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Monitoring of Bridges by Satellite Remote Sensing Using Multi-Source and Multi-Resolution Data Integration Techniques: a Case Study of the Rochester Bridge

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Monitoring of bridges and viaducts has become a priority for asset owners due to progressive infrastructure ageing and its impact on safety and management costs. Advancement in data processing and interpretation methods and the accessibility of Synthetic Aperture Radar (SAR) datasets from different satellite missions have contributed to raise interest for use of near-real-time bridge assessment methods. In this context, the Multi-temporal Interferometric Synthetic Aperture Radar (MT-InSAR) space-borne monitoring technique has proven to be effective for detection of cumulative surface displacements with a millimetre accuracy [1-3].

This research aims to investigate the viability of using satellite remote sensing for structural assessment of the Rochester Bridge in Rochester, Kent, UK. To this purpose, high-resolution SAR datasets are used as the reference information and complemented by additional data from different sensing technologies (e.g., medium-resolution SAR datasets and ground-based (GB) non-destructive testing (NDT)). In detail, high-resolution SAR products of the COSMO-SkyMed (CSK) mission (2017-2019) provided by the Italian Space Agency (ASI) in the framework of the Project "Motib - ID 742", approved by ASI, are processed using a MT-InSAR approach.

The method allowed to identify several Persistent Scatterers (PSs) – which have been associated to different structural elements (e.g., the bridges piers) over the four main bridge decks – and monitor bridge displacements during the observation time. The outcomes of this study demonstrate that information from the use of high-resolution InSAR data can be successfully integrated to datasets of different resolution, scale and source technology. Compared to stand-alone technologies, a main advantage of the proposed approach is in the provision of a fully-comprehensive (i.e., surface and subsurface) and dense array of information with a larger spatial coverage and a higher time acquisition frequency. This results in a more effective identification and monitoring of decays at reduced costs, paving the way for implementation into next generation Bridge Management Systems (BMSs).

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References

[1] 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: 1117/12.2579700

[2] Jung, J.; Kim, D.-j.; Palanisamy Vadivel, S.K.; Yun, S.-H. "Long-Term Deflection Monitoring for Bridges Using X and C-Band Time-Series SAR Interferometry". Remote Sens. 2019

[3] 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, doi: 10.1109/RadarConf2043947.2020.9266336