Advancing National Spatial Infrastructure for Sustained Digital Twin

Jernej Tekavec, Katja Sustersic, Vid Jakopin and Anka Lisec (Slovenia)

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SUMMARY

This research aims to describe the collaborative research efforts in designing a modern framework for implementation of national spatial data infrastructure as the basis for a modern Digital Twin. Motivation of the work stems from recent advancements in remote sensing technologies and available nation-wide datasets, as well as advancements in 3D topographic modelling. The approach is based on programs of cyclical Photogrammetric and LiDAR data collection campaigns done by GURS (National geodetic authority of Republic of Slovenia) by establishing a systematic and automated production pipeline of 3D topographic data that can serve as the backbone of a modern 3D digital twin environment. Procedures for establishing such modelling pipeline are explained in detail. Furthermore, the research work expands upon the critical aspects of geo-processing, real-time data integration, simulation, visualization and data distribution functionalities as core components of digital twin architecture. These functionalities are based on the topographic system's modelled environment and explore their core features required for down-stream applications. The paper presents fundamental concepts by explaining the technological aspects and data architecture that enable the development of a national digital twin. It emphasizes the use of cyclic multi-source (LiDAR and Photogrammetric) geospatial data and their role for reconstruction of 3D topography which serves as the basis of any spatial digital twin environment upon which later processing, simulation, visualization and data distribution functionalities can be established. The methodology of a national topographic 3D modelling based on cyclical nation-wide remote sensing data is presented in detail. It outlines core features of such approach which includes automated production pipeline, data homogeneity, CityGML standard compatibility, approaches to dataset updates for sustained up-to-date representation and management of spatio-temporal dynamics. Furthermore, main digital twin functional components (geo-processing, simulation, visualization and data distribution) for down-stream applications and user interactions are presented. The paper concludes with the list of most common and foreseen

use-cases that can be supported by implementation of the presented digital twin architecture and functionalities.