

PhD Dissertation Announcement

NUMERICAL AND EXPERIMENTAL STUDY OF MRI RF SIGNAL INTERACTIONS WITH VARIOUS MEDICAL DEVICES

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With the increased use of implantable medical devices and the fast spread of the Magnetic Resonance Imaging (MRI), there have been concerns of the device compatibility and safety in MRI systems. The interaction between the fields generated by MRI system and medical devices implanted in patient body could produce magnetically-induced displacement force and torque, radio frequency (RF) heating, image artifact and some electromagnetic compatibility problems on both active, and passive implanted medical devices. While most devices are manufactured using non-magnetic materials which efficiently control the displacement force and torque at a safety level, the RF induced heating near the devices becomes a primary safety issue. In this work, the first topic is the RF heating for passive medical devices. Electromagnetic simulation using the Finite Difference Time Domain (FDTD) method and thermal simulation are applied to understand potential temperature increase inside human body when patient with implantable device undergoes MR scanner. Measurements are performed to validate simulation results. The second topic is the RF heating for active implantable medical devices (AIMDs). It is studied using alternative approaches due to the fine features inside leads attached to AIMDs. The third topic covers the measurement uncertainty of using fiber optic thermal probes in RF heating assessment. The fiber optic probes which are used to measure temperature rise around the medical device can lead to significant temperature variation from the original temperature without probes. Three medical devices have been investigated to quantify the effect on temperature rise change due to the existence of thermal probes. It is found thermal probes have more influence on the temperature rise around small and tiny structures such as screws and leads.

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