



## **Landslide movement characterization using aerial digital photogrammetric techniques and LIDAR data. Application to the Diezma's landslide (Granada, SE. Spain)**

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Landslide movement characterization is a crucial aspect in the planning of corrective actions in order to minimize the associated risk to these natural hazards. Traditionally the characterization of this type of movements becomes established as from the design of geodetic deformation control network, that have associated an important economic cost, so much in its set-up like in the realization of the campaigns of control. For slides with an high to moderate activity, we presented a methodology based in the use combined of historical images, aerial photography of large-scale and a LIDAR campaign in order to obtain high quality geometric information about the terrain.

This methodology has been applied to the Diezma's landslide (Granada, SE Spain). This landslide is located in the neighborhood of A-92 highway. At 2001, a very important movement was produced and it affected of important form road traffic and that required accomplishing important works of reparation at the aforementioned roadway. The available information has consisted in two historic flights (1:6000 scale b/w flight, of date 1967 and 1989), previous to the construction of the highway (1992), and two actual flights accomplished in 2004 and 2005 (colour images with a 1:6000 scale, GSD=0.09m) for the characterization of zones that still they remain unstable at the zone. The information has completed with the realization of a LIDAR campaign that has provided a digital model of first-rate surfaces itself, so much in the density of information (with several points measured each square meter) like in the precision of the measure (with inferior errors to 0.07m in Z).

All the available photographs were digitalized using a Vexcel UltraScan5000 photogrammetric scanner in order to guarantee the geometric quality of the images and their orientation parameters have been obtained using a common coordinate reference system (using GPS control points). A very valuable information have been obtained from this process: a) geomorphological interpretation of the slope previous to the highway construction and ground leveling from the historical images; b) geomorphological interpretation of the evolution of the landslide at 2004 and 2005 years, obtaining very precise DEMs that provide the local movements by their subtraction; c) evaluation of the LIDAR information as a very useful instrument is order to obtain fast and precise DEMs in order to detect slope movements.

Using these informations several actives areas could be characterized and several movements that at a later time have manifested with geomorphological features (cracks) were detected.