Mapping Viking Age and Medieval Harbour Sites with Kite Aerial Photography

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Introduction
In 2013 two potential Viking Age and Medieval harbour sites in Norway and the Faroe Islands were intensively surveyed with Kite Aerial Photography (KAP). Large scale, high resolution terrain models of these maritime landscapes were calculated from the resulting images using Agisoft PhotoScan. The generated 3D-models serve as compensation for lacking ALS-data for general mapping and landscape visualisation as well as for inspection of relief details and modelling of geomorphological changes. [1] The aim of the poster is to show the possibilities but also the limitations of Kite Aerial Photography and Image Based Modelling in different environments.

Kites
To adapt to different wind speeds, airflows and environments a selection of kites is needed.
We used a medium-sized Rokkaku for low wind and different sized parafoul for medium to high wind speeds.
The balance of the forces airflow, lift and drag is expressed by the angle of flight. The kites used generate a high lift and a high flying angle which is an advantage for avoiding obstacles and for estimation of kite and camera position.

Camera equipment and settings
The camera used is a point and shoot Canon S90 that was hacked using the KAP Exposure Control Lua script (CHOK). It automatically controls shutter speed, aperture, ND filter, and ISO settings in order to keep the shutter speed fast but also to enable lower shutter speeds if necessary to get a properly exposed picture. The calculation algorithm includes the target, minimum and maximum values given by the user.

Results

Veøy
In Veøy 815 pictures were used to calculate the digital surface model covering 11 ha with max 1.2 cm GSD. The displayed visualisations show 4.8 cm GSD. The model is an excellent basis for mapping and further analysis, e.g. calculation of sea-level change. It shows many archaeological structures like enclosures or linear stone structures in the intertidal area belonging to some harbour infrastructure.

Sandur
A total of 1,374 images was used for 3D modelling of Sandur. The final model covers 47 ha with maximum 2.5 cm GSD. The model shown here is calculated with 10 cm GSD. It is ideally suited for detailed inspection of the coastal terrain and can be used for geomorphological analysis, as well as for general mapping purposes.

Problems
The dependence on wind speed, direction and on the tide as well as flying between high obstacles can make KAP a challenge.
However, the main drawback of Kite Image Based Modelling is that it is difficult to examine in the field whether the images can be properly aligned. Disturbances in the airflow and blurred photos can result in insufficient image overlap. This produces noise or serious artefacts that require critical interpretation. [2]

Summary
Kite Aerial Photography and Image Based Modelling offer a low cost and effective method for large-scale mapping of archaeological sites and landscapes. It results in high resolution topographic and image information that is of high value for spatial and geomorphological analysis.

By the use of different kind of kites the field of applications can be increased to cover areas with difficult conditions in terms of wind, intertidal changes and obstacles. The use of an automatic exposure script compensates for the tremors of the camera and results in a higher number of sharp pictures.

The case study of the forested island of Veøy shows some of the limitations of KAP, while in the open coastal landscape of Sandur the method shows all its potential.

References

Case study I: Veøy, Norway
The island of Veøy is located in the Romsdal fjord and is supposed to be a central place for the Christiansation in Norway. [3]
The now-uninhabited island is largely covered by dense forest, except the area between the two dominating harbours Nordvågen and Sørvågen where scattered trees, a few buildings and a churchyard can be found.

Case study II: Sandur, Faroe Islands
The site Sandur is a large bay on the island of Sandoy and one of the oldest settlements on Faroe Islands. A hoard of silver coins, mainly originating from Germany and dating to the 11th century, indicates that Sandur may have been a major harbour.
The bay of Sandur consists of a wide dune backed beach with a small river mouth and a steep cliff coast on both sides. The vegetation is low with almost no trees.

Kite Aerial Photography & Image Based Modelling
Kites are widespread camera platforms for low cost aerial imagery and were used by Sir Henry Wellcome in 1911 in archaeology for the very first time.
The camera, triggered by intervallometer, is attached to the kite line using a Picavet suspension. The wind constantly moves the camera in a chaotic behaviour while the kite is traversed by walking through the landscape. In this way a high overlap between the images is achieved which ideally fits the requirements for Image Based Modelling. Structure from Motion and Multi View Stereo algorithms are applied to calculate a texturised 3D model of the scene. In this study the software Agisoft PhotoScan was used for this task. [4]

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