

# PROJECT ARCHÉYE THE QUADROCOPTER AS THE ARCHAEOLOGIST'S EYE

Panoramic view from castle ruin Stahlberg, Germany, 58.7 MPx, 8 photos, about 15-20 m altitude above the ruin, all around view, taken with a Samsung NX100

Christian Seitz<sup>1,2</sup>, Holger Altenbach<sup>1,2</sup>, Thomas Meier<sup>1</sup> and Michael Winckler<sup>2</sup>

<sup>1</sup>Institut für Ur- und Frühgeschichte (UFG) <sup>2</sup>Interdisciplinary Center for Scientific Computing (IWR)

## INTRODUCTION

The project started in the summer term 2008 as a students software-practical aiming to find a way to generate high-resolution aerial images of archaeological excavation sites or historical monuments. The best way seemed to be a quadcopter financial support for a low-cost-solution was provided by the IWR and the MAK. It aimed to be a "proof of concept", to show the possibilities in archaeological documentation. Our workflow, based on opensource-software, is to use the Quadcopter to shoot single photos at calculated coordinates („waypoints“) and merge them into one high-resolution photo which can be dewarped and then used for documentation, surveying or feature drawings.

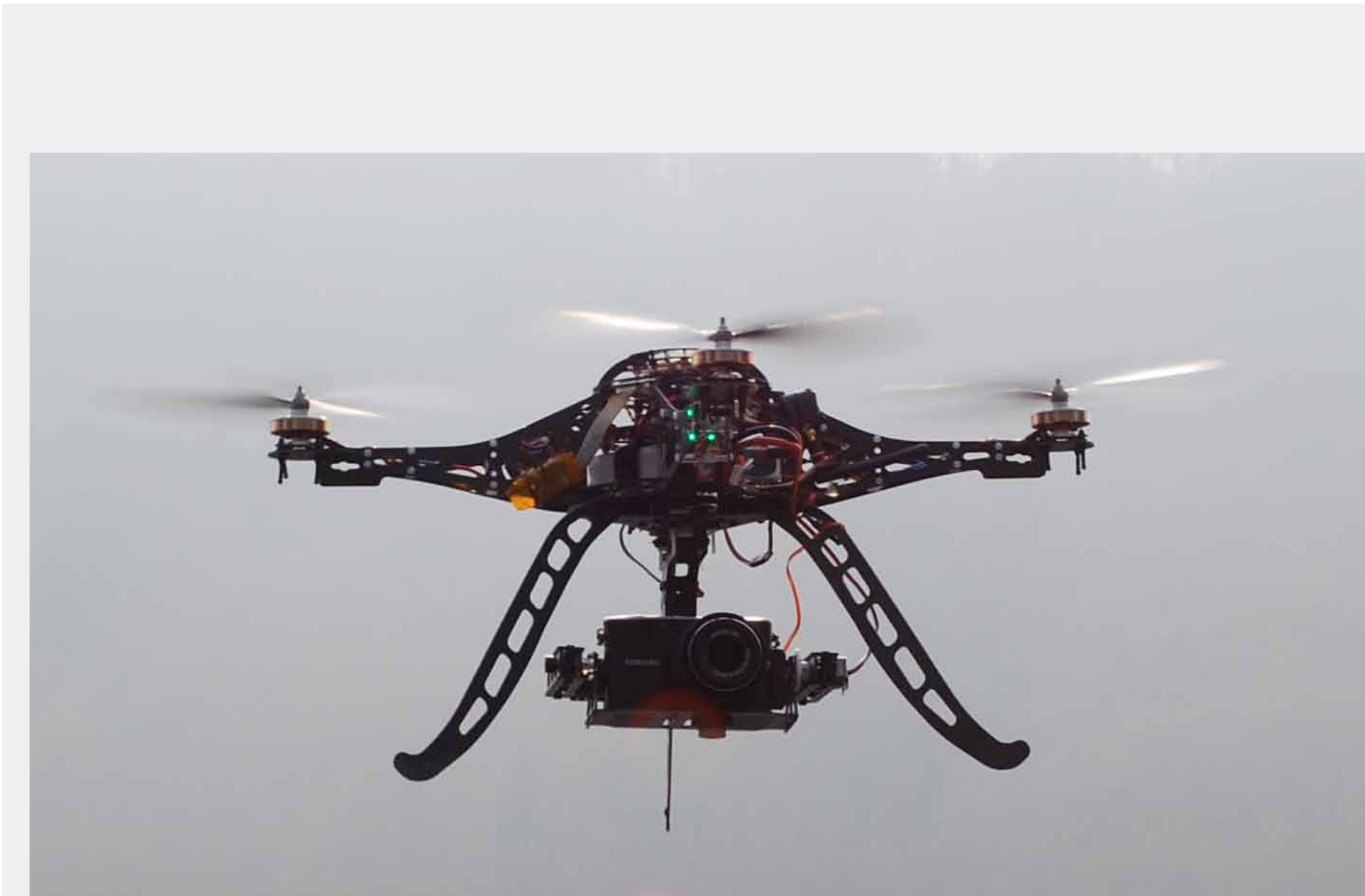
At the moment, the project has two main objectives. The first, dealing with georeferencing and stitching the photos together, will be discussed by Holger Altenbach in his magister thesis. The second, which will be discussed in the magister thesis of Christian Seitz, involves the generation of 3D-models out of the photos.

