3D Geovisualization of petrified tree trunks: The case of Lesvos Geopark

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Introduction

The aim of this research is to propose a methodology for the 3D geovisualization of petrified tree trunks. The acquisition of high-resolution aerial and terrestrial images and the collection of accurate Ground Control Points (GCPs) are the main work of the method that is being used to produce high-quality 3D models of fossilized trees.

- Geological sites should be preserved for cultural, scientific, historical and educational reasons. (UNESCO. Executive Board, 1999).
- Image-based modelling techniques are widely used for geometric surfaces and these methods use 2D images to reconstruct 3D geometrical objects (Remondino and El-Hakim, 2006).
- Aerial and terrestrial photogrammetry are used for visualizing geosites (Bauwens et al., 2017).
The Petrified Forest of Lesvos is one of the most significant natural heritage sites in the world and is situated on the island of Lesvos, Greece.

The UNESCO Global Geopark of Lesvos Island has been a founding member of the Geoparks Network.

Sigri Park of the Natural History Museum was selected as a case study and 18 petrified tree trunks were modelled and geovisualized.
Methodology

Data acquisition:
- GNSS RTK
- GCPs
- UAS
- Phantom
- Terrestrial images
- DSLR and smartphone cameras

Data processing:
- UAS images processing
- Terrestrial images processing
- Image quality control
- Image alignment
- Georeference
- GCPs post-processing
- Structure from motion reconstruction process
- 3D models, DSM, Orthophoto-maps
- WGS84
- HGRS87

Geovisualization:
- 3D model
- Virtual reality
- 3D point cloud
- Augmented reality
- 3D maps
- DSM
- Maps
- Orthophoto-maps
Data acquisition

• GNSS RTK technique is used to collect the ground control points (GCPs) around the fossils, that is required to georeference the high-resolution images.

• The marking of GCPs, is done at the fossil sites using numbered targets which must be visible in the images.

• For the accurate georeferencing, 4-5 control points are distributed around the petrified tree and on it.

• This process is achieved by using the Topcon Hiper SR GNSS
The high-resolution images of the fossils were collected with the Nikon D3400 camera and the Redmi Note 9 Pro smartphone camera.

Manual low flights of 3-5 meters were carried out to collect images of the petrified trees that were standing and tall with the Phantom 4 Pro.

Fusion of terrestrial and aerial images for tall standing or large fossils.

Approximately, 40-50 images for every site have been captured.
Data acquisition

- Capable of overlapping between images
- Fixed focal length
- Each point of the fossil appears in at least three images

Terrestrial images

Aerial images
### Results

<table>
<thead>
<tr>
<th>Fossil</th>
<th>3D point cloud</th>
<th>DSM</th>
<th>Orthophoto-map</th>
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</thead>
<tbody>
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<td>3</td>
<td>5,991,283 points</td>
<td>0.97 mm/pix</td>
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<td>X6</td>
<td>2,806,918 points</td>
<td>0.92 mm/pix</td>
<td>0.232 mm/pix</td>
</tr>
</tbody>
</table>
Results

Orthophoto-map of petrified trunk 12

DSM of petrified trunk 12

3D model of petrified trunk 12
Geovisualization

Animated map of petrified tree trunks of the Sigri Park
Geovisualization
Geovisualization
Conclusions

- This research is conducted, due to the importance of the utilization and highlighting of the geosites of Lesvos Geopark.

- A methodology based on terrestrial close-range photogrammetry was developed for the purpose of recording of the sites and the individual fossils that appear in them.

- Fusion of terrestrial and aerial photogrammetry is an efficient technique to collect images of tall standing petrified tree trunks or larger sites.

- High-resolution orthophoto-maps and DSMs are produced.

- The contribution of this methodology is the production of high-quality 3D models and their geovisualization, which aims to environmental, touristic, educational, and cultural promotion of Geoparks.


Thank you!

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