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3D Data Opens Door to New Knowledge

The ZEISS COMET L3D 2 scanner helps to document and evaluate archaeologic finds at excavation sites in Egypt

ZEISS

Julius-Maximilians-Universität Würzburg Philosophy faculty (Historical, Philological, Cultural and Geographical Sciences)

Brief Profile

Julius-Maximilians University Würzburg, Philosophy faculty

Archeology and optical measurements – though this might sound like an unusual combination, these two things are in fact perfectly matched. The Philosophy faculty at the University of Würzburg uses a ZEISS COMET L3D 2 to document and evaluate archeological finds at excavation sites in Egypt. The 3D data helps to make precise statements about the relics and even enables to reproduce them.

For a long time, the University of Würzburg has been ruminating on whether to use an optical measuring machine. Johannes Väthjunker in particular, IT Department Manager at the Philosophy faculty, has been focusing on 3D technology. When the faculty provided him with the funding he needed, he grabbed the bull by the horns and launched market research into 3D scanners together with a colleague. "We discovered that the ZEISS COMET L3D 2 scanner is best suited to our needs – particularly in terms of its mobility and robustness."

Our suspicions were confirmed during a practical test: the university's Martin von Wagner Museum houses an antiques collection that includes a display of Greek vases. "It's very difficult to transfer these pieces to the digital realm, which is why every manufacturer had to demonstrate how well their machine can cope with this challenge."

Work tent in the temple of Bastet.

Left: Tell Basta - Sedfest courtyard in the temple of Bastet. / Front page: The façade of the temple of Horus in Edfu from the 1st century BC.

Answers to a host of questions

„It has become clear that the ZEISS COMET L3D 2 scanner is best suited to our requirements, especially in terms of mobility and robustness."

Johannes Väthjunker, IT Manager at the Philosophy faculty
University Würzburg

The ZEISS machine ultimately came out on top and was the one the customer opted for. "Even when it came to measuring the highly reflective black sections of the vases, which is quite a challenge, the ZEISS 3D scanner delivered precise measurements." This was made possible in particular by the high light intensity and the high-speed camera. This proves that the system can even deliver precise 3D data under tough conditions. The university is still convinced it made the right decision. In March 2017, the compact, mobile 3D sensor was used at the Horus temple in Edfu, Egypt, and passed its first major test with flying colors. "The temple's roof is still intact and the rooms are almost completely preserved – in theory, these are excellent conditions for scanning. However, the fluorescent lighting on the ground designed to help tourists find their way through the temple is something of an obstacle," says Professor Martin Stadler, Chair of Egyptology at the University of Würzburg who is leading the excavation in Edfu. For ten days, he and his team captured the 3D data of a room in the temple that measures 5 x 5 meters and is approximately 9 meters high. The team was able to measure a third of the chapel and achieved great results with the ZEISS COMET L3D 2. The walls are completely covered in flat reliefs and hieroglyphic inscriptions that depict ritualistic scenes. The ensemble is rich in detail and has been crafted by skilled hands. "The 3D scan delivers not only precise measurements of the room, but also data sets that contain precise information on the reliefs," says Stadler.

Egyptology student Katharina Hepp and Prof. Martin Stadler checking the scan results in the mesenite of the temple of Horus in Edfu.

Work tent in the temple of Bastet.

This data can be used to determine the precise height of individual elements and how much work went into them. Whereas in the past it was only possible to take photos, highly precise 3D data now opens up whole new possibilities

"I believe this data could provide us with answers to specific archeological questions, such as whether or not different workshops were set up in the temple," says Stadler, shedding some light on how the scans can be used. "It may be possible to say when the different reliefs were crafted, and perhaps even determine the century in which they were brought to life."

That would be a major advancement in temple documentation – until now, we've only been able to work with schematic drawings. The inscriptions are only available as printed hieroglyphics, which can only reproduce the elements in this form. "This is rather unfortunate as hieroglyphics really evolved during the time the temple was constructed, i.e. between 237 and 57 BC. The details are vital in terms of understanding the texts."

