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Integration and comparison of different acquisition techniques for landslide monitoring: Cancia landslide case study

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Terrain instability, landslides and other phenomena mostly caused by hydrogeological risk, often cause damages to human infrastructures, roads and other transport lines: given the recent developments in surveying, electronics and mobile instrumentation, the quest for automated or semi-automated early warning systems is continuously increasing in order to provide reliable technological solutions to reduce risks for both human lives and human building and infrastructures.
This work deals with the monitoring a specific area of interest, a landslide located in Cancia (Belluno, Italy). This case study is characterized by the presence of several roads close to the landslide area: in particular, one of them intersects with the landslide. The closeness between landslide and human used areas (e.g. roads) motivate the interest of public authorities in order to reduce risks related to the landslide. To this aim, "Provincia di Belluno, Servizio Difesa del Suolo" actively contributed to this work by providing aerial imagery data of the region of interest.
Accessing a reliable reconstruction of certain landslides can be complex due to the difficulty for humans to reach certain areas: often only part of the area of interest can be acquired with highly accurate ground surveying (e.g. terrestrial laser scanning (TLS)), whereas other methods should be considered in order to obtain estimates of the remaining parts of the landslide. Recently, the spread of low cost drones is leading to a growing interest in the choice of unmanned aerial vehicles (UAVs) to acquire aerial imagery, hence enabling low cost photogrammetric reconstruction of the area. Despite being an attractive solution because of the clear convenience in terms of cost and acquisition time, its accuracy has typically not reached that of TLS surveying so far.
This paper considers the possibility of comparing and integrating different acquisition techniques (TLS, aerial and close-range photogrammetry) in order to reach the best reconstruction accuracy, wherever is possible, and investigates the possibility of enabling the development of appropriate warning systems based on measurements provided by the above mentioned acquisition approaches (in particular, low cost reconstruction systems are considered in order to deal with the quick detection of risky conditions).