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High-resolution mobile mapping of slope stability with car- and UAV-borne InSAR systems

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Terrestrial radar interferometry (TRI) has become an operational tool to measure slope surface displacements [1,2]. The day-and-night and all-weather capability of TRI together with the ability to measure line-of-sight displacements in the range of sub-centimeter to sub-millimeter precision are strong assets that complement other geodetic measurement techniques and devices such as total stations, GNSS, terrestrial laser scanning, and close/mid-range photogrammetric techniques.

(Quasi-)stationary TRI systems are bound to relatively high frequencies (X- to Ku-band or even higher) to obtain reasonable spatial resolution in azimuth and yet the azimuth resolution is typically only in the order of tens of meters for range distances beyond a few kilometers. These aspects are limiting factors to obtain surface displacement maps at high spatial resolution for areas of interest at several kilometers distance and also for (slightly) vegetated slopes due to the fast temporal decorrelation at high frequencies.

Recently, we have implemented and demonstrated car-borne and UAV-borne repeat-pass interferometry-based mobile mapping of surface displacements with an in-house-developed compact L-band FMCW SAR system which we have deployed 1) on a car and 2) on VTOL UAVs (Scout B1-100 and Scout B-330) by Aeroscout GmbH [3,4]. The SAR imaging and interferometric data processing is performed directly in map coordinates using a time-domain back-projection (TDBP) approach [5,6] which precisely takes into account the 3-D acquisition geometry.

We have meanwhile further consolidated our experience with the repeat-pass SAR interferometry data acquisition, SAR imaging, interferometric

processing, and surface displacement mapping using the car-borne and UAV-borne

implementations of our InSAR system based on a number of repeat-pass interferometry campaigns. In our contribution, we present the capabilities of this new InSAR-based mobile mapping system and we discuss the lessons learned from our measurement campaigns.

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