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On the human exposure produced by an Electric Vehicle (EV) equipped with a Wireless Power Transfer (WPT) system

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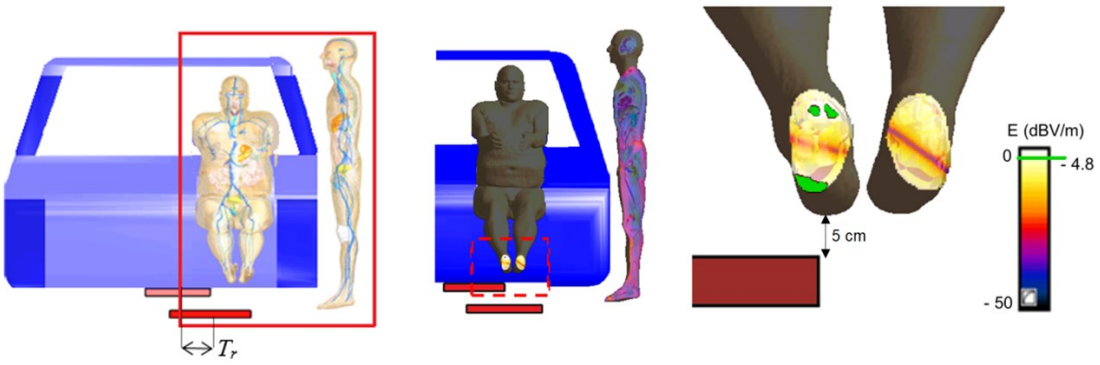
The possibility of charging wirelessly an electric vehicle (EV) is a valuable alternative to physical plugged charging stations and is being recently investigated [1]. However, the magnetic field leakage from the wireless power transfer (WPT) system is posing several concerns on the human safety either of passengers than general people passing nearby [2]. This is because a relatively large power of 3.3 kW (WPT-1) or 7.7 kW (WPT-2) is delivered to the charging system operating at a frequency of 85 kHz, as specified by the standard TIR J2954 [3].

In order to evaluate the fields induced inside these subjects, a two-step approach is proposed. First, the magnetic field produced by the WPT coils placed in the worst-case scenario (i.e., large misalignment between the coils) is evaluated by taking into account the vehicle chassis but without considering the exposed people. This is because the human body is not affecting the magnetic field at this frequency. The computed magnetic field is then employed as an input for the calculation of the induced electric field. However, in this second step, the only regions where the human body are (passenger seats or outside the car near the door) are refined for the field evaluation. In this way a faster computation is obtained compared to the classical one-step approach. Moreover, metallic objects (such us the wire coils and vehicle body) make the problem ill-conditioned and therefore slowly to converge for iterative solvers.

Different exposure scenarios (coil misalignment, chassis thickness and composition, human-to-vehicle postures) will be considered and the obtained induced fields will be compared with the basic restrictions specified by the ICNIRP guidelines [4].



(a) (b)

Figure 1. Exposure configuration (a) and numerical results (b) of a WPT system.

1. C. Wang, O. H. Stielau and G. A. Covic, "Design considerations for a contactless electric vehicle battery charger," *IEEE Trans. Ind. Electron.*, **52** (5), pp. 1308-1314, Oct. 2005.
2. V. De Santis, T. Campi, S. Cruciani, I. Laakso, and M. Feliziani, "Assessment of the induced electric fields in a Carbon-Fiber Electrical Vehicle equipped with a Wireless Power Transfer system," *Energies*, **11** (3), pp. 684-692, Mar. 2018.
3. SAE TIR J2954 "Wireless Power Transfer for light-duty plug-in/ Electric Vehicles and alignment methodology," to be published.
4. International Commission on Non-Ionizing Radiation Protection "Guidelines for limiting exposure to time-varying electric and magnetic fields for low frequencies (1 Hz - 100 kHz)," *Health Phys.*, **99**, pp. 818-836, 2010.