



## Analogue sand box simulations for detection of prefailure deformation with 3D Digitizer

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Landslides can be monitored by laser scanning technique using sequential time scan comparison. Current challenges in landslide forecasting are focused in a better understanding of the 3D dynamics, either at the pre-failure and failure stages. Analogue sand box simulation is an approach to understand real slope failure mechanisms. A high resolution 3D Digitizer Konica Minolta Vivid 9i provides high-resolution 3D images of the surface that allows detection of millimetric displacement.

To study the 3D slope deformation, we carried out a series of experimental tests in a box with one of its sides made of transparent plastic. This transparent side allowed visualising the water level and the location of failure planes. The material used for the simulation was sand with different percentage of bentonite. Several tests were carried out: the influence of different slope angles were tested, together with different hydrologic conditions (constant or variable water level).

Small spherical targets were used for the detection of pre-failure deformation and motion tracking. Small surface displacements were closely examined by laser triangulation with an accuracy of  $\pm 0.4$  mm and a precision of  $\pm 0.096$  mm. The scans were acquired each 30 seconds, up to the final collapse and the subsequent stabilisation of the slope.

Preliminary results show that the use of spherical targets allows precise detection of small scale movements and deformation. Thanks to this approach, it is possible to create motion vectors of displacement in three dimensions, to detect the planes of failure and to calculate acceleration until failure time. This approach for analyzing instability processes allows the obtaining of a complete 3D view of the deformation at surface. Nevertheless, a great challenge still remains in the development of new algorithms for the better understanding of the precursory phenomena using 3D laser devices, in order to assess whether or not TLS could be used as an early warning system.