INTEGRATING LIDAR AND TERRESTRIAL LASER SCANNING FOR A FULL AND RELIABLE DESCRIPTION OF LANDSLIDES GEOMORPHOLOGY

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A good and reliable description of the geomorphology of a landslide is a very important tool for geologists who can use the resulting Digital Terrain Model (DTM) to study and analyze the phenomenon itself along with the way it changes during time, the volumes transportation, the boundaries evolution and further interesting information by means of the comparison of a number of them. How can a good DTM be obtained? The fastest way to have a large amount of information is using a laser scanner which provides millions points to carefully describe a large area. Two are the available choices: LIght Detection And Ranging (LIDAR) and Terrestrial Laser Scanning (TLS). Which one should be chosen? Landslides often present a complex morphology and a wide extension so that it is not easy at all to perform the survey by means of TLS because the long-range type of laser is required in order to reduce the number of stations and to measure all the landslide. Choosing the LIDAR is the easiest solution for sure, anyway some problems exist, such as the bad resulting DTM when vertical walls of rock need to be surveyed. In this case, few points can be detected by the flying airborne, as a consequence a not reliable description of the wall and a not complete DTM result. The power of LIDAR methodology is highlighted when a large area is involved and/or when a lot of vegetation covers the area. This last feature should be carefully taken into account: the airborne laser scanner can easily reach the ground with respect to terrestrial laser scanner due to its vertical position of measurement and this allows a more reliable results. The last generation of terrestrial laser scanner have the skill to penetrate inside the vegetation thanks to a multi-echo technology, which is based on multiple answers depending on the detected object; the last one can be often intended as the ground itself.
The case study, which will be fully presented, is the Collagna Landslide that is located in the North Appennines (Reggio Emilia, Emilia Romagna – Italy). This landslide is made by both a rock vertical wall and a terrain covered by vegetation. According to the previous description, this is the perfect example for testing the integration of the two technologies: LIDAR will survey all the area, carefully describing the ground hidden by vegetation thanks to its vertical view, while TLS will provide a detailed description of the rock vertical wall thank to its frontal view. This mixed solution is the result of a complex process where each single technology was tested by itself confirming the previously stated limits. Finally, the integration appeared to be the best choice ever and, indeed, this is the case. All the problems and difficulties encountered will be fully described such as some filtering techniques tested to reduce the vegetation influence and detect the real ground, the influence of scanning angle and so on. One additional aspect to underline when performing the integration is the reference frame: TLS survey is referred to the centre of the instrument while the LIDAR one is usually referred to a global reference frame because of the on-board GPS (for Europe ETRF2000 is often chosen); data fusion requires a previous georeferencing of the TLS survey.