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EXPLORING RIVER GEOMORPHOLOGY DYNAMICS USING AIRBORNE AND TERRESTRIAL LASER SCANNING TECHNOLOGIES

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Abstract

In the past few decades, airborne and terrestrial laser scanning (ALS and TLS) data acquisition techniques have experienced a significant evolution, being extensively employed for topographic mapping. Due to rivers' constant activity, alluvial topography displays considerable complexity and undergoes continuous changes. This article outlines methods for improved modeling and exploration of river geomorphology dynamics based on multi-temporal ALS and TLS datasets. The considered study area is represented by an alpine river located in northeastern Austria, a protected area, part of the Natura 2000 project. To perform the geomorphological dynamics exploration, four Light Detection and Ranging (LiDAR) acquisitions were employed: two ALS (May 2013 and February 2015) and two TLS data sets (March and June 2016). Our methodological approach comprises the following steps: ALS direct georeferencing and strip adjustment, TLS registration, co-registration of TLS and ALS datasets with accuracy assessment, point cloud filtering into terrain and off-terrain points, multi-temporal ALS and TLS Digital Terrain Models (DTMs) derivation, Digital Elevation Model of Differences (DoD) computation and river topography dynamics analysis. Our adopted method proved a stable and reliable solution for an accurate multi-point cloud registration of complex natural scenes without using artificial marks on the ground, within decimeter accuracy. Moreover, based on the computed DoD, we estimated the river topography dynamics, with volumes for deposition/erosion reaching up to more than 1,500 m^3, due to the flood event from June 2013. Our proposed approach based on multi-temporal ALS and TLS data, offers high spatial resolution and accuracy, showing significant potential for analyzing river geomorphology dynamics and monitoring riparian areas.

Key words: alluvial topography, change detection, geomorphology, LiDAR, monitoring

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