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# The use of InSAR for identifying potential geotechnical hazards and establishing a baseline for urban tunnelling in London

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Interferometric Synthetic Aperture Radar (InSAR) is increasingly becoming a commonly used tool for monitoring ground surface motion at construction projects in urban areas. This research builds on the success of InSAR used as a monitoring tool during and post-construction on the Crossrail project in London [1, 2].

Persistent Scatterer Interferometry (PSI) provides a high density of measurement points in urban environments, over a large area and long-time span and is proving to be a useful tool throughout all stages of the construction project. Prior to construction, areas of unstable ground have been identified and dewatering patterns have revealed geological faults, aiding the geotechnical investigation. Displacement in InSAR is measured along the satellite line-of-sight; a vertical and horizontal component can therefore be extracted from ascending and descending orbital geometries, facilitating the distinction of, for example, geological fault driven movement, from aquifer recharge.

The focus area for this research is the East section of the Thames Tideway Tunnel; a major ongoing tunnelling project in London, designed to tackle the problem of overflowing Victorian sewers. The tunnel is 7 m in diameter, 25 km in length and runs from Acton in West London to Abbey Mills in East London. The East section has two parts, the main tunnel which leaves the line of the Thames at Bermondsey and runs north-east to meet the Lee Tunnel at Abbey Mills and the Greenwich Connection Tunnel. Tunnelling of the East section is due to begin in January 2020.

Corner reflectors, which reflect radar signals back to the satellite with a particularly strong and recognisable pattern, have been stationed both along the line of the tunnel and at secondary schools elsewhere in London to 'ground-truth' the data. Three years of Sentinel-1 and TerraSAR-X (TSX) have been processed to establish a baseline prior to tunnelling and these results have been integrated and compared with the ground-based measurement network. Sentinel-1 data were processed in ENVI SARscape; TSX data are provided by Sixense.

The potential benefits of the use of InSAR during pre-construction, to identify geotechnical hazards and establish a baseline, has been demonstrated by this study.

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2. Robles, J.G., M. Black, and B. Gomar, Correlation Study between In-Situ Auscultation and Satellite Interferometry for the Assessment of Nonlinear Ground Motion on Crossrail London; Crossrail Learning Legacy Report. Crossrail Learning Legacy Report: London, UK, 2016.