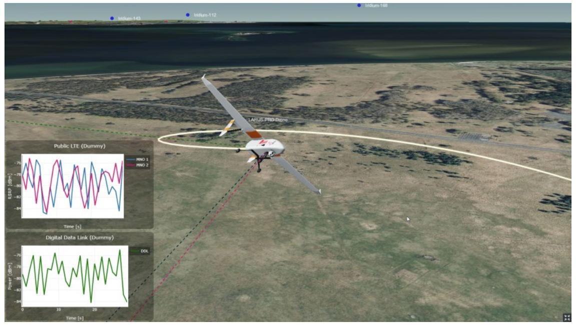
Machine Learning-based Channel Modelling for Search and Rescue Operations

Unmanned Aerial Vehicles (UAVs) are applied for various scenarios and missions in rescue services and disaster control. There, the availability of highly reliable and robust communication technologies and high-resolution camera systems enable emergency forces to get an overview of the current location in the shortest possible time. This requires high data rates in order to provide remote control of the UAVs and reliable video transmission for live evaluation.

Accordingly, realistic channel models are indispensable. Common channel models are usually designed for urban or suburban scenarios for low receiver heights and are therefore not capable of providing accurate received signal strength (RSS) predictions for UAVs.



Especially when it comes to maritime rescue operations special channel models are required that take the complex properties of water surfaces into account. Previous work showed that machine learning-based radio propagation models can yield better accuracies than classic channel models by bringing together expert knowledge with a broad range of channel and scenario describing features.

Focus of potential theses:

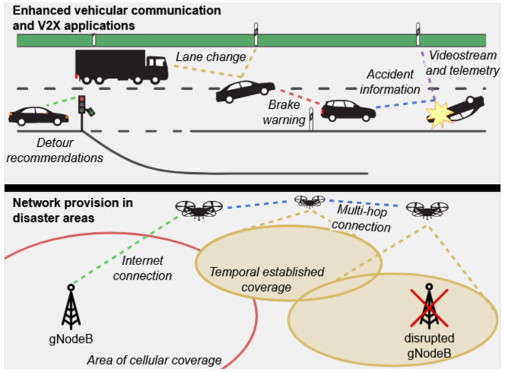
- Feature extraction of different feature sets based on existing measurements
- Familiarization with and application of various Machine Learning models (e.g. ANN, SVM, RF)
- Evaluation and application of the novel channel model (e.g. comparison with latest measurements)

Contact:
Melina Geis, melina.geis@tu-dortmund.de
Tim Gebauer, tim.gebauer@tu-dortmund.de

technische universität dortmund

Performance Evaluation of Routing Protocols for Vehicular Networks

Efficient traffic routing in vehicular ad-hoc networks (VANETs) has gained research interest in the past. Recent work has shown that the proactive integration of context information, such as trajectory knowledge and environmental sensing, leads to a significantly more robust and lower latency end-to-end performance. Although the concepts are proven, evaluation has been carried out for WiFi mesh networks. However, modern intelligent transportation systems (ITSs) are expected to rely on cellular vehicle-to-everything (C-V2X) communication technology and its following generations. Node relaying will be part of upcoming releases, as possible routing protocol stacks are currently investigated by the 3GPP standardization organization. The benefits from a direct mesh routing with C-V2X are versatile, as it enables coverage enhancements, 5G network relaying, lower latencies, spontaneous deployments, and much more.



The scope of this thesis is to implement and adapt a routing protocol to the specific needs of C-V2X. Thereby existing C-V2X simulation frameworks are to be analyzed, extended, and a simulation framework for the routing protocol is to be added. A comprehensive performance analysis is carried out based on selected V2X use cases, with focus on primary key performance indicators (KPIs), such as service level reliability, latency, and jitter, but as well as a scalability and robustness analysis.

