Human exposure in Automotive Environment

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***Abstract*— More and more antennas are used nowadays for mobile communication, radar and other applications in and around a car, covering multiple frequency bands. This paper investigates the exposure level to which driver and passengers inside the car and bystanders positioned next to the car are submitted.**

I. REPRESENTATIVE HUMAN BODY MODELS

Different realistic human body models are used in this study to represent the population. The selected body models include different children and adult's models of the Virtual Family and the visible human phantom (see Figure 1).

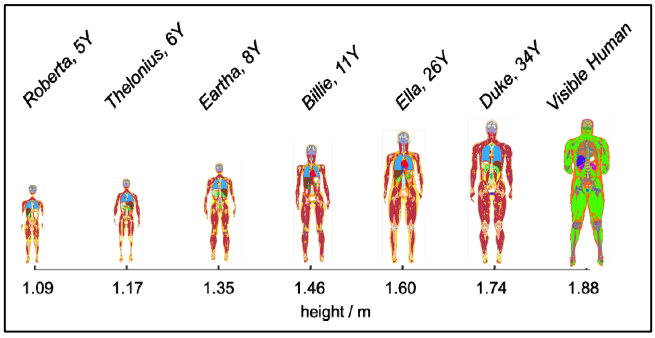

Figure 1: Investigated body models and corresponding body height (cut plane view).

II. INVESTIGATED EXPOSURE SETUPS

As a rule, full wave 3D EM simulations are used to calculate the human body exposure at frequencies from 30 MHz to 2 GHz. In this case, the 3D FDTD based software EMPIRE XCcel [3] has been used. Two different exposure setups are investigated:

A. Plane wave in free space

The first setup investigates the exposure of a human body model placed in free space (no car). A plane wave incident on the the frontal part of the body with a power density of 1 W/m^2 is considered. The simulation domain is limited by absorbing boundaries.

B. Car model with drive,passenger or bystander

One of the more realistic investigated exposure setups is the case of a monopole antenna mounted on the trunk of a simplified car model (see Figure 2). The car is placed on a dielectric ground slab.

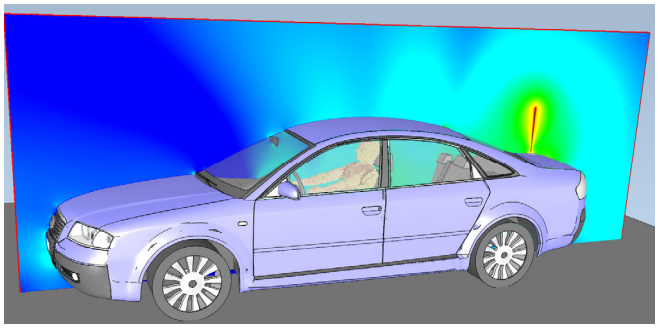

Figure 2: 3D view the car model with monopole antenna and driver (EMPIRE XCcel); Electric field @ 150 MHz

The simplified model of the vehicle consists mainly of perfect electric conducting parts (PEC). The tires, seats, windows and the ground are modeled as dielectric objects. The monopole antenna is mounted in the center plane on the trunk of the car with a distance of 350 mm to the rear bumper. The antenna length is scaled to fit the different investigated frequencies.

A 1g averaged SAR distribution in a cut plane of the car driver for an exposure by a trunk mounted monopole antenna at 150 MHz is shown in figure 3.

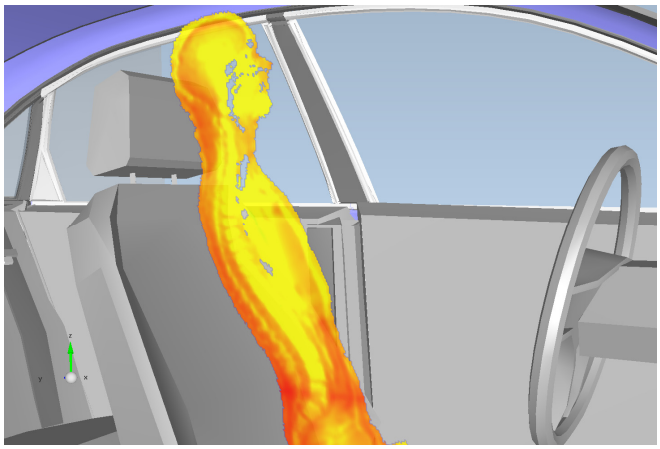

Figure 3: Car driver, 1g averaged SAR distribution at 150 MHz