# Modelling the Human Body Exposure to ELF Electric Fields

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# *Preface*

The objective of this work is to investigate the behaviour of electric fields and induced currents in the human body exposed to different scenarios of extremely low-frequency (ELF), high-voltage, low-current electromagnetic fields by means of numerical modelling with improved boundary element methods (BEM). A variety of three-dimensional anatomically shaped human body models under different exposure conditions were examined.

The background for human exposure to ELF electromagnetic fields departing from Maxwell equations and for the electrical properties of biological tissue are provided. Then, a new improved BEM approach is introduced in order to solve this type of problems. This novel strategy, based on mixing continuous and discontinuous nodes and a new analytical integration scheme for the single and double layer potentials, has helped to speed up the calculations in the preprocessing and assembly schemes with respect to the classical BEM, leading at the same time to more accurate results. In particular, the integration method maintains high accuracy even when the internal observation points approach to the boundary of the domain. The developed methodology is applied to three different case studies: (i) overhead power transmission lines, (ii) power substation rooms and (iii) pregnant woman including foetus and evolving scenarios.

In all the cases, a sensitivity analysis investigating the influence of varying geometrical and electrical properties of the tissues has been conducted.

The results obtained in all cases allow to identify situations of high and low exposure in the different parts of the body and to compare with existing exposure guidelines.

*M. Cristina Peratta and Andres Peratta*