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A new approach to the measurement of a landslide displacement field by using terrestrial laser scanner

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Terrestrial laser scanner allows the acquisition of a large amount of spatial information about the kinematics of an instability phenomenon. In particular, in the case of a relatively small landslide observed from a distance of a few hundred meters, a point cloud consisting of some millions of elements, characterized by spatial sampling of few centimetres, can be acquired. High accuracy and spatial resolution are typical performances of this system. The processing of laser scanner data consists of filtering, registration on a convenient reference frame (georeferencing), and generation of a solid model. The availability of multitemporal data allows the comparison between relative models. Volumetric measurements can be performed to individuate displacements; 'error maps', i.e. maps of differences between two models along a fixed direction, can be easily obtained. The calculation of a landslide displacement field is very important to detect failure mechanism, but it requires an additional effort: the determination of the new position of a point individuated in the first model. A technique for this computation, valid when the landslide surface is directly observable, as well as when many buildings are present and the slope surface is partially hidden, may be based on the use of the ICP (Iterative Closest Point) algorithm, implemented in all software conceived for point cloud processing. Considering a little area (few m^2) of the first model of the unstable slope, the corresponding area in the second model can be obtained by means of local surface matching, related to the robustness of the ICP algorithm against data noise and therefore to the small morphological modifications. The use of macros permits the complete automation of the calculation of local roto-translation matrices on an entire slope. This approach has been used, with encouraging results, in the areas of Perarolo di Cadore and Lamosano village, both located in the North-Eastern Italian Alps and affected by very different landsliding phenomena.