Worried about AI Hallucinations? What about Human Hallucinations? - Addressing the data acquisition challenges in the emerging AI paradigm

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SUMMARY

This paper demonstrates how Discrete Global Grid Systems (DGGS) technology can revolutionize Urban Digital Twin development through enhanced data integration and analysis capabilities. Our research presents the successful implementation of TerraNexus, a semantically-enabled 3D/4D DGGS platform that achieves seamless urban data interoperability without compromising data integrity or requiring complex spatial transformations. The platform's data-agnostic architecture integrates diverse urban datasets, including building information models, infrastructure networks, environmental sensors, and socio-economic indicators. By leveraging OGC standards, including the Abstract Specification Topic 21 and the OGC API DGGS, our implementation provides a standardized framework for urban data integration. The fourth dimension (4D) capabilities enable temporal analysis of urban dynamics, essential for understanding city evolution and planning future developments. Our research demonstrates that DGGS technologies effectively address the challenges of integrating multiple urban datasets with varying spatial and temporal resolutions. The platform's semantic enablement facilitates efficient data discovery and analysis across different urban systems and administrative boundaries. This implementation showcases significant improvements in urban data integration efficiency and enhanced analytical capabilities, successfully handling complex spatial-temporal queries while maintaining data integrity and supporting AI-driven urban analytics. Key innovations include seamless integration of multi-resolution 3D city models with real-time sensor data, temporal analysis capabilities for urban change detection, semantic enrichment of urban data, and comprehensive workflow provenance supporting decision-making transparency. This research contributes significantly to Urban Digital Twin technology advancement by providing a scalable, sustainable solution for urban data integration. The findings have immediate practical applications for smart city initiatives, urban planning, and infrastructure management, while establishing a foundation for future DGGS-based Urban Digital Twin implementations. Our work advances the

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standardization of these technologies within the geospatial community and provides valuable insights for organizations developing digital twin initiatives.