



Summer School on Digital Tools for Cultural Heritage

11 May - 7 June, 2020

Online International Summer School

Project Coordinator:

Dr Kenneth Aitchison, Landward Research

Summer School Director:

Dr Evangelos Kyriakidis, Director, HERITAGE

Summer School Instructors:

Dr Cornelis Stal, Lecturer/Researcher, HOGENT

Dr Doug Rocks-Macqueen, Landward Research

A. Introduction

The Heritage Management Organization, in close collaboration with HOGENT (Belgium) and Landward Research (Ireland) has organized three integrated and consecutive specialist courses on various topics in geomatics to help aid heritage managers in their work:

- Laser scanning
- Photogrammetry
- GIS

In this online summer school, participants will document historically significant structures. Using professional-grade laser scanners, digital cameras and GIS participants will learn how to record the structural data of these buildings, properly orient them to one another in virtual space, and georeference the data we collect to ultimately create a computer-generated representation of the historic structures. These skills are essential in heritage management for any restoration, documentation or visualization project.

B. Course Objectives

This online summer school will introduce students to a broad range of 3D recording and mapping techniques, as well as methodologies to use and analyze spatial data. Participants will be provided with instruction in these methods to record architectural remains using terrestrial laser scanning and image-based 3D modelling and process the acquired data in appropriate software. GIS will be used to publish the data in cartographic deliverables, and to use spatial data in for management and analysis. Participants should be able to work in the digitization of any site following this work.

The summer school comprises of **three specialist courses** from **11 May - 7 June 2020**:

- **General introduction and installation**
(Monday 11 May 2020)
- **GIS**
(Tuesday 12 May - Wednesday 20 May)
- **Photogrammetry and image-based 3D modelling**
(Thursday 21 May - Wednesday 27 May)
- **Terrestrial laser scanning**
(Friday 29 May - Friday 5 June)
- **Q&A for full-program participants**
(Saturday 6 June)

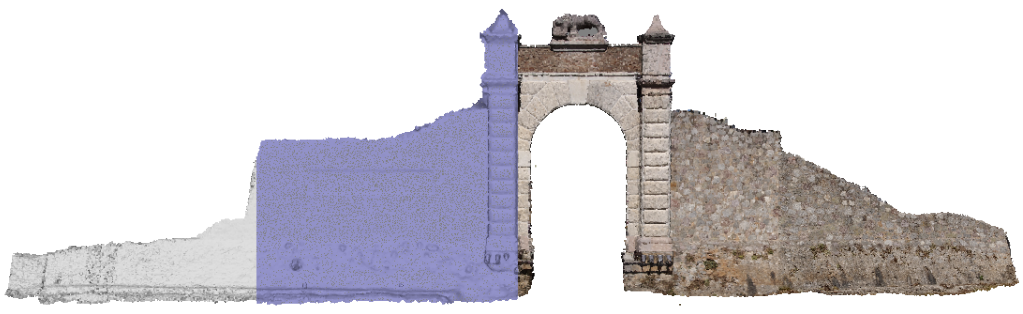
One can attend the whole summer school or anyone of these specialist courses as standalone training. Please get in touch with info@heritagemanagement.org for further information and arrangements on booking the specialist courses individually.

C. Grading Matrix

All students will be marked on a percentage basis as follows:

- 20%: Terrestrial laser scanning: presentation of a processed point cloud in a browser-based environment, provided with a technical report on the data acquisition and processing;
- 20%: GIS: GIS-based map and report based acquisition, management and analysis of spatial data;
- 20%: Photogrammetry and image-based 3D modelling: presentation of an image-based 3D model and orthophoto plan, provided with a technical report on the data acquisition and processing;
- 40%: Essay/report handed in one month after the end of the summer school (3000-4000 words).

For those only taking part in some sections of the field school the grading will be adjusted to include only those sections you participate in.



D. Instructors

- **Dr Cornelis Stal** is a lecturer and researcher at the University College Ghent and Ghent University (Belgium), where he is working on surveying engineering, geomatics and image-based 3D modelling. Within the framework of his research, he has participated in various archaeological and anthropological field campaigns, where the topics of this workshop are empirically implemented in an interdisciplinary context.
- **Dr Doug Rocks-Macqueen** is an archaeologist who has worked around the world from Belize to Scotland. He has worked in the Commercial/Cultural Resource Management Archaeology, Academia and for the Third Sector. His work focuses on the use of Agent Based Modeling with GIS, public archaeology and how we engage people with the past and examining the demographic and cultural data of those that participate in archaeology.

E. Description of the Specialist Courses

Specialist course 1: GIS

During the last century, an enormous amount of data, such as overview inventories, detailed stone plans, conservation monitoring records, buildings and landscape surveys, etc., has been recorded on cultural heritage sites all over the world. When these data are combined with spatial data, through GIS, heritage managers are able to solve complex problems. This specialist course covers the use of GIS in cultural heritage management using open source software. Important aspects of the transformation of manuscript plans to a full geographical database will be discussed and demonstrated, followed by hands on implementation of these techniques. Furthermore, the use of GIS for cartographic purposes will be expounded upon. After this course, the participant will be able to undertake a large variety of spatial challenges in a heritage management environment.

Specialist course 2: Photogrammetry and images-based 3D modelling

3D models, orthophotos or point clouds are indispensable tools for the documentation and monitoring of our heritage and allow a better understanding of the objects under research. The construction of these products is based on various concepts in photography, photogrammetry and computer vision, which are available via easy-to-use software and generally available hardware. During this specialist course, various techniques will be addressed and demonstrated during lectures and hands-on field work. Participants will get familiar with various digital tools (photography, photogrammetry, 3D modelling and model referencing, 360° photography, and vectorization by covering the entire workflow from image acquisition via data processing to model publishing. After this workshop, participants will be able to apply these techniques in a wide range of applications (heritage management, archaeology, curatorial work etc.), concerning the various parameters for high quality 3D models and orthophotos.

