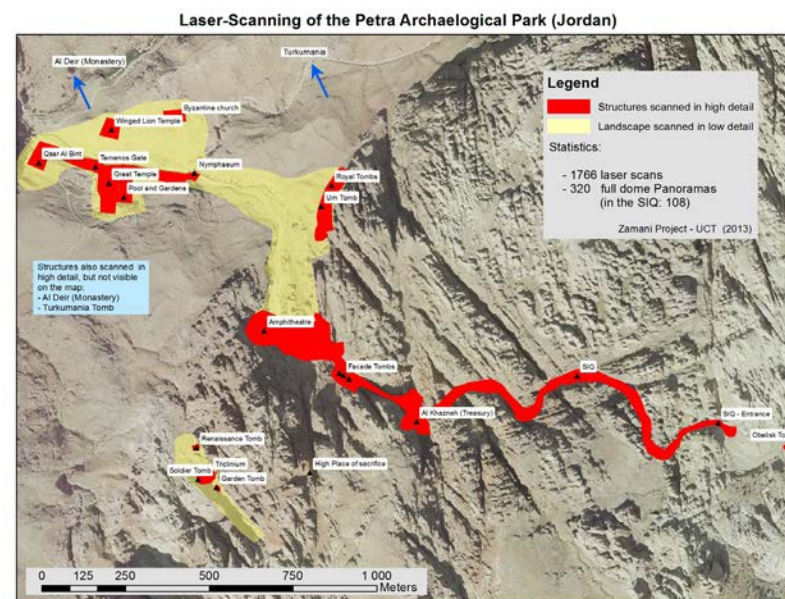
Scanning on the roof of Petra with the Z+F IMAGER® 5010

Results

The Zamani team usually refrains from using targets for registration and instead uses surface matching, based on features.

This workflow was followed also in this situation, especially because of the very large area and the very narrow sections, such as the Siq. The team first built a skeleton model consisting of more than 200 scans of the entire area, which stretches over 2.9km.

Using several similarity transformations without scale, the model was compared to multiple GPS – points, spread over the entire area. The average deviation was 4cm, which exceeded all expectations and shows that medium range scanner are not only suitable for the scanning of structures but also entire landscapes.



Map of Petra, illustrating the documented areas



360 degree Panorama of the Umm Tomb



The entire Petra Archeological Park (PAP) stretches over an area of 5km²

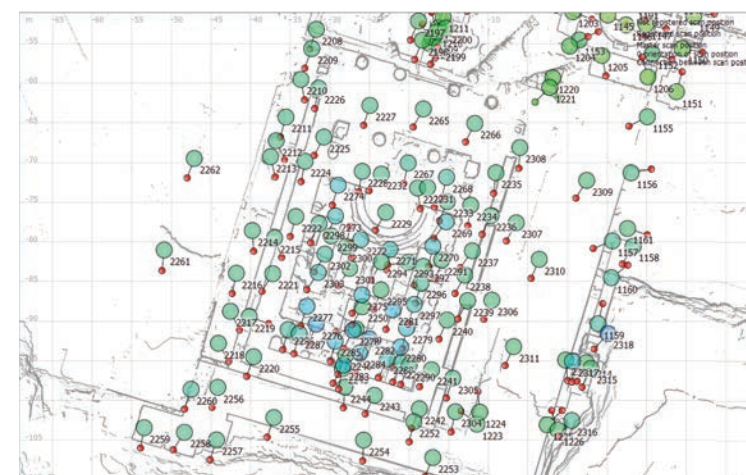
Results

The remaining scans will now be filled-in and automatically registered by the *Plane-to-Plane-module* in the software Z+F LaserControl. The tool aligns scans automatically without targets or the need for pre-registration, if enough overlap between scans is provided. Even though designed for planar surfaces, the tool proves to be robust and usable even for very irregular surfaces, such as the Petra data.

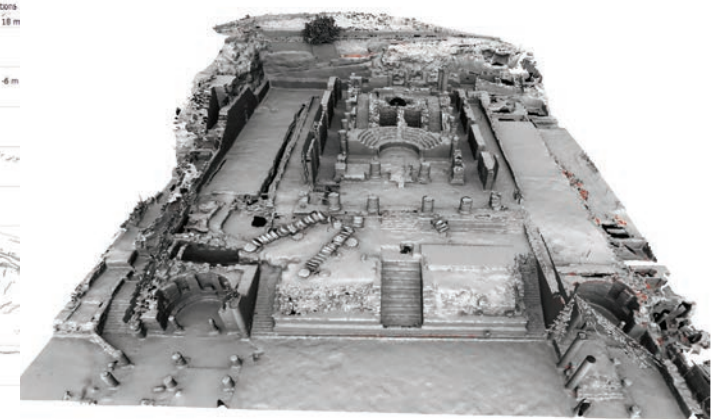
After registration, the scans will be meshed and textured by the *Zamani Project*. From these models, highly accurate sections, elevations and plans can be derived to be used by geologists and conservation experts who can identify potential risks and damages. The result will be a holistic virtual documentation of Petra for future generations.



Latest technology meets ancient transport system



Scans of the Great Temple registered with the *Plane-to-Plane module* in Z+F LaserControl®



3D Model of the Great Temple



The Monastery - 800 steps above Petra

Pictures



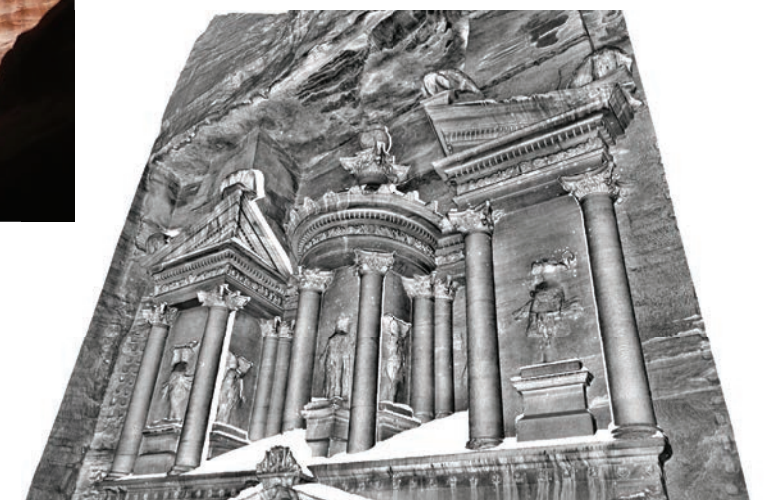
Prof. Rüther trying to find the nicest spot to hide



Point Cloud of the Monastery of Petra



The famous Al Khazneh ("Treasury")



Al Kazneh - Point Cloud of a single scan - details at over 50m distance



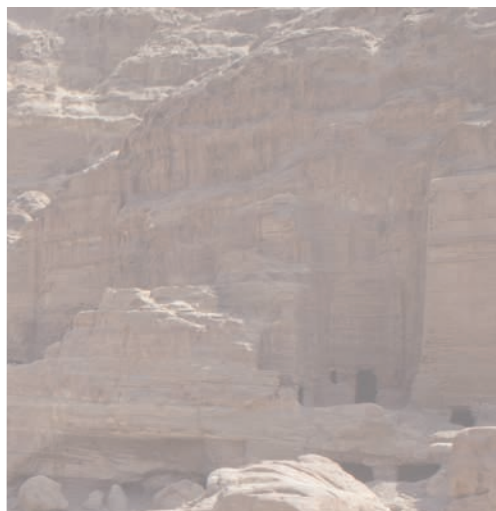
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