3D model of the fragment of a double statue in the Temple of Bastet.

Johannes Väthjunker from the University of Würzburg at the 3D-Scan in Edfu.

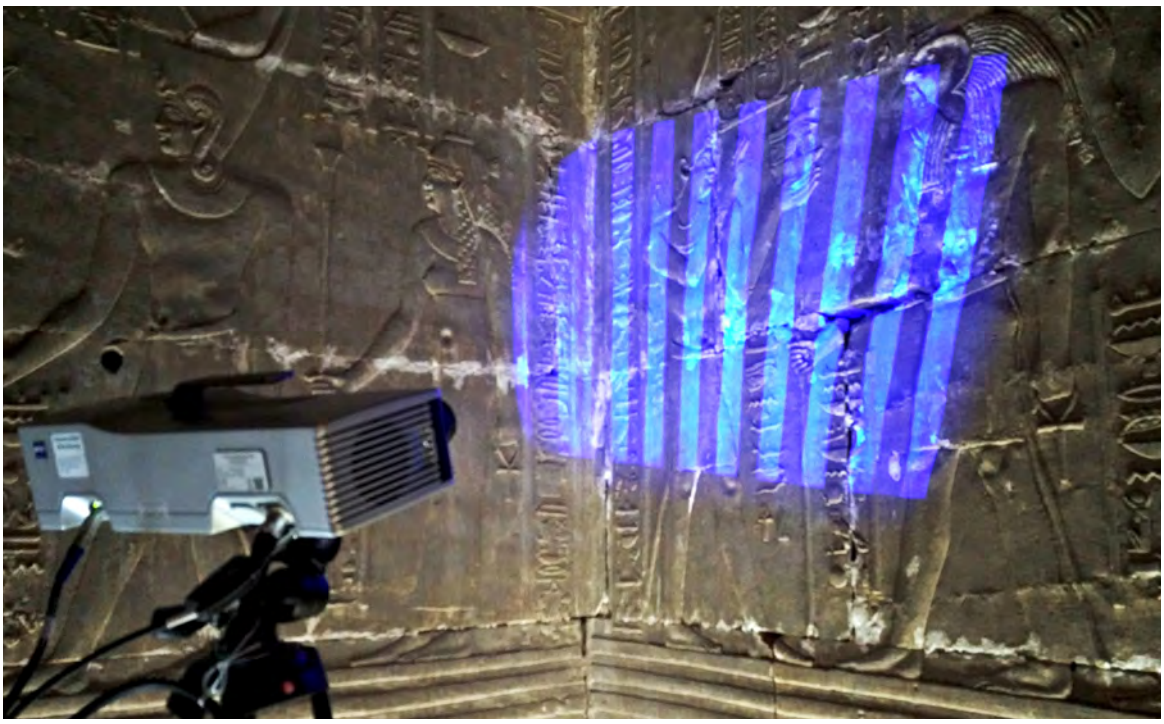
Detail of a scan result: Extract from a hieroglyphic inscription.

Detailed representation in the ZEISS colin3D software.

From 3D data to 3D printing

There are high hopes for what the data can tell. “Ideally, we’ll be able to create a 3D scan of the entire temple and obtain the same data from other, similar temples for comparison purposes. This would help advance quite a number of investigations.” Prof. Martin Stadler has high hopes for the future: “We could then even use the 3D data in 3D printing. In other words, we could replicate reliefs and key scenes from the temple in the museum, or display them at student exhibitions. For example, we could attempt to restore the colors that have long since faded.” So it’s possible to create 3D replicas of elements that are missing from the original reliefs.

Above/below:The light conditions in the chapel of the temple of Horus in Edfu.

