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Classification of breaklines derived from airborne LiDAR data for geomorphological activity mapping

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Airborne LiDAR surveys provide 3D high-resolution elevation information for area-wide applications. Due to the capability of LiDAR to penetrate vegetation cover highly accurate digital terrain models (DTMs) can be derived also for forested areas. Breaklines derived from LiDAR DTMs mark regions of slope discontinuities, describing the main characteristics of a terrain surface in an efficient manner. Breaklines are often used for DTM enhancement but also for the detection and interpretation of geomorphologically relevant landforms such as landslides, torrents, erosion scraps and tectonic faults. Because of human activities geomorphologic landforms are often disturbed and reshaped i.e. by construction of roads, skiing slopes, drainage channels and surface mining. Therefore, DTMs contain both, anthropogenic and geomorphologic discontinuities. This significantly disturbs morphometric analysis and causes problems for automatic landform mapping algorithms.

In this research an automatic breakline detection method is applied in an alpine region with high relief variation containing surface discontinuities such as torrents, creeping slope failure, and landslides, which are reshaped by anthropogenic activities.

Regions of high curvature are classified and vectorised in order to derive 3D breaklines. These are further filtered and classified based on object-based properties such as their size, shape and slope to separate natural i.e. geomorphologic relevant and anthropogenic structures. The classification result is compared to reference map data indicating a high reliability of the classification quality.

After the removal of anthropogenic breaklines the remaining natural breaklines are used to compute line density maps using a moving window approach. These density maps point out areas of different relief energy and assist to delineate areas of geomorphologic relevance. These areas are also of most interest to identify geomorphological landforms. The methodology presented contributes to enhance automated geomorphological mapping and process interpretation tasks in regions with high relief energy.