Using High-Performance Computing Resources for the Record and Analysis of Cultural Heritage Sites

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Lund University Humanities Laboratory
Lund University digital Archaeology Lab (DARKLab)

Laboratoriet för Digital Arkeologi DARK Lab

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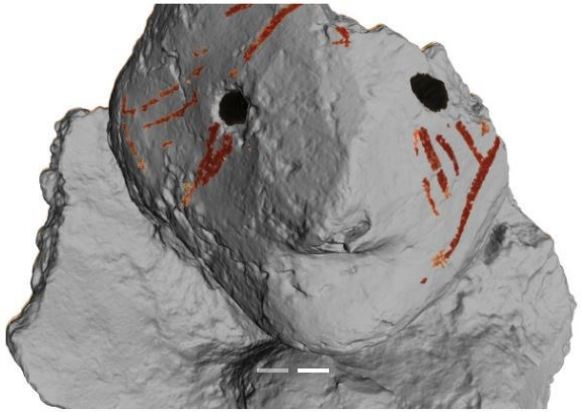

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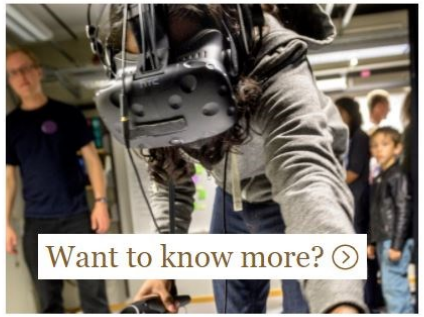

News

Humanities Lab

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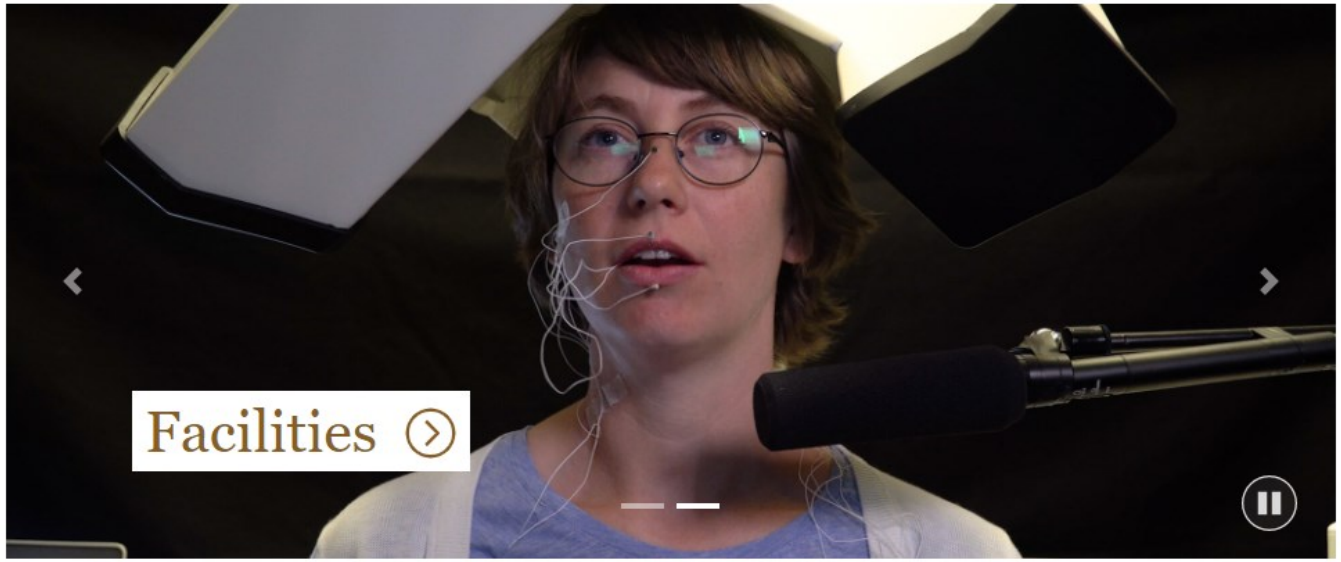

Information about project application can be found here!

Do you wish to initiate a project involving rooms and/or equipment for repeated occasions or a longer period of time?

