Impact, Applicability, and User Experience Statement of ClickDT

Yiming Li, Scarlett Francini, Zhihui Gao, Tingjun Chen
Department of Electrical and Computer Engineering, Duke University
{yl826, scarlett.francini, zhihui.gao, tingjun.chen}@duke.edu

Impacts. ClickDT lowers the barrier to building wireless digital twins (DTs) by seamlessly integrating three publicly available components—high-resolution ray tracing, nationwide USGS LiDAR datasets, and OpenStreetMap (OSM) data—through a user-friendly web interface. On top of this foundation, we also incorporate a machine learning (ML)-based propagation model from our prior work, which can optionally leverage sparse measurements to outperform baseline models. Traditional ray tracing tools often require proprietary licenses, advanced technical expertise, or extensive preprocessing of environmental and world model data, which limit their widespread adoption. Our developed framework, ClickDT, addresses these limitations by offering an open-source, web-based, and interactive platform that democratizes access to high-fidelity 3D scene generation and the downstream ray tracing and RF propagation modeling tasks.

For the MILCOM community, the impact is twofold: (1) *Research acceleration*: ClickDT enables reproducible, scalable, and customizable RF experiments for cellular, IoT, and defense communications. (2) *Operational relevance*: ClickDT provides planners and engineers with rapid, realistic signal coverage maps and channel analysis for tactical environments, supporting resilient and adaptive communication infrastructure.

Applicability. ClickDT can be applied to a wide range of real-world applications across different scenarios:

- **Military communications:** Supports coverage planning in contested or dynamic urban and rural settings without prior site surveys. The generated 3D scenes can also be used to develop digital twins targeting radar and integrated sensing and communications (ISAC) applications.
- **Next-generation networks:** Facilitates 5G/6G deployment studies with accurate propagation modeling, channel characterization, and signal mapping.
- **Dual-use research:** Extends beyond defense to benefit civilian cellular providers, IoT developers, and smart-city planners.

Because ClickDT runs entirely in a web browser setting, it is accessible to both expert researchers and operational practitioners, making it highly adaptable across academic, industry, and defense contexts.

User Experience. A core strength of ClickDT is its intuitive point-and-click interface. Users can:

- Select any geographic area by drawing a rectangle on a world map (LiDAR-based features are currently supported for most regions within the United States).
- Automatically generate 3D scenes with accurate building heights and terrain from USGS LiDAR data.
- Configure transmitter/receiver parameters, run ray-tracing simulations, and compare results from both physics-based (Sionna RT) and ML-based models.
- Visualize and download signal coverage maps, channel coefficients, and ray paths—all without coding expertise.

The demo experience emphasizes interactivity and clarity: attendees can see immediate results from their chosen parameters, compare models, and export data for further study. By design, ClickDT transforms complex wireless digital twin construction into an engaging and highly accessible experience.

Conclusions. ClickDT combines technical rigor, practical applicability, and a user-friendly interface to facilitate the efficient generation of high-resolution wireless digital twins *with just a few clicks*, exemplifying the spirit of innovation and accessibility that the MILCOM demo track seeks to highlight.