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Capturing 2D transient surface data of granular flows against obstacles with an RGB-D sensor

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Landslides are an ubiquitous natural hazard, and therefore human infrastructure and settlements are often at risk in mountainous regions. In order to better understand and predict landslides, systematic studies of the phenomena need to be undertaken. In particular, computational tools which allow for analysis of field problems require to be thoroughly tested, calibrated and validated under controlled conditions. And to do so, it is necessary for such controlled experiments to be fully characterized in the same terms as the numerical model requires. This work presents an experimental study of dry granular flow over a rough bed with topography which resembles a mountain valley. It has an upper region with a very high slope. The geometry of the bed describes a fourth order polynomial curve, with a low point with zero slope, and afterwards a short region with adverse slope. Obstacles are present in the lower regions which are used as model geometries of human structures. The experiments consisted of a sudden release a mass of sand on the upper region, and allowing it to flow downslope. Furthermore, it has been frequent in previous studies to measure final states of the granular mass at rest, but seldom has transient data being provided, and never for the entire field. In this work we present transient measurements of the moving granular surfaces, obtained with a consumer-grade RGB-D sensor. The sensor, developed for the videogame industry, allows to measure the moving surface of the sand, thus obtaining elevation fields. The experimental results are very consistent and repeatable. The measured surfaces clearly show the distinctive features of the granular flow around the obstacles and allow to qualitatively describe the different flow patterns. More importantly, the quantitative description of the granular surface allows for benchmarking and calibration of predictive numerical models, key in scaling the small-scale experimental knowledge into the field.