Read more here

LU Humanities Lab during the Covid19 pandemic

Some of our facilities are open for low scale experimental use under strict safety protocols:

@SOL, the Digital Classroom, Studio 1 and 2, and @LUX the Mocap studio. For each facility, the maximum number of people is found here and in the rooms, along with specific instructions for disinfection of equipment in each facility.

Importantly, ALL users, new and old, must contact Lab management before undertaking any activities. All users must also follow the strict participant protocol to guarantee the safety of

Research overview

3D models in archaeology are nowadays employed:

-to document an archaeological excavation.
-to provide a geometrical basis for a virtual reconstruction of the ancient space/landscape.
-to detect new archaeological features on the ground surface.

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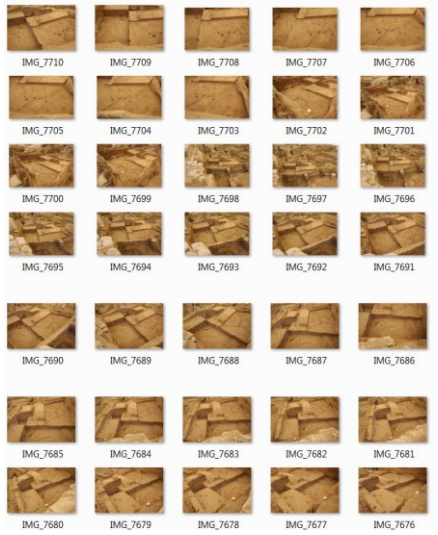
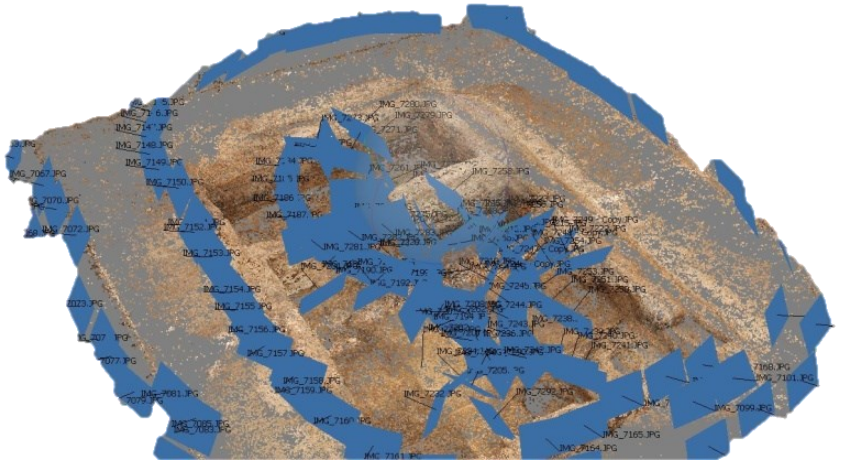
Image-based 3D modelling

1

2



3 SFM-Algorithms
CAMERA
CALIBRATION



4 Multi view stereo
reconstructions-
Algorithms

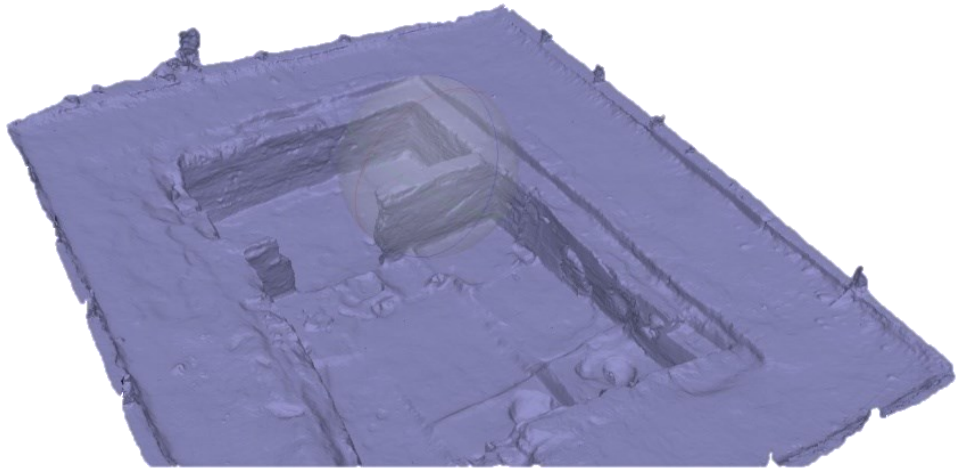


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Image-based 3D modelling and HPC

