Structural Health Monitoring with GNSS and IMU Technology: Precision Solutions for Modern Infrastructure

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SUMMARY

Monitoring buildings, structures, and bridges is essential to ensure their safety and longevity. Advances in GNSS (Global Navigation Satellite Systems) and IMU (Inertial Measurement Units) technology offer new possibilities for precise and efficient tracking of structural movements and deformations. Our research focuses on integrating GNSS and IMU systems to provide a comprehensive understanding of deformations and dynamic loads.

GNSS delivers highly accurate monitoring of long-term movements and absolute positional changes, while IMUs capture rapid shifts and subtle vibrations in real time. Combining these technologies enables seamless coverage of spatially and temporally varying deformation patterns. This hybrid approach is particularly beneficial in challenging environments, such as urban areas or remote locations.

Our work involves the development and validation of a hybrid monitoring system that leverages the strengths of both technologies. We address challenges such as signal interference, multipath effects, and sensor drift. Initial results demonstrate that our system can detect movements with millimeter-level precision and provide reliable data even under adverse conditions.

The applications of this technology are wide-ranging: from monitoring the stability of historical buildings and detecting stresses on bridges to providing early warnings of potential structural failures. This approach not only delivers valuable data for maintenance but also helps reduce costs and enhance safety.

Our presentation explores the technical foundations, practical challenges, and vast potential of this technology. It offers insights into innovative methods for infrastructure monitoring and

demonstrates how GNSS and IMU technologies, working together, can set new standards in structural health monitoring.