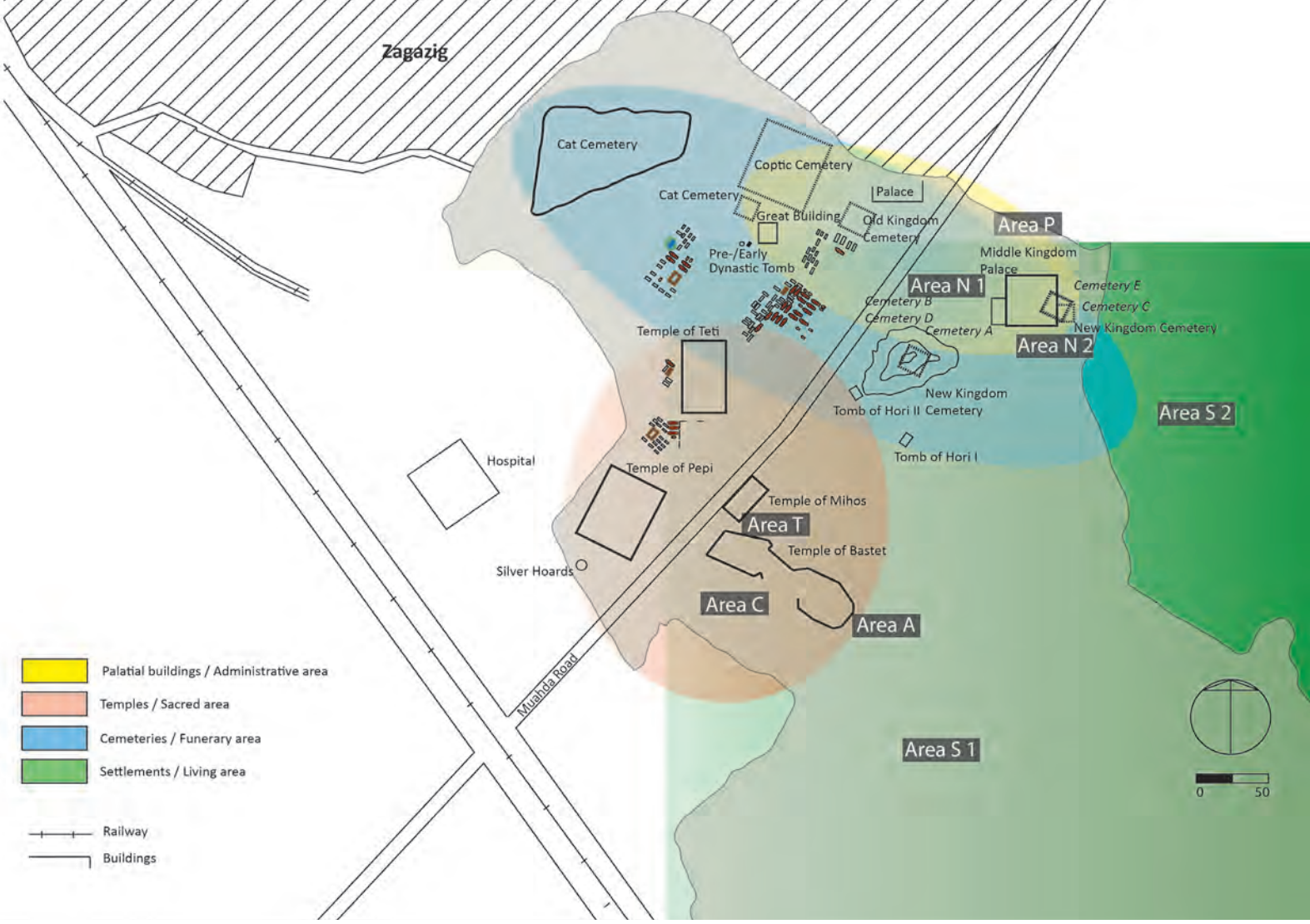


Extreme conditions along the Nile

The ZEISS COMET L3D 2's mission is far from over – it's now time to head down the Nile towards the city of Zagazig, where Dr. Eva Lange, Academic Councillor for Egyptology at the University of Würzburg, is waiting for the team. She is leading the dig here, which presents some tough conditions for measuring. This is an altogether different kind of task: the team is now faced with scanning a destroyed temple, which means that many of the reliefs are scattered around the site and exposed to the elements. "I was familiar with the 3D scanning method as we'd already obtained 3D data when we worked here with another surveyor – also using a ZEISS machine that served us very well back then," says Lange.

