

EGU21-11815

<https://doi.org/10.5194/egusphere-egu21-11815>

EGU General Assembly 2021

© Author(s) 2022. This work is distributed under the Creative Commons Attribution 4.0 License.



Time-lapse point clouds of moving granular flows: Preliminary insights and future outlook

Raffaele Spielmann¹, Jordan Aaron¹, and Brian McArdell²

¹Geological Institute, ETH Zürich, Zurich, Switzerland (rspielma@student.ethz.ch)

²Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), Birmensdorf, Switzerland

Debris flows are extremely rapid, flow-like landslides that can impact people and infrastructure far from their source. Reducing debris flow hazard requires an understanding of the mechanisms which govern debris flow behavior, such as grain size segregation, entrainment, deposition and liquefaction, as well as accurate numerical models, which must be validated based on laboratory and field data. Thus, knowledge of debris flow mechanisms, as well as forecasts of debris flow behavior, require accurate measurement of a number of quantities that vary through time, which include slope inclinations, front velocity, flow depth and flow volume. These parameters are difficult to measure in moving granular flows, however newly available sensors have the potential to accurately capture them. These sensors include high resolution LiDAR and depth cameras, which are potentially useful for the field and laboratory scale, respectively. In the present work, we implement a processing pipeline to attempt to estimate these four parameters, and associated errors, using two such sensors; a LiDAR sensor (Ouster OS1-64 Gen 1) which is planned for a field installation and a depth camera (Intel RealSense Depth Camera D415) which is useful for laboratory scale experiments.

We performed a series of laboratory experiments, where different dry sediment mixtures were released down an inclined plane, and both sensors were used to collect time-lapse point clouds of the moving material. These point clouds were recorded at a rate of 10 Hz and 30 Hz, for the Ouster OS1-64 sensor and Intel RealSense Depth Camera D415 respectively. Our processing pipeline involves aligning the point cloud frames, isolating the moving material based on reflectivity or infrared thresholds, and then measuring the four parameters detailed above in each frame. Both sensors are able to measure slope angle, velocity and volume, however the measurement of the free surface gradient was subject to more error. The experimentally determined noise levels for the sensors were different, with 3 cm for the LiDAR scanner, and 0.5 cm for the depth camera. Additionally, the more accurate depth camera enabled tracking of larger particles on the flow surface. Interestingly, we measure a consistent volume dilation of the flowing debris, with a volume increase of about 39% over 0.1 s.

Thus, both sensors will be useful tools for understanding fundamental debris flow mechanisms. Future work will focus on defining a relationship between flow velocity and material contraction/dilation, and will further refine the processing algorithm to more accurately assess

these four parameters. Additionally, we will present an overview of the set-up and installation of an OS1-64 sensor in the Illgraben catchment, Europe's most active debris flow catchment.