AIPLAN: Infrastructure Monitoring through AI-Integrated Geospatial Solutions

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SUMMARY

In today's landscape, both natural and man-made features are highly sensitive to millimetric perturbations resulting from land deformation and daily operational activities. However, continuous, automated, and remote monitoring systems addressing these perturbations remain largely unavailable or too costly for widespread implementation. The innovation of the AIPLAN system marks a pivotal step towards filling this gap in the market, specifically aimed at safeguarding critical infrastructure.

AIPLAN is an amalgamation of knowledge and expertise across various technology domains. By integrating established technologies like geodetic engineering, Global Navigation Satellite Systems (GNSS), and Synthetic Aperture Radar (SAR) for land deformation, it promises substantial advantages across industries such as surveying, infrastructure monitoring, and environmental observation. The team at Geomatic Ventures Limited (GVL) has significantly advanced GNSS and SAR measurements through renowned projects like GeoSHM (ESA), ISHM, EOSCANS (InnovateUK), and Monitoring UK Critical National Infrastructure (UKSA). The ongoing R&D focuses on refining a cloud-based platform housing algorithms for Real-Time Kinematic (RTK) to ensure high-precision deformation measurements and employing AI/ML analysis for comprehensive 'big data' processing sourced from both GNSS and Earth Observation (EO).

The key novelty of AIPLAN is not only the fusion of technologies but also the development of a deployable system that utilizes data from low-cost GNSS devices, a departure from expensive geodetic survey instruments. The AIPLAN device comprises a compact, cost-effective, high-precision multi-sensor GNSS receiver package, integrating bespoke control boards, multi-constellation GNSS chipsets, Inertial Motion Units, and IoT modules. It is tailored as a survey and monitoring tool, finely tuned to measure sub-centimetre movements and vibrations in various

modes, including RTK and NetworkRTK.

Additionally, the project involves the research and development of a machine learning system, merging low-cost, low-power GNSS devices utilising L1/L5 signals with InSAR corner reflectors to measure surface deformation at fixed points. Calibration, achieved through various instruments and infrastructure, is pivotal for AI algorithm training and will be executed with corner reflectors, GNSS survey control markers, and geodetic-grade GNSS receivers.

The prototype will be deployed at a test site with the leadership of SME GVL. The entire project is structured to last 18 months, spanning across five work packages, culminating in thorough testing and validation to place AIPLAN as a cutting-edge solution in infrastructure monitoring and protection. This includes trailing monitoring scenarios in railway tracks, landslide-prone areas near infrastructure, and controlled sites with minimal known movement.