Induced electric fields and currents in the body by movements in a MRI facility: a numerical analysis

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Personnel working in the framework of Magnetic Resonance Imaging (MRI) facilities undergo exposure to static magnetic fields, switched gradient magnetic fields, and radiofrequency pulsed electromagnetic fields. A further source of exposure is represented by the movements of the human body through the static magnetic, spatially non-homogeneous, stray field around the MRI scanner: such movements cause exposure to low frequency (< 1 Hz) time varying magnetic fields inducing electric fields and currents in the human tissues. Exposure to switched gradient magnetic fields and radiofrequency electromagnetic fields is only possible when staying close to the scanner during a diagnostic procedure.
Indications of acute transient symptoms (vertigo and other sensory perceptions) associated to occupational exposure in MRI are reported in the literature, but limited data is available on the incidence of such symptoms or on the possible long-term health effects of repeated exposures to MRI fields. Beyond the laboratory and epidemiological evaluations of the possible health effects, a systematic characterization of the electromagnetic exposure conditions occurring in MRI facilities is crucial for a thorough analysis of the occupational exposure.
To this aim, a numerical code developed to estimate the dB/dt, the electric field and current density induced in a simplified model of the human body by the movement in the static magnetic field, will be presented in this work. Moving from the tool developed by Hartwig and co-workers (V. Hartwig, et al, *Magn. Reson. Mater. Phy*, **24**, 2011, pp. 323-330,) the code has been implemented in Matlab environment and provided with a graphic user interface which allows to define a path walked by the worker with a trapezoidal speed profile and to estimate the dB/dt, and the induced electric field and current density for an ellipsoidal coil representing the major section of a body moving through the magnetic field and perpendicular to its direction. Different exposure scenarios have been simulated and results have been compared to those obtained from exposure assessment in a real MRI facility carried out by using personal dosimeters worn by the personnel during the working activity.