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Request for Information on the National Digital Twins R&D Strategic Plan

Dr. Mina Sarpi, UTC Professor and Director of the UTC Research Institute

Mr. Charlie Brock, President and CEO of the Chattanooga Quantum Collaborative

The University of Tennessee at Chattanooga (UTC) Response

Ecosystem, International, Artificial Intelligence, Data

The Research Institute at UTC - https://www.utc.edu/research/research-institute - manages and continues to develop a large urban testbed (100+ signalized, instrumented and connected intersections) for connected and automated vehicles. An expanding Digital Twin (DT) for a 2km corridor is part of the infrastructure.

The US DOE, DOT, DOC, NSF and other agencies have been supporting R&D in Chattanooga performed by UTC, by Oak Ridge National Laboratory, and by the Electric Power Board (EPB) the City owned electric utility and communications company.

In the course of this work, several accomplishments involved the development of DTs of key infrastructure assets, such as transportation and energy. The research team is the expanding Digital Twin (DT) for a 2km corridor, a key piece of infrastructure through advanced simulation technologies like VISSIM and CARLA. VISSIM, a sophisticated traffic simulation software, models detailed traffic dynamics, signal operations, and vehicular interactions. When combined with Unreal Engine, these simulations are visualized within a high-fidelity, immersive 3D environment. Unreal Engine's realistic mapping and visualization capabilities enhance the user experience, making it easier for planners and stakeholders to comprehend and interact with complex traffic scenarios.

CARLA, an open-source autonomous driving simulator, adds another supportive layer to digital twin models. It focuses on simulating autonomous vehicle behavior and processing sensor data, enabling detailed testing and validation of autonomous driving algorithms. CARLA's co-simulation capability with both VISSIM and Unreal Engine to create realistic driving scenarios that include interactions between autonomous and human-driven vehicles. Together, these developed tools enable the creation of dynamic and accurate digital twins that reflect real-world conditions, supporting research, development, and deployment of advanced transportation solutions.

Similar efforts have been done for the energy sector. Majority of these efforts have been on pseudo digital twin that uses historical data. The future efforts need to include several enhancements: 1) integrated digital twin that includes transportation and energy; 2) real-time and adaptable such digital twins. Making these interconnected digital twins will enable to address the challenges from a system-of-system approach and enabling them to adapt to real-time real-world data enhances their accuracy and reliability. Furthermore, these enhancements will allow for real-time decision making that will effectively bridge the physical and digital worlds.

Chattanooga has been a paradigm for urban renewal, and is recognized widely as the first US city deploying a fiber optic communications network, which generated $2.7B in economic value over a decade (https://cities-today.com/chattanoogas-municipal-broadband-pays-off-with-2-69-billion-in-benefits/). These efforts have also resulted in the deployment of phase I of a commercial quantum network - https://quantum.epb.com/. This ecosystem is now working to create a quantum-ready environment (https://www.chattanoogaquantum.com/).

Developments of dynamic, adaptable, and interconnected digital twins are becoming an integral part of these activities. The expertise, capabilities and infrastructure assets in Chattanooga can be leveraged to inform the development of the National Digital Twins R&D Strategic Plan.

Chattanooga Points of Contact:
Dr. Mina Sartipi, UTC Professor and Director of the UTC Research Institute
Mr. Charlie Brock, President and CEO of the Chattanooga Quantum Collaborative