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New techniques for characterizing 3D landslide slope evolution from LiDAR point cloud

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In recent years laser scanning use has increased in different geosciences fields especially in natural hazards. Landslides can be monitored by laser scanning technique using sequential time scan comparison. Current challenges in landslide forecasting are focused in better quantifying the real 3D deformation of the slope, in order to understand global landslide kinematics. In this study, we propose the use of two new automatic techniques able to track deformation over the slope: rigid shape tracking and non-rigid shape tracking algorithms. To achieve this, we used 3D remote sensing techniques (3D digitizer Konica Minolta Vivid 9i) to acquire 3D information of surface topography with high accuracy and high resolution over analogue landslide simulations. To study the 3D slope deformation, we carried out a series of experimental tests in a sandbox with both sides made of glass allowing visualizing the water level and the location of the failure planes. We carried out several deformation tests by increasing water pressure and acquiring 3D geometry at high temporal rate (2 scans/minutes) allowing hundreds to be compared.

Results show that the use of both tracking algorithms allows precise detection of small enough (mm order of magnitude) deformation. Thanks to this approach, it is possible the obtaining of a global comprehension of the 3D deformation at surface. to compute motion vectors of displacement and to analyze slope surface processes. In order to obtain a better visualization, a new color coding technique was used to illustrate the surface deformation. Our results will help improve our understanding on kinematics of different landslides.