High Frequency Electromagnetic Device Modelling with COMSOL: Simulation Vs. Experiment

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Abstract

Computer simulation is mandatory for the optimization of electromagnetic devices. Here we concentrate on two classes of devices operating in the MHz and GHz range, namely microwave ovens and TEM cells for electromagnetic compatibility testing. In particular we concentrate on the issue that numerical results are usually different from the experimental ones and this can be due, among others reasons, to a much too simplified numerical model or uncertainties in material parameters. In order to address the first problem, we use very accurate numerical models, including electromagnetic and thermal simulation, and perform sensitivity analyses including possible deviations from the ideal case due to manufacturing tolerances (Figure 1), giving us the possibility to simulate a realistic use of the device. For the second problem, in order to avoid inhomogeneity of the load, we performed thermal measurements on a particular material made by agar (2%) and water (98%): its thermal and dielectric properties are very similar to water, but it has the consistency of a semi-solid gel, this allowing us to use different measurements approaches. Using this load, in fact, we can perform several thermocouples measurements (accurate both in position and in amplitude) and we can combine them with results obtained by an infrared camera in order to have a good mapping of temperature distribution inside different loads (both in volume and in shape). Both numerical and experimental results will be presented in order to validate the numerical models; then we'll discuss different solutions for the optimization of the actual microwave ovens and TEM cells.

Figures used in the abstract

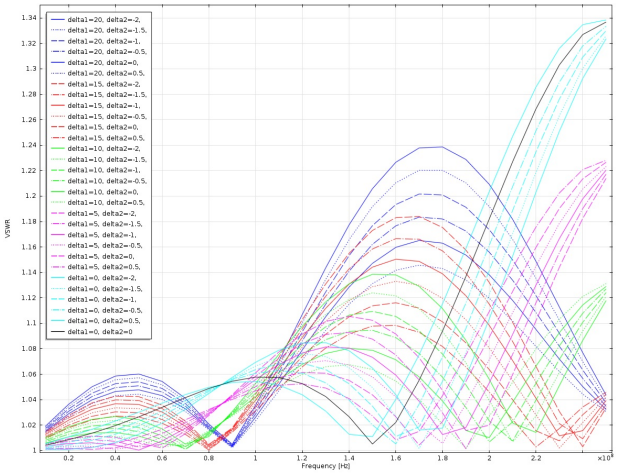

Figure 1