## MOTIVATION

Aerial photos are very important for archaeological documentation. They provide an overview about the situation of features or a birds view of historical buildings.

At the moment this is achieved by ladders, bucket trucks or photos taken from a manned aircraft. But the results of the first two methods are not satisfying and the third is very expensive and inflexible. Building documentation could additionally be challenging if spots are barely reachable.

The quadcopter can help improve this in many ways, for example with its ability to fly within buildings like churches.

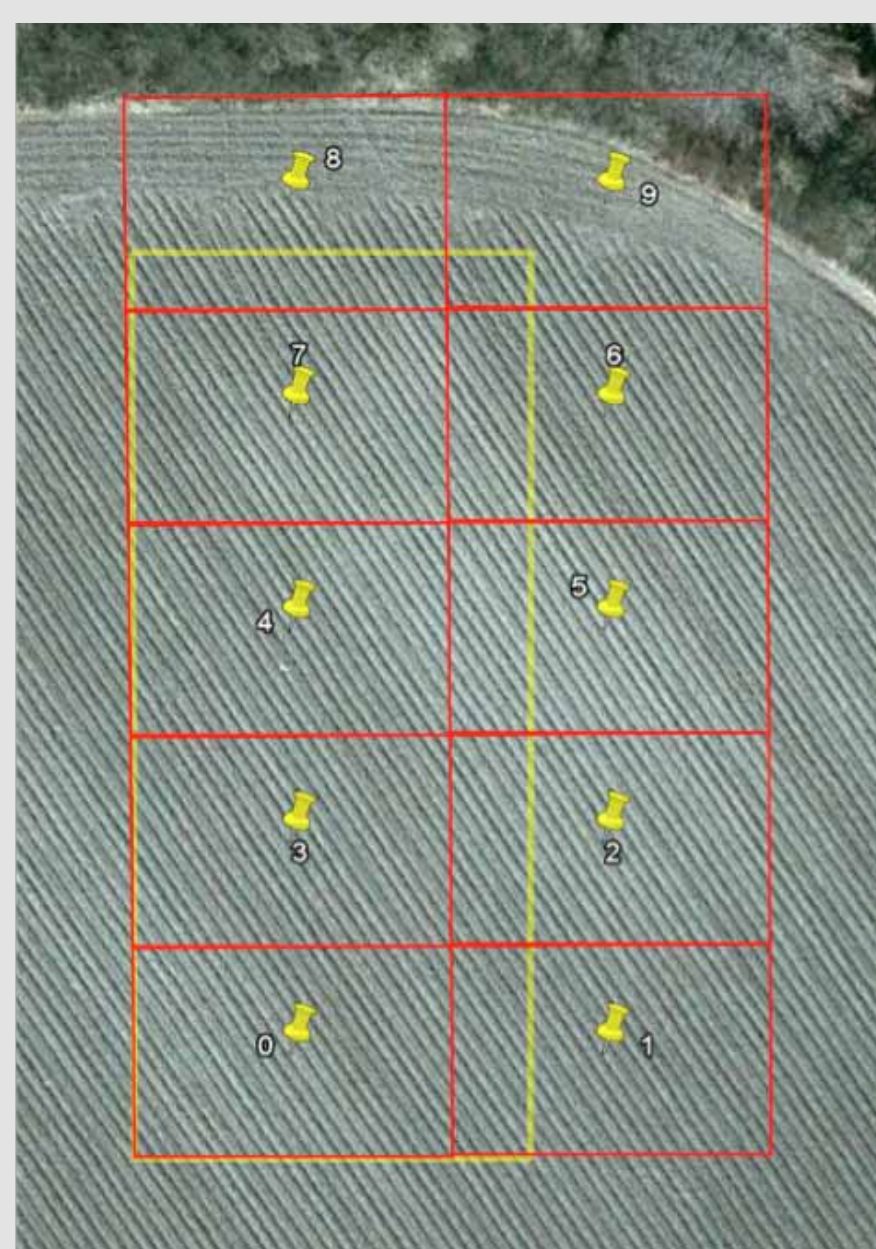


## THE QUADROCOPTER

- weighs 1430g at takeoff, using a frame of carbon fibre built by powerframe.de
- using SLS EP 5000 mAh LiPo batteries, a flight time around 10 minutes can be reached
- reaches an altitude up to 120 m, usually ranging from 20 to 50 m, depending on camera, lens and requested photographic resolution
- automatic flight attitude control and wind compensation through sensors and GPS data
- flying along waypoints with automatic camera triggering
- nick and roll compensation of the camera keeps the camera at the right angle and position during control maneuvers
- livelink with a notebook

## THE ARCHÉYE'S SOFTWAREFRAMEWORK

- Combines a workflow out of self developed software using C++ / Qt and open source tools (e.g. hugin, QGIS and different 3D-toolkits)
- Calculates waypoints over the excavation site based on altitude, desired resolution, camera sensor and lens specification and transfers them to the quadcopter as GPS coordinates. Visualises the flightpath as optical check before transmitting it to the quadcopter
- Merges (stitches) the single photos to a high resolution photography which afterwards will be dewarped with the help of similar points or passpoints based on local or GPS coordinates
- Allows the calculation of 3D-models using a set of photos
- Integration into GIS and CAD projects



Dharamsala, Banteay Chhmar, Cambodia, April 2010  
"House of the Guests" built in the late 12th century



5 MPx, single photo, 40 m altitude, Canon Ixus 50

## RESULTS

Haßloch, Germany, March 2011, neolithic excavation by the „Institut für Ur- und Frühgeschichte“



