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Terrestrial Radar Interferometry: The current state-of-the-art demonstrated by real-world slope stability case studies

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Risk associated with natural terrain is typically mapped and monitored using established geodetic, geotechnical and remote sensing (satellite and airborne) techniques; however such techniques can pose challenges related to health and safety, cost and the density and frequency of measurements.

Terrestrial Radar Interferometry (TRI) systems offer users new capabilities in the mapping and monitoring of ground displacements, and more specifically, slope stability. Use of portable radar systems that facilitate quick deployment and data acquisition, rapid and long distance scanning, and the ability to function and operate in most weather conditions, are revolutionising the terrestrial survey industry.

This work presents a summary of the capabilities, limitations and applications of a state-of-the-art TRI system. The system is quick to deploy, allowing data acquisition within tens of minutes of arrival on site and requiring little or no permanent site infrastructure. Imaging scans are typically completed in less than 1 minute for a field of view of up to 360°, with repeat scans possible at up to 1-2 minute intervals. The system gives an azimuth resolution of around 8 m at distances of 1 km, with the capability to image slopes at distances of between 50 m and 10 km from the sensor with a deformation accuracy of less than 1 mm. These capabilities represent a significant advance over more traditional stability monitoring methods.

The benefits of the TRI technology will be demonstrated through various natural and artificial slope stability case studies. Measurements on artificial slopes in environments such as quarries and open-cast mines allow benchmarking of capabilities across a variety of surface characteristics and failure mechanisms. These results allow an informed consideration of the applicability in various natural slope stability applications, and enable discussion on how TRI can meet the additional challenges encountered in natural environments.