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Monitoring of Airport Runways by Satellite-based Remote Sensing Techniques: a Geostatistical Analysis on Sentinel 1 SAR Data

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Maintenance of airport runways is crucial to comply with strict safety requirements for airport operations and air traffic management [1]. Therefore, monitoring pavement surface defects and irregularities with a high temporal frequency, accuracy and spatial density of information becomes strategic in airport asset management [2-3]. In this context, Multi-Temporal Interferometric Synthetic Aperture Radar (MT-InSAR) techniques are gaining momentum in the assessment and health monitoring of infrastructure assets, proving their viability for the long-term evaluation of ground scatterers. However, the implementation of C-band SAR data as a routine tool in Airport Pavement Management Systems (APMSs) for the accurate measurement of differential displacements on runways is still an open challenge [4]. This research aims to demonstrate the viability of using medium-resolution (C-band) SAR products and their contribution to improve current maintenance strategies in case of localised foundation settlements in airport runways. To this purpose, Sentinel-1A SAR products, available through the European Space Agency (ESA) Copernicus Program, were acquired and processed to monitor displacements on "Runway n.3" of the "L. Da Vinci International Airport" in Fiumicino, Rome, Italy.A geostatistical study is performed for exploring the spatial data structure and for the interpolation of the Sentinel-1A SAR data in correspondence of ground control points.The analysis provided ample information on the spatial continuity of the Sentinel 1 data, also in comparison with the high-resolution COSMO-SkyMed and the ground-based topographic levelling data, taken as the benchmark.Furthermore, a comparison between the MT-InSAR outcomes from the Sentinel-1A SAR data, interpolated by means of Ordinary Kriging, and the ground-truth topographic levelling data demonstrated the accuracy of the Sentinel 1 data. Results support the effectiveness of using medium-resolution InSAR data as a continuous and long-term routine monitoring tool for millimetre-scale displacements in airport runways. Outcomes of this study can pave the way for the development of more efficient and sustainable maintenance strategies for inclusion in next-generation APMSs.

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