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From field to lab: the acquisition campaign and the setup of a 3D GIS for exploring Ancient Hermione

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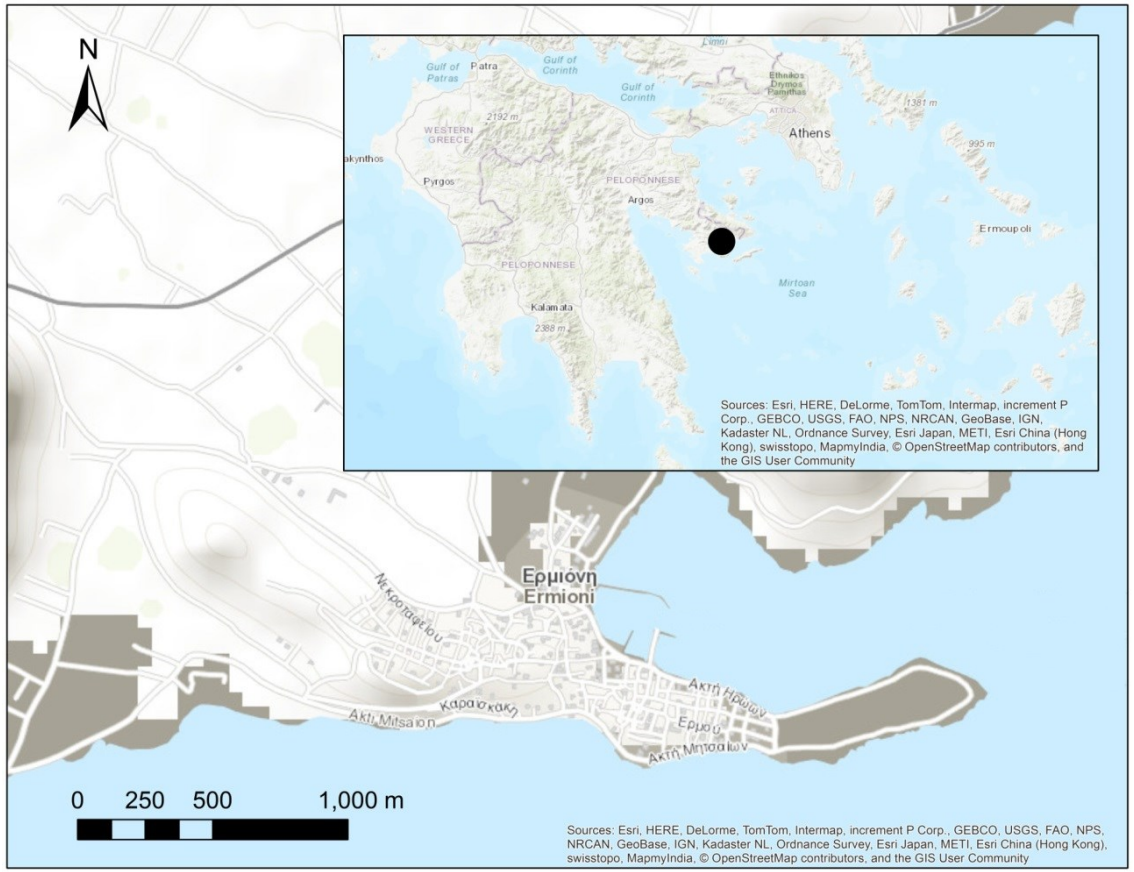
Project pipeline

The project is a collaboration between the Ephorate of Antiquities of Argolid and the Swedish Institute at Athens, involving representatives of Lund University.

Ancient Hermion or Hermione (today's Ermione in the Argolid) was a city of importance throughout its long history. Positioned on a peninsula with two excellent natural harbours, Hermion is mentioned already in Homer as one of the cities under Diomedes' leadership (Hom. Il. 2.560).



