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Implementation and testing of the second generation portable radar interferometer GPRI-II

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Satellite interferometry has been used extensively for ground-motion monitoring with good success. In the case of landslides space-borne SAR (Synthetic Aperture Radar) interferometry has shown good potential to obtain an overview of slope stability. Furthermore, relatively slow, temporally uniform movements can be quantitatively monitored from space. Of particular interest is the two dimensional coverage potentially achieved and that there are rich data archives readily available to be explored for the time after 1991. The results achieved have caught the interest of a relatively wide user community involved in a broad range of applications. Nevertheless, some important requirements cannot be met by satellite SAR interferometry. Given the typical multiple-week repeat-interval, uncertainties related to data availability and delays in receiving data in a timely manner, as well as limitations related to the SAR imaging geometry, signal decorelation and other problems render the technique inappropriate for applications requiring short period acquisitions, high spatial resolution and sensitivity, typically required for landslide monitoring and early warning.

In recent years, ground-based SAR instruments demonstrated a good potential for deformation mapping and monitoring. An important aspect is that ground-based instruments can be used more specifically to monitor landslides, rock falls, or infrastructure than space-borne systems. The observation geometry and observation times can more freely be selected and can be used to optimize the measurements for the specific case. The ground-based radar instruments are also quite complementary to ground-based laser scanners. Strengths of the radar systems can measure up to several km in distance and have high sensitivity for measuring movement. Another important advantage is that the correspondence of repeat measurements is very well controlled through the coherence of the interferograms.

Considering this potential a ground-based radar system (GPRI) was developed, which incorporates a number of new innovative concepts for performance optimization. As an alternative to ground-based SAR, real aperture radar (RAR) technology was implemented which has the following advantages:
- Better focused images (no decorelation during acquisition time).
- Coverage of a wide view angle in a single image, 360° possible.
- Reduction of image acquisition time.
- Direct measurement of topography, (for use in geo-referencing).
- Fully portable system for rapid deployment and use in inaccessible areas.

The GPRI-I prototype system has been advanced into a new generation with a variety of improvements making it a robust and reliable instrument. Significant developments include greater weather resistance, better stability in windy conditions, autonomous operation at temperatures between -30° and + 45° C over long-periods, a very fast image acquisition (a few seconds for a 180° scan), improved antenna design and a built-in GPS disciplined oscillator providing timing and frequency reference so that multiple radars can make quasi-simultaneous measurements. Another important aspect of the project is the testing of the new instrument for different fields of applications. The development is supported through the Swiss initiative to foster and promote Swiss scientific and technological competences related to space activities by the Swiss Space Office of the Swiss State Secretariat for Education and Research.

In our presentation we will discuss the new GPRI-II system together with results gained from test campaigns on natural targets and infrastructure.