Geophysical Research Abstracts
Vol. 21, EGU2019-3424, 2019
EGU General Assembly 2019

Automated point cloud classification and analysis of rock slope processes using machine learning

Luke Weidner, Gabriel Walton, and Ryan Kromer

Colorado School of Mines, Department of Geology and Geological Engineering, Golden, United States (weidner@mines.edu)

Lidar and photogrammetry methods have increasingly been utilized in rockfall monitoring applications. Not only can these technologies improve the speed and accuracy of hazard investigations, but they also open new opportunities to observe millimeter-scale slope changes over time. Advances in field setups now allow for near-real-time monitoring at weekly, daily, and even sub-daily time intervals, presenting a major data management problem. An operational rockfall monitoring system must be able to very quickly and robustly generate information meaningful to decision-makers. Recent research has focused on developing semi to fully-automated point cloud processing workflows to generate change maps for slopes. However, a large amount of manual interpretation is still typically required, especially when the scene contains vegetation, talus slopes, and other features not relevant to the rockfall processes of interest. The current study investigates the use of machine learning algorithms to adaptively analyze rock slope point cloud data, including change data. A case study is presented on a rock slope adjacent to an interstate highway in Glenwood Springs, Colorado, USA. For lidar systems, our proposed workflow consists of two modules. First, the slope is automatically classified into one of four material types: bedrock, talus, vegetation, and snow. Second, significant change is to be extracted and analyzed to determine rockfall volumes and identify potential pre-failure deformation. Slope material classification was accomplished using a Random Forest algorithm trained with multi-scale neighborhood-based geometry, slope angle, and return intensity statistics as features. Features derived from slope change data were also investigated. Initial validation tests indicate very good classification performance, with F scores of up to around 95% for bedrock, 92% for vegetation, 85% for talus, and up to 90% for snow. Our method shows significant improvement over results from the commonly used CANUPO software. The proposed framework is valuable in part because it can be taught to handle slope changes, such as seasonal variation in vegetation and weather. It is natively multi-class and can easily be modified to incorporate new data types and classes that may be useful is special cases. Ongoing research seeks to employ transfer learning approaches to generalize the algorithm to other sites, and a modified version of this framework is under development for a photogrammetric system.