MANAGING MOVING MONUMENTS

USING MODERN TECHNOLOGIES TO SAFEGUARD THE CADASTRE

Ground deformation directly impacts physical survey marks and monuments, in turn causing problems for surveyors trying to use these marks. The uncertainty surrounding mark movement has long plagued the surveying industry, requiring a reliable yet accessible solution.

This was addressed by the author's undergraduate honours research thesis, undertaken at UNSW and supervised by Dr. Craig Roberts, which received the 2023 EISSI University Student of the Year award. The project sought to investigate the effectiveness and practicality of modern measurement techniques for large-scale ground monitoring across Australia in an attempt to increase the certainty of identifying mark movement.

Specifically, public pre-processed InSAR data from Geoscience Australia was analysed and compared against surface velocities determined using GNSS positioning and differential levelling. A critical factor of the study was to only consider publicly available datasets and methods, to ensure they were affordable and accessible to all surveyors.

Using a subsidence-affected area in NSW's Southern Coalfield as a case study, positional changes of survey marks in and around the area were identified using the methods mentioned. The survey marks in question were overlayed onto the InSAR product, i.e. an array of 50 m x 50 m pixels, each with a unique displacement velocity in either the up-down or east-west direction.

The pixels intersected by the overlayed survey marks were adopted to represent the nature of the ground movement at that point, as determined by InSAR. Velocities were also calculated for each survey mark using values from a traditional ground-based survey in 2018 and from each mark's recent attributes in SCIMS. A direct comparison was then made between the InSAR velocities and the ground-based velocities.

The ground-based velocities were used as the controlling variable, as their surveyed values were known to be accurate. Contrasting the derived InSAR velocities against these values provided mixed results. The magnitude of the InSAR values – the amount of deformation either vertically or horizontally – generally showed little correlation to the ground-based values.

However, the determined direction of the ground movement – being either up or down, or east or west – was fairly consistent between all methods. The vertical values were particularly accurate, supporting the notion that InSAR is generally stronger in the vertical than the horizontal component.

Whilst there were some limitations in the design of the study, it was generally successful in satisfying the aim of the project, which was to test the accuracy and practicality of publicly available datasets for the benefit of all practising surveyors. The study proved that generic InSAR datasets can provide surveyors with an intuitive resource of adequate quality to support their planning and in turn their conclusions when attempting to prove that mark movement has occurred.

Importantly, this project enabled collaboration between cadastral, geodetic and geospatial experts, which will help to further bridge the gap between these once distant fields. For those seeking further information, a paper will be published in the proceedings of the APAS2024 conference in late March.

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Example of survey marks measured using static GNSS, overlayed onto the vertical InSAR velocity product.