Special section: Recent progress in low-frequency dosimetry modeling: from induction to electrostimulation

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In 2014 the International Committee on Electromagnetic Safety (ICES), an organization under the auspices of the IEEE Technical Committee 95, formed Subcommittee 6 (SC6) on EMF (electromagnetic field) Dosimetry Modeling. Its purpose is to address perceived gaps in knowledge concerning numerical modeling of the biophysical processes that are important to the development of limits on human exposure to EMFs or contact current. The initial focus of SC6 has been on effects related to electrostimulation (ES) of excitable tissue—typically the dominant mechanism at frequencies below 100 kHz. Although the frequency regime of interest to ICES and SC6 extends from zero to 300 GHz, this initial focus was adopted because unanswered questions about ES processes were seen to be primarily responsible for the greatest discrepancies in exposure limits recommended by two of standards-setting organizations recognized by the World Health Organization.

As its initial formal project, ICES SC6 organized a Workshop on Current Status of LF Dosimetry Modeling, held on 14 June 2015 in Asilomar California, USA, in cooperation with the BioEM-2015 Conference. The objective of that workshop was to explore developments regarding numerical models that specify the electric fields induced within a body exposed to EMFs or contact current, thresholds of excitation of central and peripheral nervous system neurons in response to the spatial and temporal characteristics of the induced fields, and methods for combining the two. Both theoretical and experimental perspectives were considered relevant. The two principle organizers of that workshop were the two guest editors of this special section.

Although the initial motivation for the formation of SC6 was to help facilitate the development of human exposure limits, it was clear that such information would be equally important to designers of medical equipment that impart electrical energy into the body for diagnostic or therapeutic purposes, or to medical practitioners who use such equipment.

Although experimental findings are essential for predicting human reactions to applied electrical forces, numerical models are needed as well. Such models are important because it is impossible to experimentally test all possible conditions of exposure. These may include spatial variations of an applied EMF or electric current, variations of the body locations where electrical energy is applied, temporal variations (waveforms) of the applied field or current, or variables associated with the subject, such as body dimensions and posture, and physiological factors affecting individual sensitivity. Experimental findings under limited test conditions can be used to validate or ‘tune’ numerical models that can be used to predict physical outcomes under a much more extensive set of hypothetical conditions.

The agenda of the EMF Dosimetry Modeling Workshop formed the organizing principle of this special section. Contributors to the workshop were invited to submit full papers for consideration via the normal vetting process of this journal. In addition, investigators in related fields who were not necessarily speakers at the workshop were invited to submit papers. We
are confident that the scope and quality of the papers presented here will form a valuable resource for investigators in this field.

The first article in this special section, authored by the guest editors, lists the initial research agenda of SC6, which identifies 25 tasks identified by the members of SC6 as it was constituted at the time the article was created. The papers in this special section address some of these tasks, and are subdivided into the following categories: (i) ES models; (ii) anatomical models; (iii) dosimetry; (iv) exposure guidelines (v) medical applications.

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