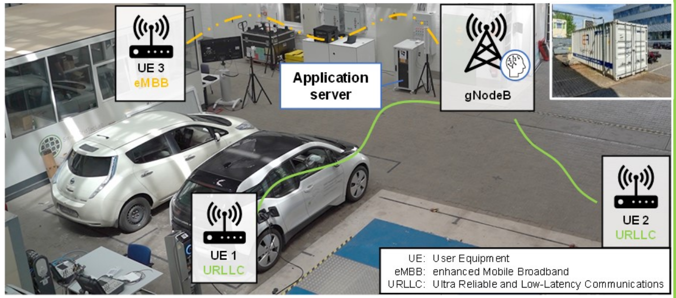
Contact:
Cedrik Krieger, cedrik.krieger@tu-dortmund.de

technische universität dortmund

Machine Learning-driven 5G and Beyond Network Slicing Solutions

With 5G and beyond mobile radio networks, the requirements for efficient communication diverges for different use cases. To meet these new demands, the technology of network slicing acts as key enabler, providing resources for each network slice virtually, while being placed within a physical shared infrastructure. While this virtualization within the core network has already gone into production, the Radio Access Network (RAN) slicing offers a wide range of research possibilities here at the Communication Networks Institute (CNI).

Beside the traditional approach of allocating resources based on requests from the user equipment, machine learning (ML) algorithms can be utilized, for example, to provide them proactively, thus enabling precise and latency-free allocations. Therefore, innovative schedulers are to be designed and tested within real-world environments such as the Smart Grid Technology Lab on the campus of TU Dortmund university. Further possible research aspects concentrate on ML enhancements to reduce the trade-off between mission-critical and best effort network slices.



The general shift towards network virtualization progresses with the concept of OpenRAN, enabling for more flexible radio networks, which illustrates another point of the work carried out at the CNI. Here, so-called xApps are to be designed to provide enhanced functionalities to the mobile radio and core network embedded in the OpenRAN framework.

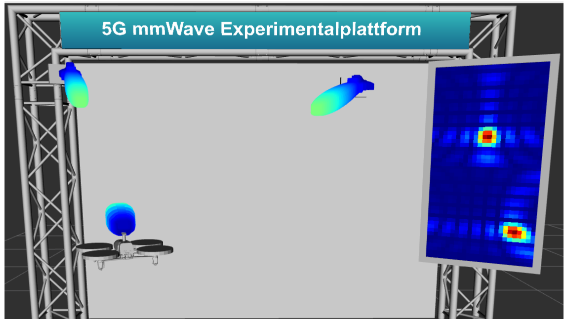
Contact:
Dennis Overbeck, dennis.overbeck@tu-dortmund.de

technische universität dortmund

High-Performance mmWave Communications for Beyond 5G and 6G Networks

The continuously increasing penetration and utilization of mobile networks require the development of new frequency bands. The millimeter wavelength range (mmWave), i.e. frequencies greater than 24 GHz, offers a large number of currently unused spectral resources that can thus be exploited to meet the high data transmission demands of mobile networks.

However, more challenging propagation characteristics of radio signals prevail in the mmWave spectrum, requiring the use of advanced technologies such as phased array antennas and beamforming. Directional transmissions will finally overcome the challenging radio channel characteristics, for which, nevertheless, novel beamsteering protocols for link establishment and maintenance have to be researched, tested and optimized.



In this context, the CNI is addressing efficient methods to enable robust mmWave communications for mobile network subscribers. Furthermore, as part of the activities towards the next mobile communication standard 6G, innovative technology approaches such as intelligent reflective surfaces are experimentally and simulatively investigated, which, if appropriately attached and incorporated into the mobile communication protocols, improve the usability of mmWave spectra for high-performance mobile communications.

Contact:
Simon Häger, simon.haeger@tu-dortmund.de
Karsten Heimann, karsten.heimann@tu-dortmund.de

technische universität dortmund

Contact

TU Dortmund University
Communication Networks Institute (CNI)
Lehrstuhl für Kommunikationsnetze
Otto-Hahn-Str. 6
D-44227 Dortmund

Head of Institute

Prof. Dr.-Ing. Christian Wietfeld

Further information can be requested at any time from the specified supervisors, or can be viewed at the chair's webpage:

https://cni.etit.tu-dortmund.de/ CNI YouTube Channel

Theses assigned at the CNI are always designed to enable you to apply and deepen your acquired knowledge in current problems and research projects. You can choose between simulative and analytical performance evaluations as well as prototypical implementations.

technische universität dortmund

Communication Networks Institute (CNI)

Topics for
Final Theses
(Bachelor/Master)
2022/2023