



UWL REPOSITORY

repository.uwl.ac.uk

Bridge monitoring and deformation time-series analysis by high-resolution
Multi-Temporal SAR Interferometry (MT-InSAR)

Gagliardi, Valerio, Bianchini Ciampoli, Luca, Alani, Amir, Tosti, Fabio ORCID logoORCID:
<https://orcid.org/0000-0003-0291-9937> and Benedetto, Andrea (2021) Bridge monitoring and
deformation time-series analysis by high-resolution Multi-Temporal SAR Interferometry (MT-
InSAR). In: EGU General Assembly 2021, 19-30 Apr 2021, Online event.

This is the Accepted Version of the final output.

UWL repository link: <https://repository.uwl.ac.uk/id/eprint/7648/>

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.

EGU21-15147

EGU General Assembly 2021

© Author(s) 2021. This work is distributed under the Creative Commons Attribution 4.0 License.



Bridge monitoring and deformation time-series analysis by high-resolution Multi-Temporal SAR Interferometry (MT-InSAR)

Valerio Gagliardi¹, Luca Bianchini Ciampoli¹, Amir Alani², Fabio Tosti², and Andrea Benedetto¹

¹Roma Tre University, Department of Engineering, Rome, Italy (valerio.gagliardi@uniroma3.it)

²University of West London (UWL), School of Computing and Engineering, London, United Kingdom

Multi-temporal Interferometric Synthetic Aperture Radar (InSAR) is a space-borne monitoring technique capable of detecting cumulative surface displacements with millimeter accuracy in the Line of Sight (LOS) of the radar sensor [1-3]. Several developments in the processing methods and the increasing availability of SAR datasets from different satellite missions, have proven the viability of this technique in the near-real-time assessment of bridges and the health monitoring of transport infrastructures [2-4].

This research aims to demonstrate the potential of satellite-based remote sensing techniques as an innovative health-monitoring method for structural assessment of bridges and the prevention of damages by structural subsidence, using high-resolution SAR datasets integrated with complementary Ground-Based (GB) Non-Destructive Testing (NDT) techniques. To this purpose, high-resolution COSMO-SkyMed (CSK) products provided by the Italian Space Agency (ASI) were acquired and processed.

In particular, a multi-temporal InSAR analysis was developed to identify and monitor the structural displacements of the Rochester Bridge, located in Rochester, Kent, UK. To this extent, a clustering operation is realised to collect the identified Persistent Scatterers (PSs) over the structural elements of the bridge (i.e., bridge piers and arcs). Furthermore, several sub-clusters with a comparable deformation trend were identified and located over the bridge elements. This operation paves the way for an automatisisation of the process through a Machine Learning (ML) clustering algorithms to assign each PS data-point to specific groups, based on the structural element type and the trend of seasonal deformation time-series.

The outcomes of this study demonstrate how multi-temporal InSAR remote sensing techniques can be synergistically applied to complement non-destructive ground-based analyses, paving the way for future integrated methodologies in the monitoring of infrastructure assets.

Acknowledgments: The authors want to acknowledge the Italian Space Agency (ASI) for providing the COSMO-SkyMed Products® (©ASI, 2017-2019), in the framework of the ASI-Open Call Project “MoTIB, ID 742” accepted by ASI. In addition, the authors would like to acknowledge the Rochester Bridge Trust for facilitating and supporting this research. This research is supported by the Italian Ministry of Education, University and Research under the National Project “EXTRA TN”, PRIN 2017, Prot. 20179BP4SM.

References

- [1] Alani A. M., Tosti F., Bianchini Ciampoli L., Gagliardi V., Benedetto A., Integration of GPR and InSAR methods for the health monitoring of masonry arch bridges. NDT&E International. (2020)
- [2] Gagliardi V., Bianchini Ciampoli L., D'Amico F., Alani A. M., Tosti F., Battagliere M. L., Benedetto A., Bridge monitoring and assessment by high-resolution satellite remote sensing technologies, Proc. SPIE 11525, SPIE Future Sensing Technologies. 2020. doi: 10.1117/12.2579700
- [3] Selvakumaran, S., Plank, S., Geiß, C., Rossi, C., Middleton, C. (2018). Remote monitoring to predict bridge scour failure using Interferometric Synthetic Aperture Radar (InSAR) stacking techniques, Int. J. .Appl. Earth Obs. and Geoinf. 73, 463-470.
- [4] Qin X, Liao M., Zhang L., & Yang M., Structural Health and Stability Assessment of High-Speed Railways via Thermal Dilation Mapping with Time-Series InSAR Analysis. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing