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Three-dimensional dynamic topographic survey of granular flows using photogrammetric techniques

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In order to better characterize the behavior of fast dry granular mass movements, such as dense snow or rock avalanches, laboratory analyses have been undertaken in a model scale (Froude similarity, geometrical scale of the order of 50:1 – 100:1).
To this end, an experimental flume, consisting of two planes with adjustable inclination, has been used: the upstream plane, with slope varying from 15% to 60%, simulates the flowing zone and the downstream plane, with slopes ranging from 0% to 30%, simulates the deposition zone.
The experimental apparatus has been completed in order to obtain a three-dimensional dynamic topographic survey of the sliding free surface, using photogrammetric techniques.
The experiments are being performed using a maximum of eight industrial digital video-cameras.
A full photogrammetric camera calibration process has been first conducted in order to define the parameters of inner orientation of the cameras and of the objective lenses distortion, in order to reduce the uncertainties in the collinearity equations.
The recording time is digitally triggered at the same time to all the cameras. A dedicated acquisition code, based on LabView software, has been realized to achieve the best accuracy in the frames synchronization. The surface is reconstructed, at different times, using the frames taken at the same instant from the different video-cameras.
The photogrammetric analysis has being performed by means of commercial dedicated software.
As a final product of the research it is expected the tuning of an automatic procedure for the photogrammetric analysis of the series of frames taken in order to describe the dynamic evolution of the motion of a granular mass driven by the gravity and the limits of the proposed techniques.
The dynamic three-dimensional reconstruction of the free surface of the sliding granular mass will be used in the calibration process of granular mathematical-numerical models. The comprehension and the estimation of the rheological parameters to be used in the numerical simulations is one of the most important aspect of the research, in order to allow greater reliability in the evaluation of the avalanche and landslide risk at prototype scale.