Abstract

The aim of the work is the photogrammetric survey and digital reconstruction of a climbing area of the western part of the climbing rock below Kalvária in the city of Nitra. The accuracy of the photogrammetric model is supplemented by geodetic measurements using a total station and GNSS reference coordinates. The result of the work is the georeferenced model of the climbing area with drawn climbing routes, as well as the case study of use of aerial photogrammetry in recreational and leisure activities.

Key words:

Lowcost photogrammetry, Close-range photogrammetry, Structure from Motion

Materials and methods

Site description:
- City of Nitra, southwestern orientation under a limestone peak altitude 215 meters above sea level.
- The rock belt of the climbing area is 300m long, large part is not suitable for climbing due to unstable rock affected by limestone mining in the past.

Before the image capturing, a network of 11 ground control points (GCP) has been installed at different elevations for precise positional determination of the model. The GCP's surveyed with the total station Trimble M3 (DMS). Once the GCP's were surveyed, the site was aerially photographed by a Dji PHANTOM 4 PRO V2 with a 1 "CMOS chip with a resolution of 20MPx and a focal length of 8.8mm. To ensure coverage of the entire site, the photos was taken from several angles and distances, where we tried to maintain a high overlap of images to minimize blind spots in the processing of the model.

Total of 439 images were processed using Agisoft Metashape software. During this process, program calculates the position and orientation of each photo and creates a sparse point cloud of the surveyed rock site. After images were aligned, we manually plotted control points with coordinates into the software by using reference tools. At this stage software recalculated the position of sparse point cloud and georeference points into S-JTSK Kľašov East North (EPSG: 5514) coordinate system. In same way, once the images were aligned it is possible to generate dense cloud and then TIN model. The next step of processing was adding textures on 3D model based on captured images.

In the last step we exported the TIN model to the software Blender 3D model suite, where we used the curves to redraw the climbing routes from the climbing guide to the 3D model by comparing routes in topo guide with topography of model.

Results

By photogrammetric processing we have created a highly detailed 3D model with over 10,000,000 vertices and 21,000,000 faces. The model was decimated to 1,000,000 faces due to the reduction of data volume and easier handling of the model. Using the open-source software Blender 2.91, 19 climbing routes were drawn into the model based on a topographic sketch of a rock surface. Following the drawing of climbing routes, the model was uploaded to the viewing platform Sketchfab. <https://skfb.ly/omS2Q>

Conclusion

Decisive aspects of mapping of the steep and hard-to-reach forms of rock walls in 2D cartography is visualization. In this case we used low-cost aerial photogrammetry to capture, visualize and reconstruct the climbing guide of Kalvária in 3D. By making a 3D model and then drawing climbing routes based on a topographic sketch we added details and information to the „topo“ model of surface, which can be used by the climber to plan and facilitate climbing. Adding more details and information to topos could make the preparation make the climbing route easy to spot and compare to others in the same area. However, we want to point out that by helping the climbing community with the digitization of climbing guides, we can raise awareness and interest in photogrammetry and encourage more people to digitize not only climbing areas but also natural, cultural heritage.

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