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Use of LiDAR drone data for O-mapping and change detection in mountainous areas

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Abstract:

In recent years, aerial laser scanning data has become one of the most important and useful basic topographic data for surface description and has become the basis for many applications and tasks, such as terrain analyses, source data for map production, recognising traces of ancient buildings and infrastructure, river network analyses, abyss detection etc. In many countries, a systematic laser scanning of the entire territory has been carried out in the past years from airplanes or manned helicopters, and in many countries a system of cyclical recording is also being established at intervals of several years. Despite that, the data quality of system laser scanning is not sufficient for individual special cases of use and small areas. For non-urban, unpopulated areas, the scanning density is often too low. In steep mountainous terrain, erosion and creep due to increasingly frequent extreme weather events cause significant frequent terrain changes, which the frequency of system laser scans is not sufficient to detect. In all these cases, the utility value of a mobile aerial system (Figure 1), consisting of a remotely piloted aerial vehicle (UAV) and a laser scanner, often with the addition of a camera in the visible spectrum, is beneficed.

Figure 1. UAV DJI Matrice 300 with laser scanner L1.

With such a system, data for smaller areas can be obtained as needed, without the need for prior planning and following time consuming processing, and can be used very soon after the recording has taken place. In the paper, based on the obtained UAV laser scanning data using DJI Matrice 300 and Zenmuse L1 lidar (Figure 1) in two selected areas and their comparison with official national laser scanning data, we analyzed their useful value for two different purposes. In the first case we compared the use of the UAV lidar data with official Slovenian laser scanning data as a source for creating an orienteering map, at which the up-to-dateness of the data status is extremely important (Figure 2). We particularly focused on hardly distinctive terrain features captures and runnability of the area as a result of vegetation density, two contents, that are of the main importance in the orienteering maps, but can’t be captured from any available databases.

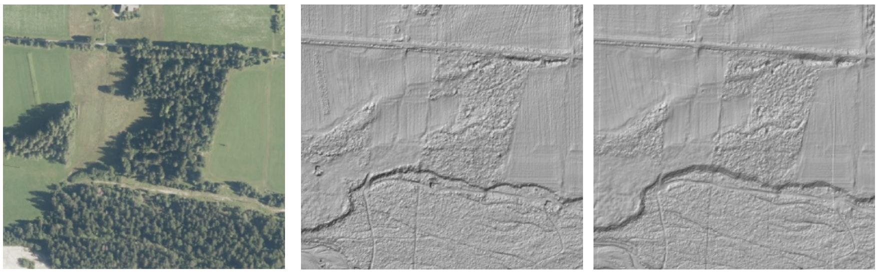

Figure 2. Orthophoto, ALS national data, UAV lidar data for creating orienteering map.

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The other test case was focused in identifying terrain changes, which can be used to update topographic or touristic maps and databases. Possible aim should be in identifying the passability of hiking trails after the long rain period or snow melting in spring. The other possibility should be identifying changes in riverbeds (Figure 3) that may affect changes in the water regime of the catchment and thus the risk of endangering lower-lying areas.

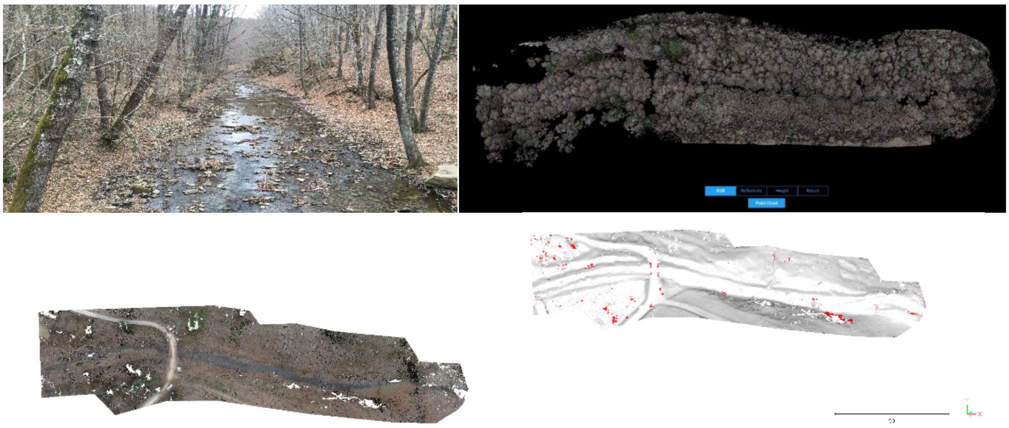

Figure 3. Watershed, coloured point cloud, coloured segmented point cloud, detected changes.

The main difference between both cases, which need different study plan is that while producing orienteering map we are capturing the selected area completely, the entire content, which is standardised to be presented on maps. While at the second case we are focused on change detection and updating the content on the previously existed map.

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