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Time-lapse stereo-photogrammetry to monitor electrical sounding electrodes on an unstable slope

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Time-lapse electrical resistivity tomography (ERT) of landslides allows at characterizing the water flows inside the moving mass. Inversion of electrical measurements imposes to locate and track in time the positions of each electrode. The spacing of the electrodes is typically unknown if the electrodes are not equipped with a displacement monitoring system (total station, dGPS antennas, extensometers). Here we tackle this practical problem with time lapse stereo-photogrammetry. In the field, the electrodes were overlaid with white 10cm-diameter Styrofoam spheres and tracked in the stereophoto sequences through image processing of very-high resolution terrestrial photographs.

The acquisition profile (114 m long) is located in the most active part of the Super-Sauze landslide which is experiencing average velocities of 2 to 3 cm.day-1 with possible sudden acceleration (0.4 m to 2.0 m.day-1 as observed in 2008). The two cameras are spaced by 75 m which leads to a B/h ratio ranging between 1.6 and 2.1 according to the distribution of electrodes within the image plane The image processing is composed of 4 stages: (i) removal of the slow camera motion, (ii) identification of the electrodes in the 2D image planes; (iii) correction of the lens distortion; (iv) computation of 3D electrode location for each image pair; (v) computation of ERT profile displacement.

The method was applied on a serie of 17 photographs over a period of 29 days in June and July 2011. The displacements obtained from stereo-photogrammetry were compared to dGPS campaign measurements, and to the displacement monitored by a permanent GPS receiver.