Chair of Theoretical Information Technology
Department of Electrical and Computer Engineering
Technical University of Munich

September 2022

Opportunities for Talents

Master Thesis: Experimental Analysis of Channel Propagation Models in LTE and 5G NR Systems

Description:

This master thesis focuses on the analysis of channel propagation models in LTE and 5G radio access technologies (RAN) and its evaluation in realistic scenarios carrying out both simulations and laboratory experiments using software defined radios (SDR).

The work will be developed in four phases, each of them with increasing level of difficulty. At the end of the master thesis, the student should be able to describe the low-level design of the LTE/5G NR physical layer channels and procedures in detail, as well as the effects of different channel models studied by the 3GPP Working Groups responsible of the radio access network (RAN) design.

The roadmap includes conducting first a scientific literature review of the state of the art on LTE and 5G NR channel models and their performance, accompanied by the technical reports and specifications published by 3GPP. This will be the basis for the simulations that are foreseen in the second phase, where with the help of Matlab's LTE and 5G Toolboxes different channel propagation models for LTE and 5G NR transmissions will be evaluated and characterized both in downlink and uplink.

The third phase focuses on the simulation the channel models using I/Q samples generated using an experimental LTE/5G NR framework. LTE/5G NR waveforms will be generated using this framework, while the 3GPP-compliant channel models will be still simulated using Matlab. For the signal transmission and reception, such framework based on OpenAirInterface (OAI) will be modified and deployed at the ACES Lab of the Chair of Theoretical Information Technology (LTI). The modifications involve the storage of I/Q samples containing 5G NR waveforms at the transmitter and reading from stored files I/Q samples at the receiver before carrying out further 5G NR physical layer processing steps. The I/Q samples that are read from disk have been previously offline processed using Matlab's channel models. Key performance indicators (KPI) such as bit error rate and error vector magnitude under different signal power metrics (RSRP, RSSI, RSRQ, SNR) will be analyzed.

The fourth and key phase of the master thesis focuses on purely hardware experiments. The OAI eNB/gNB and UE will be integrated with a Spirent channel emulator to analyze the effects of LTE and 5G NR channel propagation models in real time. For comparison purposes and as a baseline, 5G NR waveforms with low phase noise will be generated using our R&S spectrum analyzer and vector signal generator, which contain 5G NR licenses for such purpose. The comparison of the KPIs of the three different setups will finally provide a thorough analysis of the state-of-the-art channel propagation models in cellular networks.

Throughout the course of the master thesis, it is expected that you document your work in our internal wiki pages, and finally submit the thesis as well as hold a presentation with your main achievements.

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Your qualifications

- Master student in Communications Engineering (MSEI, MSCE)
- Knowledge of communications engineering, mobile communications, signal processing, and cellular communications (experience with 5G NR is a plus)
- Interest in novel communication concepts as well in their practical implementation
- Software experience: C (mandatory), C++, Matlab, Python
- Comfortable working with Linux operative system (Ubuntu) and distributed version control tools (e.g., gitlab)
- Goal-oriented and structured work style

To apply

Please send your application by e-mail to Luis Torres-Figueroa (luis.torres.figueroa@tum.de) with the following documents:

- Curriculum vitae
- Academic transcript
- Short motivation (0.5 – 1 page)

General Information

TUM is aiming to increase the number of women employees, and applications from women are expressly welcomed. People with disabilities, with essentially the same suitability and qualification, will be preferred. As you apply for a position at the Technical University of Munich (TUM), you provide personal data. Please note our data protection information according to Art. 13 Data Protection Basic Regulation (DSGVO) on the collection and processing of personal data in connection with your application http://go.tum.de/554159. By submitting your application, you confirm that you have taken note of the data protection information of the TUM.

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