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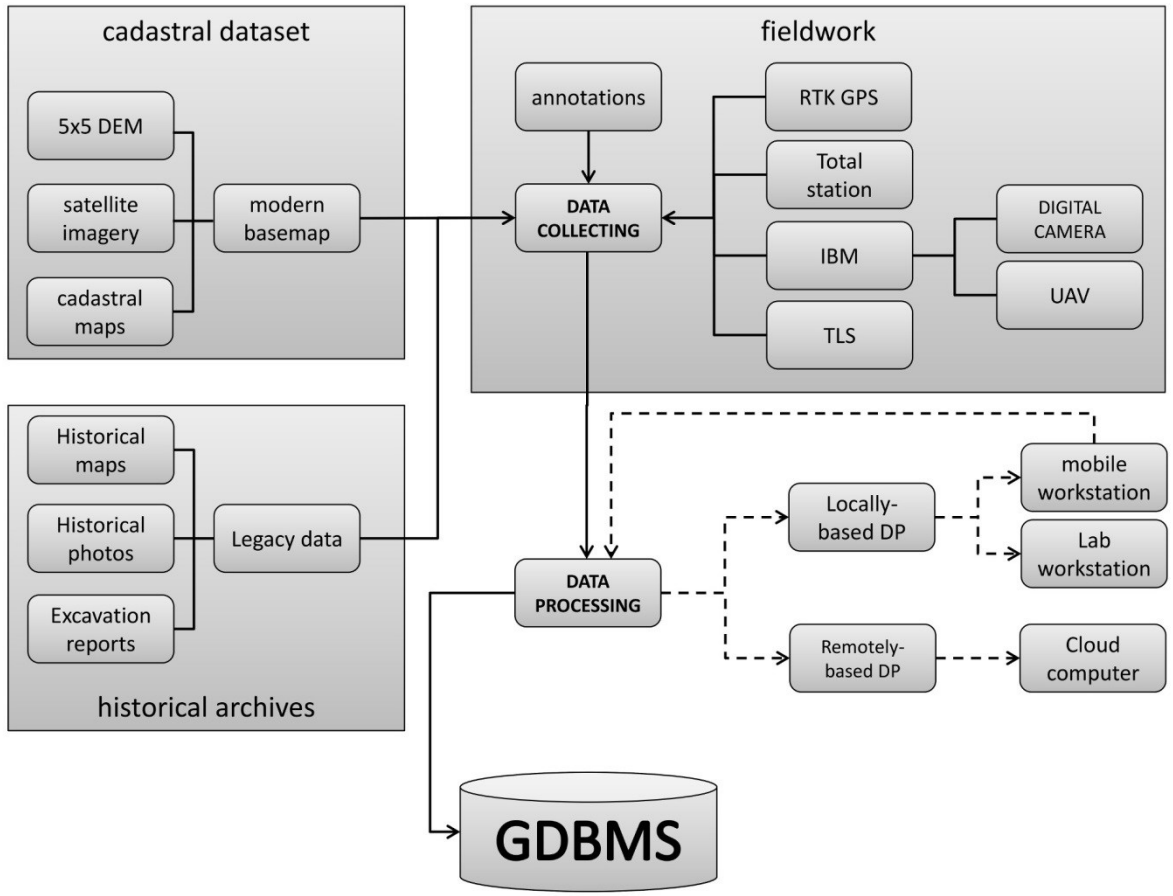
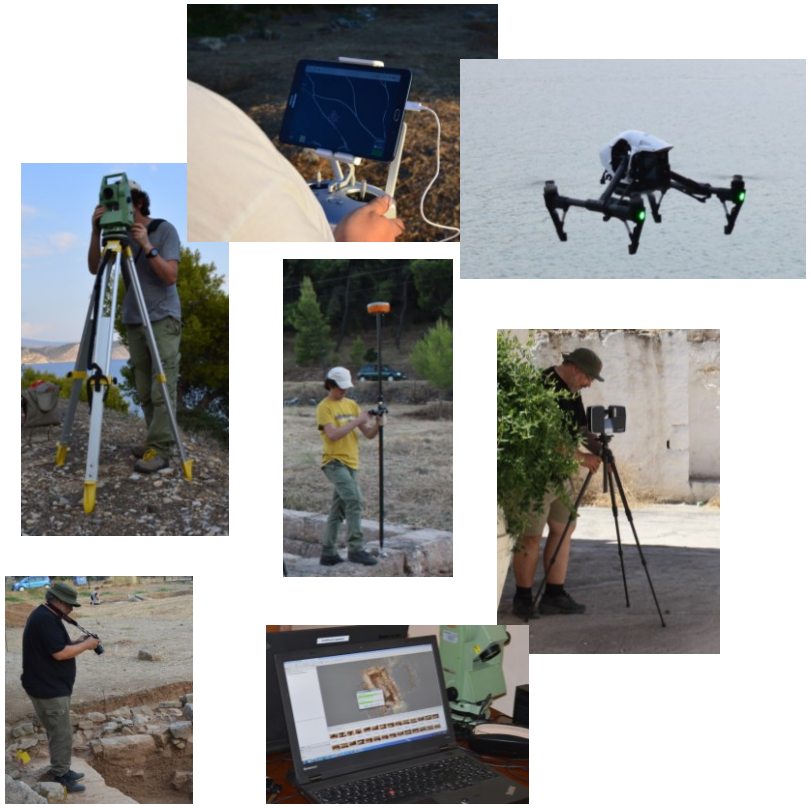
Project pipeline





