Terrestrial radar for deformation monitoring

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Water multipath effect in Terrestrial Radar Interferometry (TRI) in open-pit mine monitoring

Terrestrial Radar Interferometry (TRI) has established as the reference technology for slope monitoring in the open-pit mining sector. Along with the many benefits this technique provides, there remain some limitations that have not yet been fully resolved by current technology. One of the most curious disturbance factors, is signal interference caused by the reflection of the electromagnetic waves on a water surface. This phenomenon is well known in radio communications and is called multipath propagation. The presence of multipath effects in open-pit mining is not uncommon due to the presence of ponds at the bottom of the pit. In this context, a simulation algorithm has been developed for the evaluation of TRI water multipath, to be able to predict its presence and help monitoring campaign planning. In this work the general characteristics of TRI water multipath are described together with standard mitigation techniques. Furthermore, the simulation algorithm is presented and its application to some real case study is discussed.

Keywords: Terrestrial Radar Interferometry, Open-pit mining, Multipath, Interference, Simulation

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Appropriate strategy for GB-RAR measurements - One radar is not sufficient

Over the past 10 years, ground-based radar interferometry has become a frequently used technology for determining dynamic deflections of bridge structures induced by vehicle passages. When measuring with only one radar device, the so-called Interpretation Error (EI) considerably rises. When using two radars, it is possible to simultaneously determine, for example, vertical and longitudinal displacements and to eliminate the Interpretation Error. The aim of the article is to inform about a suitable strategy for determining dynamic and quasi-static response of bridge structures based on the accuracy analysis of measurement by two radars. The necessary the-

ory for displacements determination by means of two radar devices is presented. This is followed by an analysis of errors when measuring with only one radar. The accuracy of the resulting displacements by simultaneous measurement with two radars is also mentioned. The practical example of bridge structure displacements determination by measuring with two radar devices in the field is presented. The key contribution of the paper is the possibility to estimate and plan in advance the achievable accuracy of the resulting displacements for the given radar configurations in relation to the bridge structure.

Keywords: Interferometric radar; GB-RAR, Remote measurements, Bridge monitoring, Dynamic vertical and horizontal displacements, Measurement accuracy analysis

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Ground-based InSAR and GNSS integration for enhanced dam monitoring

The monitoring of dams is essential to ensure their safe operation for the production of renewable energy. Common tools to monitor dams are permanently installed plumblines and surveying by means of total station and levelling within a geodetic network. The major lack of these methods is respectively the spatial and temporal resolution. Recent studies with Ground-Based InSAR have shown promising results to be used for geodetic dam monitoring. The fast acquisition speed combined with the surface monitoring capabilities enable to monitor several hundreds to thousands of points on the dam every day or several times a day. However, GB-SAR is a relative phase-measurement technique, and any interruption in the data acquisition leads to difficulties to unwrap differential phase observations and join the disjunct time series. The combination with other absolute measurement tools is promising to create an absolute deformation map of the dam. GNSS is a very efficient and reliable method providing point-wise absolute displacement time series and mm-accuracy. This paper proposes a combination of GNSS and GB-SAR observations to enhance the consistency of the surface-based dam displacement maps obtained by solely GB-SAR measurements.

Keywords: GB-SAR, InSAR, GNSS, Dam, Monitoring