

Year 10 - Project Update

- ▶ **Project 10a.002.TAU_WP7 - Learning-aided mobile THz communications**

Project Team

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Project Goals & Novelty of Approach

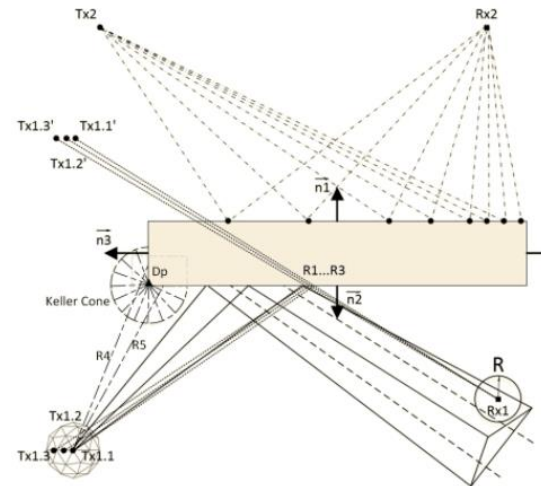
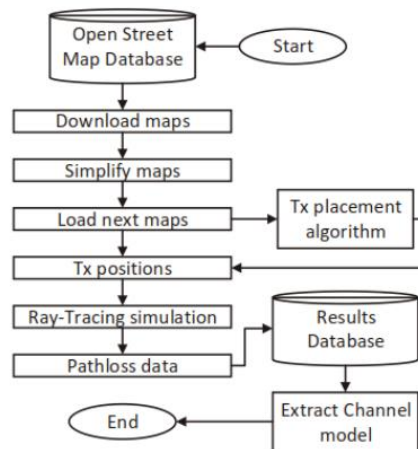
- The terahertz (THz, 0.33 THz) band offering tens of gigahertz of consecutive bandwidth is nowadays considered as a major candidate for new radio access technology for 6G cellular systems
- By utilizing this bandwidth one may not only provide extreme data rates but enable principally new applications such as holographic telepresence and virtual reality.
- In this project, we develop Machine Learning (ML) aided raytracing simulation methodology capable of representing dynamically changing propagation conditions in realtime for extension of propagation models obtained for specific environments to other typical deployment options.
- **Previous ray-tracing do not account high dynamism of THz wireless channel**
- Novel approach based on ML will unlock new opportunities to create fast and precise real-time channel simulation techniques, thus time consuming raytracing simulations will become faster
 - J M Eckhardt, V Petrov, D Moltchanov, Y Koucheryavy, T Kuerner “Channel Measurements and Modeling for Low Terahertz Band Vehicular Communications”, IEEE JSAC, 2021. 2- J
 - Kokkonemi, J M Jornet, V Petrov, Y Koucheryavy, M Juntti “Channel modeling and performance analysis of airplane-satellite terahertz band communications”, IEEE Transactions on Vehicular Technology, 2021.

Benefits to IAB

The developed algorithms and their implementation in ray-tracing simulation software will be especially beneficial for YL-Verkot Oy since it can be used to adequately simulate THz channels, where YL-Verkot Oy accumulates industrial expertise.

Project Accomplishments

- To analyze environments that substantially differ from the measured ones, we explore the option of complementing ray-tracing simulations with supervised ML-based algorithms
- Particularly, we will first construct geometric and physical models of the measured environment in a manner consistent with the conventional 3D engines, including faces, vertices, bounding boxes, etc., using the data from Open Street Map project, our minor measurement campaign providing reflection/diffraction specifics of surfaces and Kirchhoff's diffraction theory



Research Results

- As the raytracing simulators available on the market, e.g., COMSOL Multyphysics, Wireless InSite, are either in capable of taking into account all the propagation effects in THz band or use extremely slow versatile methodologies such as grid method, we will utilize the software developed by YL-Verkot and utilized in our recent THz studies
- We currently
 - Design 3D cluster-based stochastic propagation models for precise link and system-level analysis of communications algorithms to be later implemented in the software
 - Develop ML-based algorithms to create fast and precise real-time channel simulation techniques to be later implemented in the software

Next Steps/Deliverables & Timeline

Next Steps/Deliverables	Start Date	Completion Date
Development 3D cluster-based stochastic propagation models for precise link and system-level analysis of communications algorithms	Sep 1, 2021	Feb 28, 2022
Implementation and analysis of the developed models in simulation tool	Mar 1, 2022	May 31, 2022
Analysis and publication of results	Jun 1, 2022	Aug 31, 2022

Questions?