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UAV acquisition

The drone employed is an Inspire 1 RAW with a Zenmuse x5 camera. It is made by a Chinese company called DJI and to control it an app from DJI is installed in the tablet connected to the remote control unit that is used to control the drone

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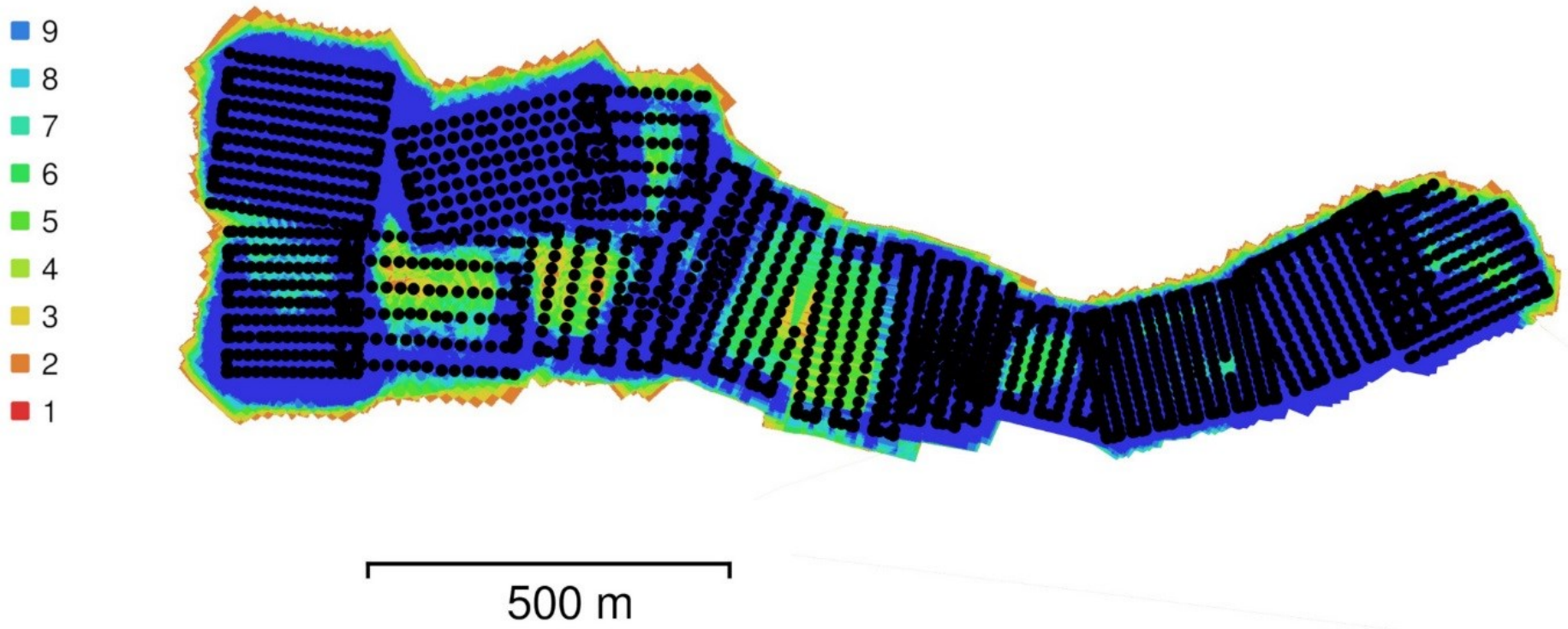
UAV acquisition



Total flight plan illustrating each camera location and image overlap. A total number of 2226/2265 photos was aligned to cover an area of 0.974 km^2. Interestingly , overlap was lower in the portions of the historical center of the city, where many hidden spots resulted from a higher density of buildings and the presence of narrow streets.

