MSc thesis project: radio wave exposure modelling of 5G NR base stations based on queuing theory

Background

Human exposure to radio frequency electromagnetic fields (EMFs), also known as radio waves, from mobile communication equipment is specified in terms of specific absorption rate (SAR), field strength, or power density. EMF compliance assessments are conducted by manufacturers and operators to make sure that equipment complies with relevant regulatory requirements before it is placed on the market and installed on site. The base station equipment is installed to make sure that the RF exposure in areas accessible to the general public is below the applicable limits.

A differentiating factor between 5G and previous radio access technologies is the beam-centric design, which aims to transmit energy in the directions where it is needed rather than constantly transmitting energy in a wide angular sector. Because of this, the time-averaged EMF exposure from 5G new radio (NR) base stations is not only dependent on the traffic load but also determined by the beam steering, making EMF exposure assessment more challenging.

Motivation and Description

The time-averaged EMF exposure of 5G NR base stations varies with the incoming traffic, spatial user distribution, and steered beams. Thus, the realistic EMF exposure is much lower compared to the theoretical maximum exposure. The aim of this thesis work is to develop a simulation tool to emulate complicated queuing systems that are able to properly model the time-averaged power emission under different traffic conditions for 5G NR radio base stations and make relevant EMF exposure assessment .

Thesis Objectives

The thesis work will be conducted at Chalmers, and co-supervised by Prof. J. Chen at Chalmers and Dr. B. Xu at Ericsson Research.

- Study literature about the 5G NR downlink transmission mechanism and the background of EMF exposure.
- Develop a simulation tool to emulate complicated queuing systems that can properly model the realistic time-averaged power emission and EMF exposure from 5G NR base stations in different traffic conditions and transmission configurations.
- Document and present results and conclusions.

Qualification

- MSc Student in Communication System, Electrical Engineering, or equivalent.
- Knowledge of wireless communication and queueing theory.
- Programming skills in MATLAB or Python.
- Good communication skills in written and spoken English.
- Ability to work and solve problems independently.

Preferred starting date: Fall 2020

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