Specialist course 3: Terrestrial laser scanning

Terrestrial laser scanning offers a fast and accurate methodology to generate dense geometrical representations of objects. This specialist course aims to get a thorough understanding of the principles of terrestrial laser scanning and best-practice application of this technique for the acquisition of point clouds. Based on

on-site measurements and intensive practical sessions, participants will obtain necessary experience to apply this technique in their own field work and research. The focus of this course is put on the creation of applications for 3D recording of archaeological sites for conservation purposes. Research is also conducted on procedures and techniques to optimize the acquisition and to generate deliverables covering heritage sites. Among others, these deliverables are conventional maps, 3D models and online visualizations.



F. Course Schedule

Initial start-up

- Overview of the Heritage Management Organization (HERITAGE), objectives and organization of the specialist courses

Specialist course 1: GIS

- Participant welcome and installation SC1
- Introduction to GIS, QGIS, data styling
- Georeferencing, data generation, use of webservice
- Labels, data queries, publishing maps
- Combining data, geoprocessing
- GIS and 3D
- Task: design of map series, including historical, touristic, commercial, etc. maps
- Presentations and discussion. End of SC1.

Specialist course 2: Photogrammetry and images-based 3D modelling

- Participant welcome and installation SC2
- Introduction to photography, photogrammetry, image-based 3D reconstruction
- Field work, data processing, introduction to referenced 3D modelling (topography, processing workflow)
- Field work, data processing, publishing 3D models (online, offline)
- Field work, data processing, integrating image-based models in GIS
- Theory and practice of 360°-photography
- Presentations and discussion. End of SC2.

Specialist course 3: Terrestrial laser scanning

- Participant welcome and installation SC3
- Introduction to terrestrial laser scanning
- Demonstration of the terrestrial laser scanner, field preparation, point cloud registration, data registration
- Field work, introduction to point cloud data filtering and data management
- Field work, data processing, introduction to data deliverables
- Field work, data processing, publishing data (point clouds, deliverables)
- Presentations and discussion. End of SC3. End of summer school.



G. Selected Bibliography

General readings

Grussenmeyer, P., Landes, T., Voegtle, T., & Ringle, K. (2008). Comparison methods of terrestrial laser scanning, photogrammetry and tacheometry data for recording of cultural heritage buildings. *International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences*, 37(B5), 213-218.

Maeyer, P., ... & van de Put, W. (2014). Integrating geomatics in archaeological research at the site of Thorikos (Greece). *Journal of Archaeological Science*, 45, 112-125.

Remondino, F. (2011). Heritage recording and 3D modeling with photogrammetry and 3D scanning. *Remote Sensing*, 3(6), 1104-1138.

Stal, C., Van Liefferinge, K., De Reu, J., Docter, R., Dierkens, G., De Maeyer, P., ... & van de Put, W. (2014). Integrating geomatics in archaeological research at the site of Thorikos (Greece). *Journal of Archaeological Science*, 45, 112-125.

Stylianidis, E. & Remondino, F. (2016). *3D Recording, Documentation and Management of Cultural Heritage*. Dunbeath (UK): Whittles Publishing

Yastikli, N. (2007). Documentation of cultural heritage using digital photogrammetry and laser scanning. *Journal of Cultural Heritage*, 8(4), 423-427.

GIS

D'Urso, M. G., Corsi, E., Nemeti, S., & Germani, M. (2017). From Excavation to web: a GIS for archaeology. *International Archives of the Photogrammetry, Remote Sensing & Spatial Information Sciences*, 42(5), 219-226.

Gillings, M. & Wise, A. (2009). GIS: guide to good practice. *Archaeology Data Service / Digital Antiquity*. Archaeology Data Service (<http://guides.archaeologydataservice.ac.uk>).

Huisman, O. & De By, R. (2009). Principles of Geographic Information Systems. *International Institute for Geo-Information Sciences and Earth Observation*. Enschede, the Netherlands

Photogrammetry and images-based 3D modelling

Barnes, A. (2009). Close-Range Photogrammetry: A Guide to Good Practice. *Archaeology Data Service / Digital Antiquity*. Archaeology Data Service (<http://guides.archaeologydataservice.ac.uk>).

Historic England 2017 Photogrammetric Applications for Cultural Heritage. Guidance for Good Practice. Swindon. Historic England (<https://historicengland.org.uk>).

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Yilmaz, H. M., Yakar, M., Gulec, S. A., & Dulgerler, O. N. (2007). Importance of digital close-range photogrammetry in documentation of cultural heritage. *Journal of Cultural Heritage*, 8(4), 428-433.

Terrestrial laser scanning

Historic England 2018 3D Laser Scanning for Heritage: Advice and Guidance on the Use of Laser Scanning in Archaeology and Architecture. Swindon. Historic England. (<https://historicengland.org.uk>).

Lerma, J. L., Navarro, S., Cabrelles, M., & Villaverde, V. (2010). Terrestrial laser scanning and close range photogrammetry for 3D archaeological documentation: the Upper Palaeolithic Cave of Parpalló as a case study. *Journal of Archaeological Science*, 37(3), 499-507.

Payne, A. (2009). Laser scanning for archaeology: a guide to good practice. *Archaeology Data Service / Digital Antiquity*. Archaeology Data Service (<http://guides.archaeologydataservice.ac.uk>).