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HPC data processing

Through a remote access it was possible to connect any local computer to a cluster named Aurora, consisting of more than 200 compute nodes. Each node has in turn two Intel Xeon E5-2650 v3 processors (Haswell), offering 20 compute cores per node. The nodes have 64 GB of DDR4 ram installed.

Then Agisoft Photoscan Pro software has been installed to run a parallel processing on several nodes by taking advantage of all the available cores within a node. Through a user-friendly Graphic User Interface (GUI) users had the possibility to set the numbers of nodes and the walltime for that part of the data processing, consisting of point alignment and dense cloud reconstruction

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HPC data processing

Part of this process was performed in combination with an additional cloud-computing resource named L-VIZ, which has been specifically designed for running GPU-demanding operations, such as the dense point reconstruction

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HPC data processing

General	
Cameras	2265
Aligned cameras	2226
Markers	48
Coordinate system	WGS 84 / UTM zone 34N (EPSG::32634)
Rotation angles	Yaw, Pitch, Roll
Point Cloud	
Points	669,810 of 4,588,869
RMS reprojection error	0.39653 (0.762502 pix)
Max reprojection error	17.6821 (45.6948 pix)
Mean key point size	1.90715 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	3.43513
Alignment parameters	
Accuracy	Highest
Generic preselection	Yes
Reference preselection	Yes
Key point limit	40,000
Tie point limit	0
Adaptive camera model fitting	Yes
Matching time	2 hours 16 minutes
Alignment time	1 hours 50 minutes
Optimization parameters	
Parameters	f, b1, b2, cx, cy, k1-k4, p1-p4
Adaptive camera model fitting	No
Optimization time	23 seconds
Dense Point Cloud	
Points	233,639,780
Point colors	3 bands, uint8
Reconstruction parameters	
Quality	Medium
Depth filtering	Aggressive
Depth maps generation time	13 minutes 49 seconds
Dense cloud generation time	33 minutes 39 seconds

DEM	
Size	47,256 x 17,667
Coordinate system	WGS 84 / UTM zone 34N (EPSG::32634)
Reconstruction parameters	
Source data	Dense cloud
Interpolation	Enabled
Processing time	15 minutes 33 seconds
Orthomosaic	
Size	109,874 x 44,064
Coordinate system	WGS 84 / UTM zone 34N (EPSG::32634)
Colors	3 bands, uint8
Reconstruction parameters	
Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Processing time	49 minutes 19 seconds
Software	
Version	1.4.2 build 6205
Platform	Linux 64

