HIGH RESOLUTION DEM GENERATION IN HIGH-ALPINE TERRAIN USING AIRBORNE REMOTE SENSING TECHNIQUES

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Abstract

Up-to-date and accurate digital elevation models (DEM) are essential for many applications such as numerical modeling of mass movements or mapping of terrain changes. Today the Federal Department of Topography swisstopo provides digital Terrain models (DTM) and digital surface models (DSM) derived from airborne LiDAR data with a high spatial resolution of two meters covering the entire area of Switzerland below an elevation of 2000m a.s.l. However, above an elevation of 2000m a.s.l, which is typical for high-alpine terrain, the best product available is the a DTM with a spatial resolution of 25m. This spatial resolution is insufficient for many applications in complex terrain. In this study, we investigate the quality of digital surface models (DSM) derived from opto-electronic scanner data (ADS80, acquired in autumn 2010) using photogrammetric image correlation techniques based on the multispectral nadir and backward looking sensor data. As reference, we take a high precision airborne LiDAR data set with a spatial resolution of ca. 0.5m acquired in late summer 2010 covering the Grabengufer/Dorfbach catchment near Randa, VS. We find the deviations between the two datasets are surprisingly low. In terrain with inclination angles of less than 30° the RMSE is below 0.5m. In extreme steep terrain of more than 50° the RMSE grows up to 2m and outliers increase significantly. We also find dependencies of the deviations on illumination conditions and ground cover classes. Finally we discuss advantages and disadvantages of the different data acquisition methods.

Keywords: digital terrain model DTM, remote sensing, high-alpine terrain, LiDAR, ADS80, photogrammetry

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