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Coltop-3D: A new software for analyzing rock-slope relief using 3D-imaging cloud points

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The increasing precision of ground-based Lidar technologies makes possible to perform more detailed systematic structural and morphological analyses than ever reached before. Using the orientation of each single collected vertex, a point cloud data set can be represented by a 3D image where each single point has a color defined by the local dip and strike direction, which allows a very simple slope analysis. This can also be applied to any surface reconstructed through the data set, making the detection of planar structures within a cliff, i.e. in the presence of overhangs, possible, which is not with classical 2D digital elevation models. Such simple analyses applied to 3D clouds of points make it possible to quickly identify structural features affecting topography. They open new perspectives in relief analysis. Although the principle of the analysis is simple, it is not straightforward to manage and to create surface from clouds of points. The basis (kernel) of a software (Coltop-3D) has been developed toperform these tasks.

Terrestrial laser scanners allow for capturing dense 3-dimensionnal data set (up to millions of points) on the surface of an object, within a few minutes. However, the post-treatment and the standard operating use of such large data set may impair an in-depth analysis for specific applications, such as landslide and rockfall analysis. This is mainly due to computer access time for the data point near a given location and to the required size to store the data in the random access memory (RAM). To solve both problems, a structure based on octrees which allow for fast localization of points and low consumption of RAM is used.

Using eigenvalue of the covariance matrix of the points's clouds in a neighbourhood, it is possible to compute surface very quickly. Using the same matrix a threshold of

points dipersion can be used to delete foliage from points's clouds.

Surface reconstruction is a topic of great interest in computer graphics and there are numerous works for surface reconstruction. Our interest in surface reconstruction is firstly for automatic delineation of faults, and secondly for visibility culling purpose, as points in the background may make the interpretation difficult. Most, if not all, of the surface reconstruction algorithms imply that the surface to reconstruct is smooth and that the sampling density is fine enough to capture all its features. However, this assumption can not be met in our case, as the scanned surfaces show to be almost always noisy because of the intrinsic roughness of the study site and/or the distance from the Lidar device to the target site, which may be up to 1'000 m. To overcome these problems, a local reconstruction algorithm is used.

This is illustrated with some examples (Burdon rockfall area and Randa landslide area, both located in the Swiss Alps).