

UWL REPOSITORY
repository.uwl.ac.uk

Monitoring of airport runways by satellite-based remote sensing techniques: a geostatistical analysis on sentinel 1 SAR data

Gagliardi, Valerio, Trevisani, Sebastiano, Bianchini Ciampoli, Luca, D'Amico, Fabrizio, Alani, Amir, Benedetto, Andrea and Tosti, Fabio ORCID: <https://orcid.org/0000-0003-0291-9937> (2022)

Monitoring of airport runways by satellite-based remote sensing techniques: a geostatistical analysis on sentinel 1 SAR data. In: EGU General Assembly 2022, 23-27 May 2022, Vienna, Austria.

<http://dx.doi.org/10.5194/egusphere-egu22-2533>

This is the Accepted Version of the final output.

UWL repository link: <https://repository.uwl.ac.uk/id/eprint/8875/>

Alternative formats: If you require this document in an alternative format, please contact: open.research@uwl.ac.uk

Copyright: Creative Commons: Attribution 4.0

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy: If you believe that this document breaches copyright, please contact us at open.research@uwl.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

EGU22-2533

EGU General Assembly 2022

© Author(s) 2022. This work is distributed under the Creative Commons Attribution 4.0 License.



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

Valerio Gagliardi¹, Sebastiano Trevisani², Luca Bianchini Ciampoli¹, Fabrizio D'Amico¹, Amir M. Alani³, Andrea Benedetto¹, and Fabio Tosti³

¹Roma Tre University, Department of Engineering, Via Vito Volterra 62, 00146, Rome, Italy (valerio.gagliardi@uniroma3.it)

²University IUAV of Venice, Dorsoduro 2206, 30123 Venezia, Italy

³School of Computing and Engineering, University of West London (UWL), St Mary's Road, Ealing, London W5 5RF, UK

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.

Acknowledgments and fundings: The authors acknowledge the European Space Agency (ESA), for providing the Sentinel 1 SAR products for the development of this research. The COSMO-SkyMed Products—©ASI (Italian Space Agency)- are delivered by ASI under the license to use. This research falls within the National Project "EXTRA TN", PRIN 2017, supported by MIUR. The authors acknowledge funding from the MIUR, in the frame of the "Departments of Excellence Initiative

2018–2022”, attributed to the Department of Engineering of Roma Tre University

References

- [1]Gagliardi V., Bianchini Ciampoli L., D'Amico F., Tosti F., Alani A. and Benedetto A. “A Novel Geo-Statistical Approach for Transport Infrastructure Network Monitoring by Persistent Scatterer Interferometry (PSI)”. In: 2020 IEEE Radar Conference, Florence, Italy, 2020, pp. 1-6
- [2]Gagliardi V, Bianchini Ciampoli L, Trevisani S, D'Amico F, Alani AM, Benedetto A, Tosti F. "Testing Sentinel-1 SAR Interferometry Data for Airport Runway Monitoring: A Geostatistical Analysis". 2021; 21(17):5769. <https://doi.org/10.3390/s21175769>
- [3]Gao, M.; Gong, H.; Chen, B.; Zhou, C.; Chen, W.; Liang, Y.; Shi, M.; Si, Y. "InSAR time-series investigation of long-term ground displacement at Beijing Capital International Airport, China". *Tectonophysics* 2016, 691, 271–281.
- [4]Department of Transportation Federal Aviation Administration (FAA), Advisory Circular 150/5320-6F, Airport Pavement Design and Evaluation, 2016