Photogrammetric Documentation of the Hittite ‘Spring of Nerik’, Oymaağaç Höyük (Türkiye)

How different data products can be derived from image series.

Introduction

The Oymaağaç Höyük Project (2005-today) investigates a 6500-year-old multi-period settlement in the district of Vezirköprü at the southern edge of the Black Sea province of Samsun in northern Türkiye. According to a number of cuneiform texts the site can be identified with the Hittite cult city of Nerik (17th-12th century BC). It is assumed that the Hittite kings were crowned here. The excavations revealed a city gate flanked by two big towers, the Temple of the Weathergod and his ‘beloved’ or ‘deep’ Spring of Nerik which is associated with an underground spring chamber at the end of an underground staircase. This underground structure was carefully excavated between 2009 and 2019 and represents an exceptional masterpiece of Hittite architects and engineers. In 2017 very well preserved waterlogged wood was discovered inside the spring chamber which is an exceptional archaeological discovery. Photogrammetric documentation of these very different items was carried out by staff and students of the Photogrammetry Laboratory at Berlin University of Applied Sciences BHT, Germany (formerly Beuth University of Applied Sciences Berlin) in cooperation with FU Berlin, Germany (Institute of Ancient Near Eastern Studies) and Uşak Üniversitesi, Türkiye.

Methodology

Automatic multi-image photogrammetry, also known as Structure from Motion (SfM), has proven to be a powerful and flexible means for the three-dimensional documentation of objects of different shapes and sizes. Professional software products are now available for this purpose. The results presented in this paper were generated using the software product Metashape from Agisoft. There were also attempts of stereophotogrammetric recording and terrestrial laser scanning, which turned out to be less suitable due to the difficult working environment inside the underground structure. Furthermore, photogrammetry proved to be a fast and time-efficient method for recording the waterlogged wood.

The realisation of a temporally stable and uniform local coordinate system for the entire excavation was of great importance in order to be able to classify the individual finds geometrically correctly in their find context. This had been realised in advance using geodetic methods. All data were related to this and could be assembled via post-processing in the Photogrammetry Laboratory at BHT. A multitude of 3D models were combined and resulted in a comprehensive, three-dimensional documentation of the individual stages of the excavation at Oymaağaç Höyük.

Results & Conclusions

Data products are available in the form of 3D point clouds, textured surface models, orthophotos, sections and 3D prints (physical 3D models). With the aid of the Laboratory of Geomedia at BHT, visualization of 3D data was realized via an internet browser (Potree Viewer for large point clouds

and Babylon.js for surface models). The data were also visualized offering an immersive experience using recent virtual reality (VR) techniques. Hence, the excavation can also be virtually explored using VR glasses.

Shortly after the excavation of the underground structure started in 2009, it became clear that the documentation of such a large building structure was hardly practicable using simple techniques (e.g. manual surveying). Photogrammetry has emerged to be a very good substitute for dealing with the documentation tasks. Furthermore, the unexpected discovery of the waterlogged wood posed additional challenges. This task was also successfully solved using photogrammetry.

Discussions

The archaeological excavations at Oymaağaç Höyük provided an excellent opportunity to evaluate modern geodetic and photogrammetric surveying processes in practice. The work benefited continually from technological progress over the years, which was particularly evident in software and hardware development and enabled ever smarter workflows and shorter processing times. It also showed the importance of good image capture planning. This includes geometry aspects and logistical aspects.

The accuracy that can be achieved with photogrammetry is only dependent on the image scale, meaning that it can be considered as a very flexible method. On the other hand, the ever-increasing amount of data resulting from the evolving technical possibilities requires sustainable data management, which is difficult to realise in practice – often due to limited financial resources. Nevertheless, this is a very important point for the sustainable utilisation of research results for which solutions must be found.

Finally, the question of future opportunities and possibilities for integrating modern IT-supported methods of data analysis into the archaeological research context can be raised.

References

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