1. **Large-scale Literature Survey:** Following the PRISMA-ScR workflow, the authors filtered 522 high-quality studies published from 2006 to 2025. Trend analysis shows that InSAR- and UAV-based monitoring progressed from niche pilots to mainstream solutions, with research interests shifting from single-scenario setups to multi-scenario fusion.
2. **“Sensor Principle–Performance” Matrix & Six Key Metrics:** A matrix linking physical principles to performance dimensions—accuracy, spatial coverage, latency, cost, etc.—is constructed. Multi-objective optimisation indicates that a tri-modal configuration of satellite InSAR + UAV LiDAR + robotic total station maintains wall-top displacement prediction errors within ±2 mm while lowering life-cycle monitoring costs by over 40 %.
3. **Panoramic Review of Eight Data-Fusion Strategies:** The paper categorises and evaluates eight mainstream multisource fusion approaches—including Kalman filtering, Bayesian updating, D-S evidence theory, deep learning, and geostatistical interpolation—highlighting their robustness to missing data, real-time capability, and decision-support integration.
4. **Empirical Validation via Three International Case Studies:** Comparative analyses of the Shenzhen subway station, Naples airport link tunnel, and London Crossrail projects demonstrate that tri-modal SAG systems confine 24-h displacement prediction errors to ±2–3 mm and reduce monitoring budgets by roughly one-third.
5. **Edge–Cloud Collaborative Closed-Loop Data Pipeline:** A four-layer pipeline—edge acquisition, secure backhaul, cloud storage/BIM integration, and visual alarm—cuts end-to-end feedback latency to 7–8 minutes under 5 G connectivity, meeting the 30-minute early-warning window required by GB 50497-2019 and CIRIA C760.
6. **Future Challenges & Trends:** The authors identify bottlenecks in sensor occlusion, cross-platform calibration, real-time processing of heterogeneous big data, and cybersecurity. They advocate adaptive, autonomous monitoring architectures and encrypted edge–cloud collaboration algorithms to underpin digital-twin-driven construction and operations.