UNIVERSITY OF St.Thomas
Geography and Environmental Studies

Drones, Landscape and Archaeology

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Introduction

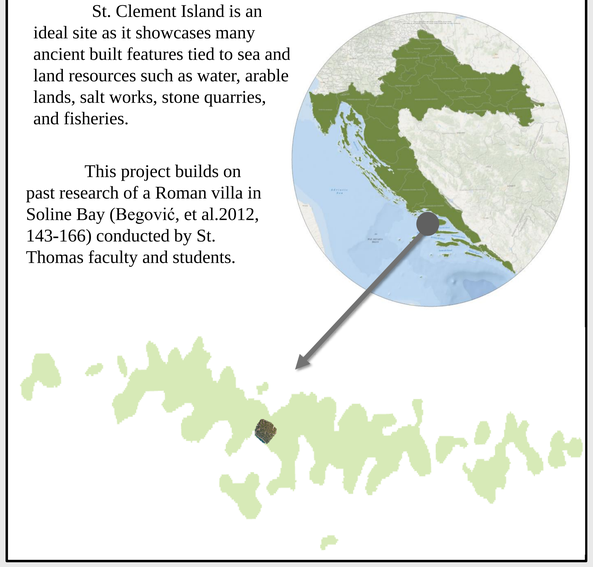
Remote sensing via aircrafts and satellites is significantly helpful to archaeological efforts, especially for site analysis and targeting excavation efforts (Kelley et al. 2017). Unfortunately, most of this imagery is very low resolution, making detecting change on small-scale sites very difficult (Tang et. al 2015). Where acquiring remotely sensed data via aircrafts and satellites is costly and generates low resolution images, drones are an increasingly valuable archaeological tool.

The archaeological work at this site has not yet implemented this drone technology to map the site or to study the relationship between the environment and ancient human sites. This research greatly contributes to the preservation of Croatian cultural and archaeological heritage and to the local community development.

Study Area

St. Clement Island is an ideal site as it showcases many ancient built features tied to sea and land resources such as water, arable lands, salt works, stone quarries, and fisheries.

This project builds on past research of a Roman villa in Soline Bay (Begović, et al.2012, 143-166) conducted by St. Thomas faculty and students.



Research Question

This research highlights target areas of potential archaeological significance by extracting edges which are proxies for human presence. In addition, vegetated areas mapped are isolated as vegetation obscures ground level features. This is accomplished by:

- Generating a study area
- Conducting flights and acquiring high resolution georeferenced images
- Processing images in GIS environment to create useful primary layers including orthomosaics and digital elevation models
- Modeling landscapes from primary layers to extract straight lines
- Using NDVI tool to depict presence of vegetation, this layer was then used to mask portions of the landscape obscured by vegetation.

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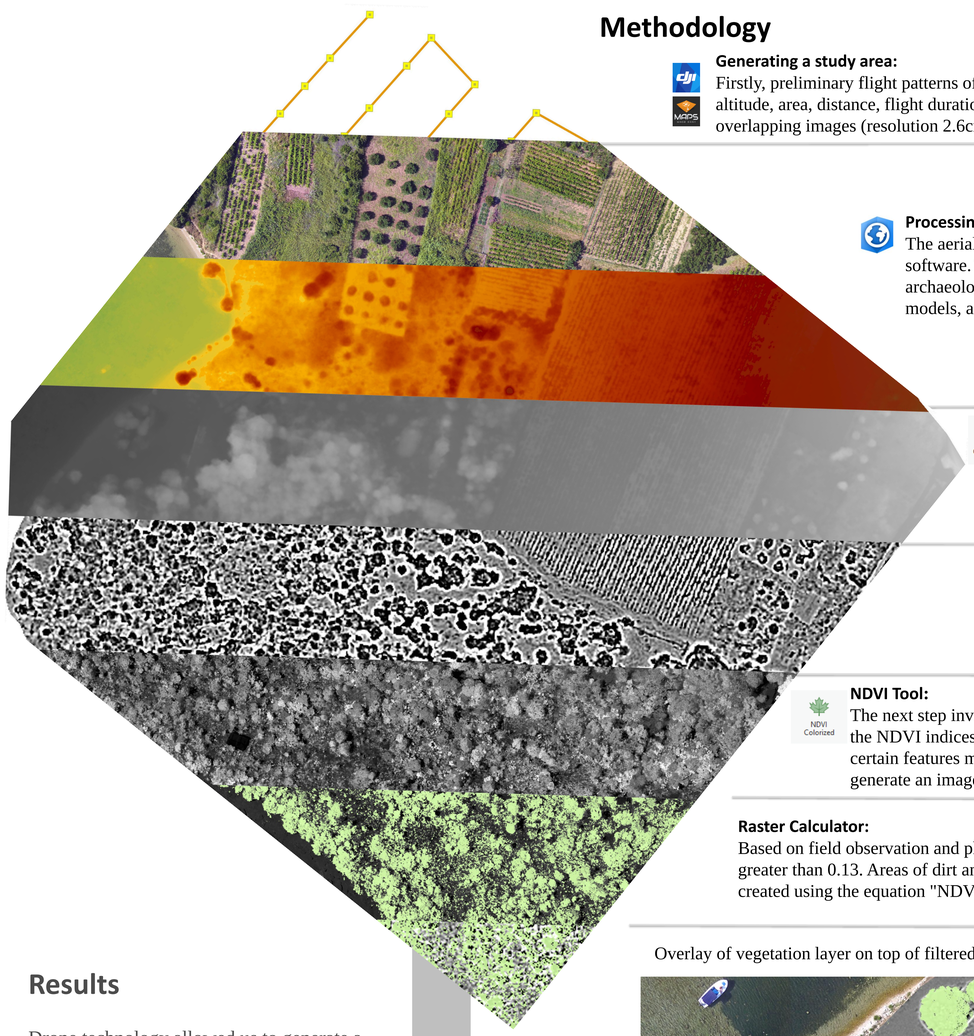