3D scanner ZEISS COMET in action in Tell Basta.

3D model of the surface plan of the temple of Bastet in Tell Basta.



Site plan of the ancient site Bubastis/Tell Basta.

The actual conditions at the dig site are much more complex than they were in Edfu: not only has the weather wreaked havoc on the surfaces of the blocks, it's now making life difficult for the team, too. The strong sunlight makes it impossible to scan anything without a tent. "We just about managed to set up a tent large enough to accommodate the block and the team that also allowed us to maintain an appropriate distance from the scanner." Added to that are the strong winds, which not only skew the measurement results but are frequent enough to sometimes prevent the team from working outdoors as it's simply too dangerous. The tent could blow away, injuring people and damaging our equipment – this is one risk none is willing to take. Local technical expert Johannes Väthjunker has come up with a makeshift solution: he's scanning small parts in the caravan. As if all of that wasn't enough of an adventure, there's yet another problem – the team is working right near a main road that leads into the city proper. "There must be a direct underground link to the dig site via pipes or contact veins because whenever convoys of trucks drove down the street, we had to deal with the resulting vibrations." The vibration detection feature of the ZEISS colin3D data capturing software was a great help, as otherwise the team would have had lots of inaccurate findings on their hands.

The main advantage of the 3D scanner during the work in Zagazig was its ability to reconstitute individual sections of the temple virtually using the scanned relief blocks. This meant the team was able to "recycle" many of them. In other words, no complete walls were scanned, but rather some of the individual reliefs were positioned atop pieces of older statues or structural elements. "There are no stone quarries in the delta and at the beginning of the first century BC when the temple was constructed, Egypt's rulers no longer had unrestricted access to the stone quarries of the Nile valley. That's why they resorted to using old temples and statues. These were razed, the resulting smooth surface covered in reliefs and the recycled block was then walled up," explains Dr. Eva Lange.

Section of a 3 m high part of the north wall in the mesenary of the temple of Horus in Edfu.

Detail of the 3D scan of a ritual scene in Edfu: Pharaoh stands in front of the falcon-headed Horus of Edfu.

Big plans for the future

The Temple of Bastet in Tell Basta. View to the east.

All of this makes it difficult to reconstitute the temple complex, partly because some of the blocks weigh several tons. "It's much easier to reconstruct the temple on a computer screen as this enables us to see which elements fit together and how we could bring this to life using statics. Capturing the 3D data means we can reconstitute all the reliefs on the different sides of the blocks and say when they were created. We will then be in a position to show the public how certain parts of the block were decorated and how they all fit together."

All the blocks in the temple in Tell Basta will also be measured, i.e. around 1,000 pieces, some of which are several meters long and wide. "The first thing we need is a tent large enough to accommodate them. We'll need to keep adjusting our equipment in order to scan the pieces precisely," explains Johannes Väthjunker.

"Thanks to the high measuring speeds, the ZEISS COMET L3D 2 is capable of, we'll be able to measure one block per day." Even at this rate, the operation will still take quite a bit of time.

At the University of Würzburg in any case, people are impressed by the measurements taken with the 3D sensor, which is used in a host of ways and yields excellent results. That's why there are plans to launch many projects to capture 3D data from historical buildings and objects, thus enabling new findings and experiences. "We can't wait to see what innovation ZEISS will come up with next."

Summary

- *Portable and rugged 3D scanner for extreme conditions such as difficult weather conditions and strong vibrations.*
- *Even with challenging surfaces, the ZEISS 3D scanner provides accurate measurement data.*

ZEISS IMT - Application + Success Story

System	ZEISS COMET L3D 2
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Industry	University
Created	August 2018

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CZ-OPTO_08-2018