How hot can you get? Determining the envelope of electromagnetic exposure using anatomical phantoms

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We are constantly exposed to electromagnetic waves of a broad spectrum, ranging from light to communication frequencies to wireless charging. These electromagnetic waves interact with human tissue and can stimulate nerves or deposit power, resulting in tissue heating. Therefore, new technologies in the communications and medical sector require safety assessment to comply with standards and operate within safe limits. Computational modeling and simulations, referred to as *in silico* technologies, can be used to perform complex analyses to address these bioelectromagnetic problems, e.g., to predict the power deposition in the human brain during mobile phone use or heating of medical implants by electromagnetic fields during magnetic resonance examinations. To determine the potential envelope of induced fields for any given exposure scenario, human anatomical models in various postures are needed to cover the exposed population, since field coupling strongly depends on anatomy and posture. Due to these strong dependences, computational electromagnetics was the first *in sillico* clinical trial application accepted by regulators.

This lecture will discuss the fundamentals of computational modeling, describe how anatomical models can be generated, and introduce the Sim4Life simulation platform (ZMT Zurich Med Tech AG, Switzerland) that combines multi-physics solvers to predict the interactions of biological tissues with electromagnetic exposures. Finally, some practical experience will be gained by conducting a small simulation study to assess the safety of patients with implants undergoing magnetic resonance examination.