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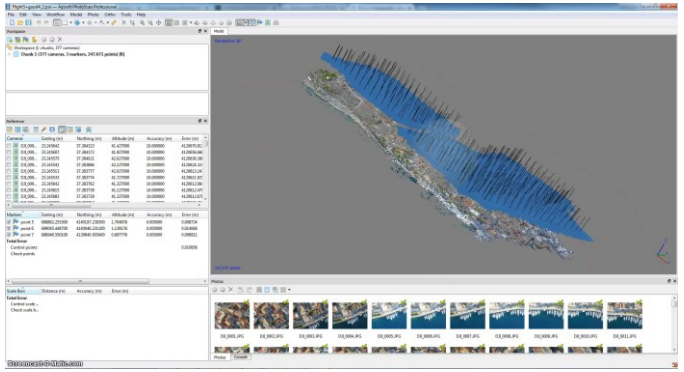
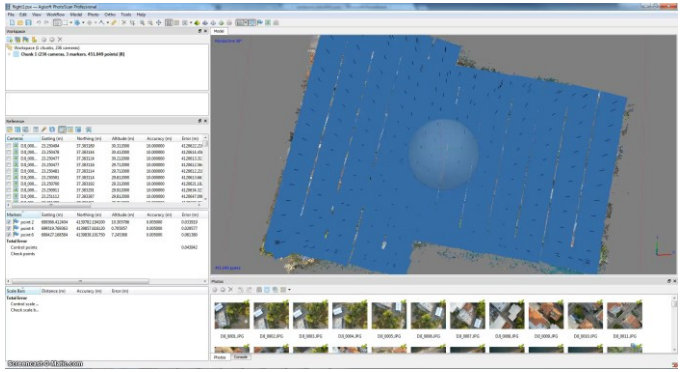
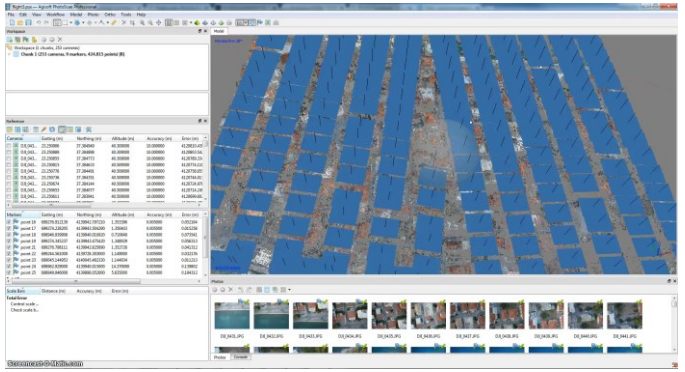
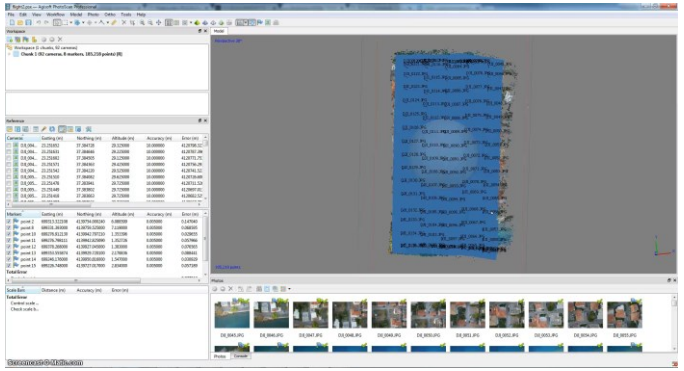
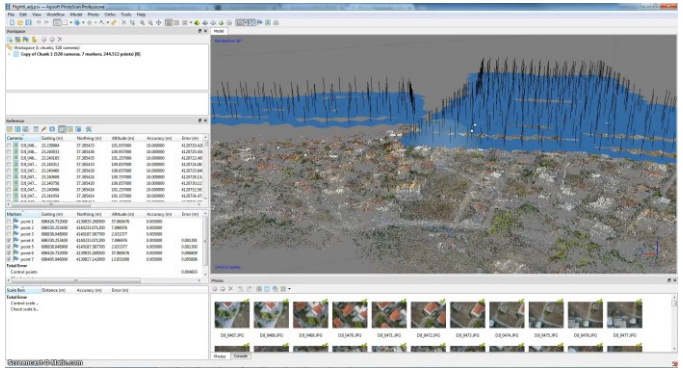
Data processing: separate chunks

