UNIVERSITÄT DUISBURG ESSEN

Fachgebiet Hochfrequenztechnik

H F T

Fachbereich Ingenieurwissenschaften
Abteilung Elektrotechnik und Informationstechnik

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Aufgabe der Abschlussarbeit im ISE Bachelorstudiengang

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Thema: **Design and develop a homogeneous E-field phantom for testing the RF induced heating in MRI due to the existence of a medical implant**

Beschreibung:

Description:
Magnetic resonance imaging (MRI) is an imaging technique to generate high quality images of the inside of the human body. With the development of the MRI technology, the safety of patients wearing medical implants during MR imaging becomes more critical. The International Organization for Standardization (ISO) developed a new standard called ISO\TS 10974 “Assessment of the safety of magnetic resonance imaging for patients with an active implantable medical device”. According to ISO\TS 10974 Chapter 10: ”protection from harm to the patient caused by RF-induced heating”, the implant should be immersed in a homogeneous tissue medium, with a uniform E-field amplitude and phase.

Task:
In Annex M of ISO\TS 10974, an example of such a phantom is provided. However, it is difficult to place a larger implant like a hip joint in a phantom with narrow homogeneous area inside this phantom. A suitable new phantom has to be developed which could have a specific area for immersing the implant, while other areas could be inhomogeneous. Geometric design elements of dielectric materials (maybe adjustable in size, angle) could help to direct the E-fields as needed for specific implant alignment.

The final goal is to find the geometric dimensions of the phantom which can realize a suitable E-field distribution. Finally, the phantom has to be manufactured and the E-field distribution measured in order to evaluate the design.

1. Study the theory of electromagnetic fields in different media.
2. Get acquainted with EM simulation using the SEMCAD X tool.
3. Design a phantom with homogeneous E-field in phase and amplitude:
   a) Use the SEMCAD X simulator to study the E-field distribution produced by MRI radio frequency coils in air and gel.
   b) Design and investigate the desired phantom for different implant size and shape using the SEMCAD X simulator.
   c) Optimize the designed phantom.
4. Fabricate the optimized phantom and measure the E-field distribution inside the gel using a generic RF coil for excitation and a moveable E-field probe.

At the end of the work, a public presentation of results is to be given.