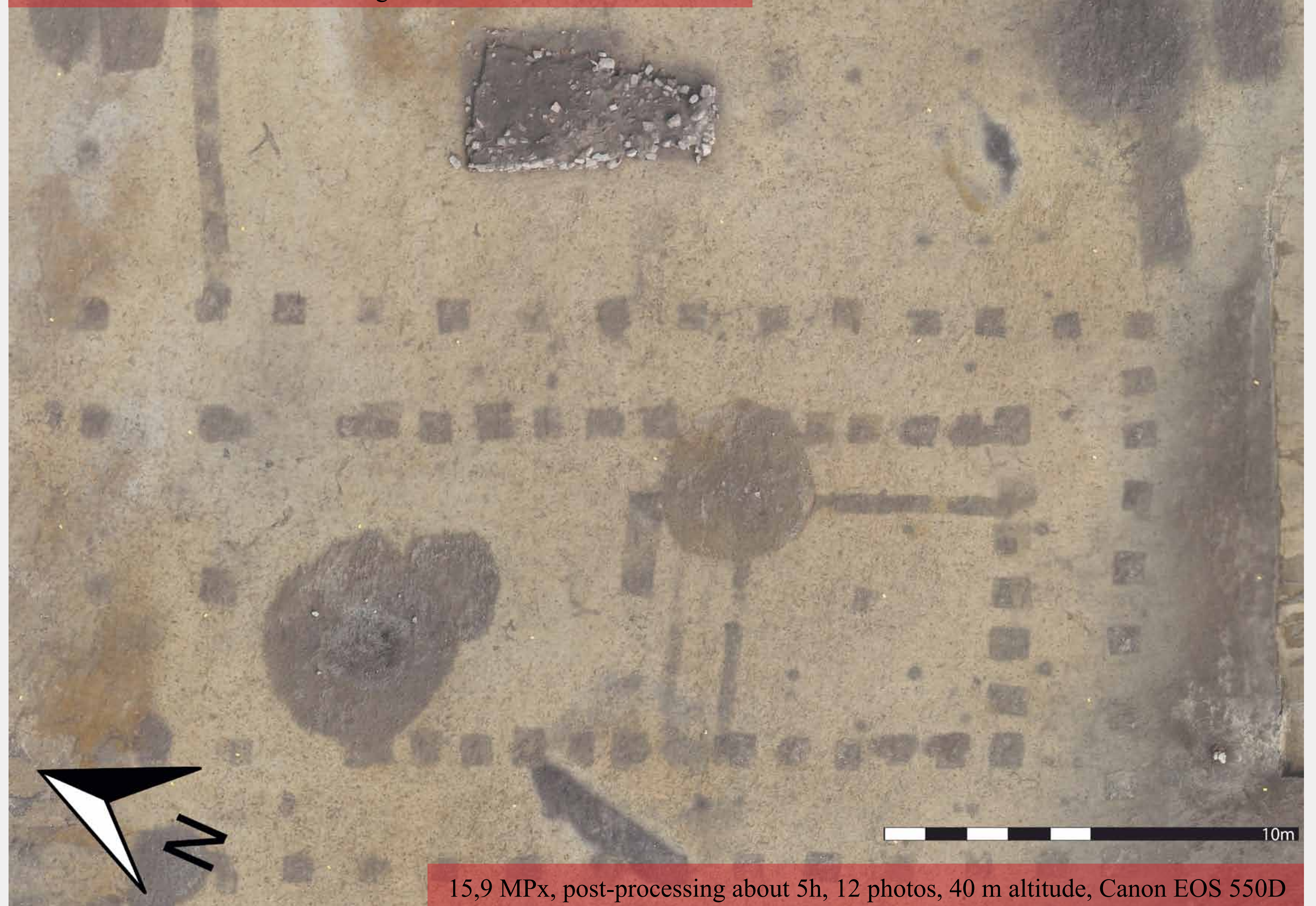
19,8 MPx, post-processing: 3 h, 5 photos, about 50-60 m altitude, Canon EOS 550D

Haßloch, Germany, March 2011



3D Model of the excavation

Neuhofen, Germany, October 2010, Excavation by the GDKE Speyer  
Roman "Vicus" near the fort Rheingönheim



15,9 MPx, post-processing about 5h, 12 photos, 40 m altitude, Canon EOS 550D

## CONCLUSION AND FUTURE WORK

Although the project is a work-in-progress, it already yields very good and archaeologically useful results. The concept has been proved and will now be expanded. The following future work is planned or already in development:

- Improving the flightcontrol to make the quadcopter controllable by an excavation-technician without much knowledge of the project
- Adoption of image processing and pattern recognition algorithms for computation of automated line drawings of architectural structures.

Besides our usual workflow the project is also already used for other applications, like reconstructing the view from a tower.

## ACKNOWLEDGEMENTS

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