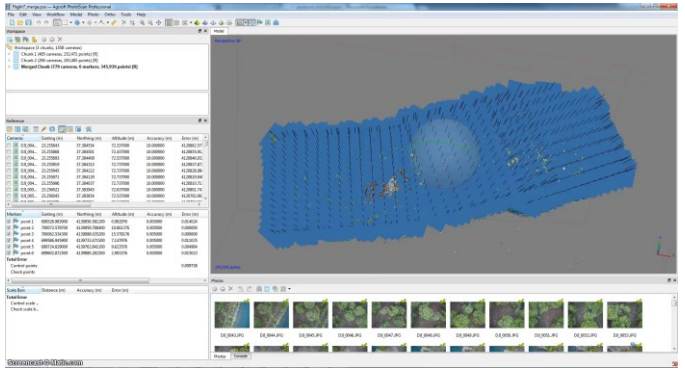












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Data filtering

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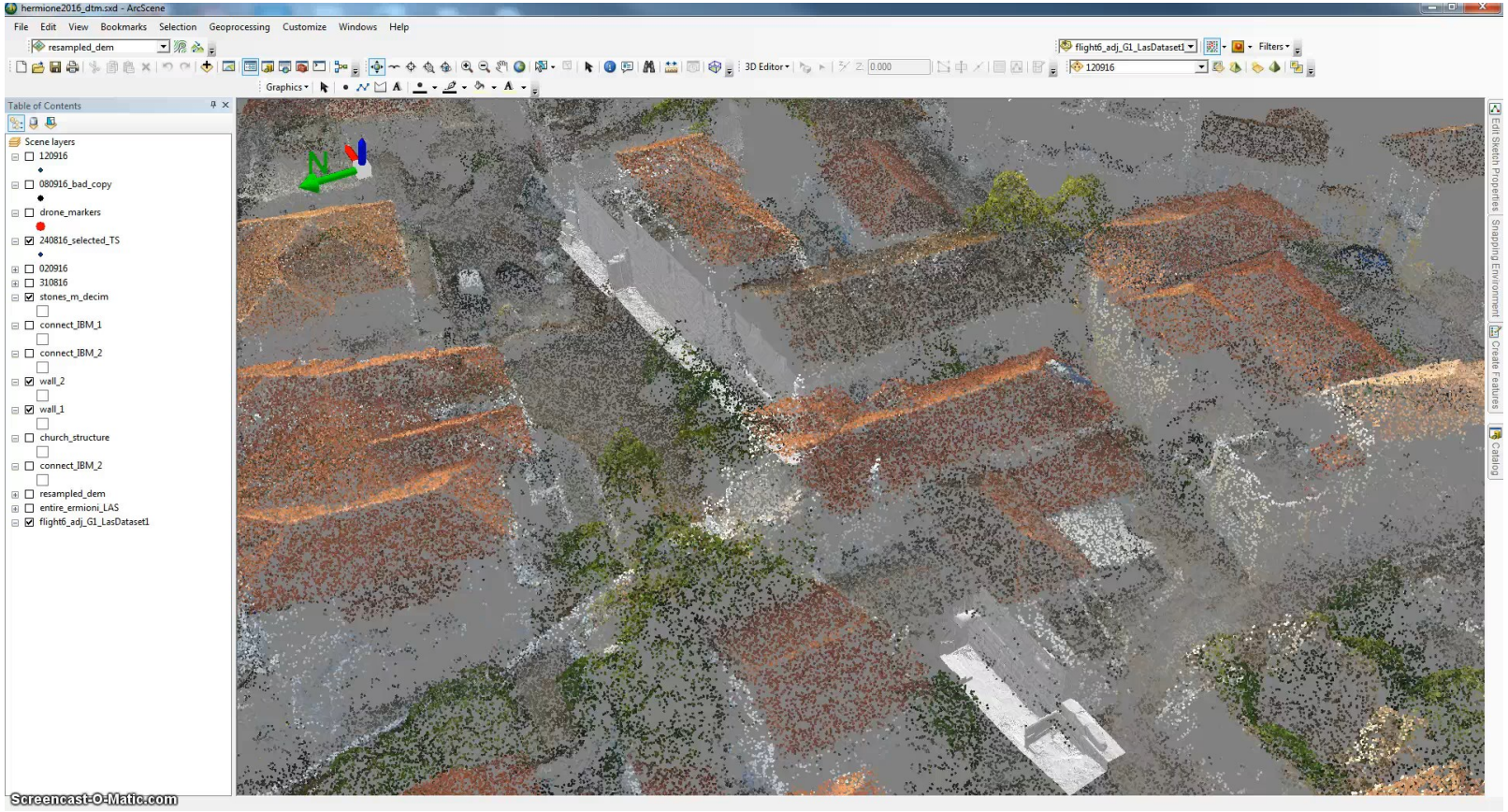
Data analysis: 3D approach



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Data analysis: 3D approach

Main advantages of running IB3DM combined with HPC:

1. To enable archaeologists to process huge datasets made by thousen of pictures in a reasonable amount of time (a few hours compared to a few days).
2. To run the data processing with values of point alignment and dense reconstruction set to highest.
3. To check the data completeness when still in the field.
4. To process big datatsets even in geographically-remote ares.
5. To run point classification on vast areas (from site to landscape).

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