Methodology

Generating a study area:
Firstly, preliminary flight patterns of our study area will be generated in DJI and MapPilot apps. Within this app I will establish altitude, area, distance, flight duration, speed, photo resolution, photo overlap, and number of photos. The flights would collect overlapping images (resolution 2.6cm/px) that are geotagged with a corresponding latitude, longitude, and elevation.

Processing:
The aerial imagery and data collected by the drone will be processed in the ArcPro ortho mapping software. This program overlays and mosaics images to generate a series of map layers depicting the archaeological site and surrounding environment. These include: digital surface models, digital terrain models, and a 3D orthomosiac images.

Convolution Function:
In order to extract bare ground and straight lines that indicate ancient and contemporary human features, the convolution function is applied. The convolution function performs filtering on the pixel values in an image, which can be used for sharpening, blurring, detecting edges, or other kernel-based enhancements within an image. All convolution functions were applied to the digital surface model. Firstly, we applied the smoothing 3x3 convolution function to DSM.

This is a product of applying **Lapacian 3x3 to the previous smoothed layer.** Laplacian filters are often used for edge detection, and are often applied to an image that has first been smoothed to reduce its sensitivity to noise. Notice as edges stand out much more in this layer than the previous maps.

NDVI Tool:
The next step involves masking out vegetation, as our goal is to study the ground in which built features exist. We first use the NDVI indices to better contrast vegetation from ground surfaces. Changing the color bands of the orthographic makes certain features more visible. "The normalized difference vegetation index (NDVI) is a standardized index allowing you to generate an image displaying greenness, also known as relative biomass.

Raster Calculator:
Based on field observation and photo analysis the value of trees was chosen. Within the NDVI layer, vegetation contained pixel values greater than 0.13. Areas of dirt and human presence contained pixel values less than 0.13. In the raster calculator tool a vegetation layer is created using the equation "NDVI > .13"

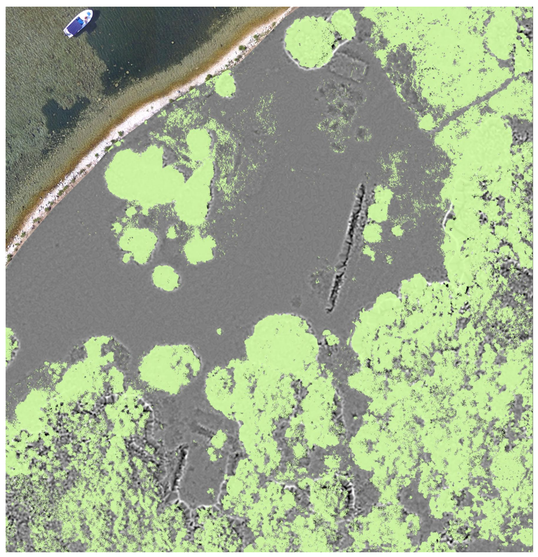
Results

Drone technology allowed us to generate a study area and acquire high resolution images. Through ArcPro OrthoMapping we processed an orthomosaic and digital elevation model depicting the landscape.

Thus, we were able to successfully mask out vegetation that blocked ground level features below and able to extract built features from the landscape. This research demonstrates that drones are a useful tool in archaeological research and effectively highlights target areas of potential archaeological significance.

By creating detailed maps of contemporary and ancient human features we gained useful insight regarding how these human features relate and reflect the environment. This research not only assists in the archaeological research of the site but also contributes to the general knowledge of historical rural settlements on St. Clement.

Overlay of vegetation layer on top of filtered convolution layer. Now edges that indicate ancient and contemporary human features are clear.



Processed map after convolution filtering and extracting vegetation.

Orthomosaic image before convolution and extracting vegetation

Literature Citied

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