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Ultra-high-resolution Digital Photogrammetry (DP) by Remote Piloted Aerial System (RPAS) for discontinuity detection and kinematic analysis of unstable rock slopes

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The discontinuity detection for the kinematic analysis of unstable rock slopes conducted by traditional field surveys (e.g. by compass-clinometer), terrestrial DP and laser scanner techniques often suffer of several limitations, such as the scarce presence of accessible outcrops for data acquisition, discontinuity orientation bias, discontinuity trace truncations and occlusions. Due to the possibility of the RPAS to move in different user-inaccessible positions, RPAS-DP can improve vertical rock slope stability analysis developing high-resolution (< 1 cm/pixel) Digital Outcrop Model (DOM) that fully represent the different geometry of the rock slope and its discontinuities. In fact, images acquired from different points of view can reduce the shadow areas that could not be investigated using only terrestrial solutions.
Moreover, RPAS-DP can dramatically increase the amount of the measures ensuring their replicability. From the RPAS-DP dataset, it is possible to know the exact position and dimension of all the measured discontinuities allowing to develop ad-hoc kinematic analyses of the different portions of the rock slope.

A complete RPAS-based workflow for the detection of the discontinuities affecting an unstable rock slope is proposed and applied to a near-vertical rock outcrop located near the village of Ormea (CN, Italy) in the Ligurian Alps. Different approaches of fracture detection (manual and automatics) are compared and evaluated in order to assess the correct workflow for the discontinuity determination and the kinematic analysis of the main failure mechanisms.