

Metamaterials for Improving Magnetic Resonance Imaging

PROJECT DESCRIPTION

Magnetic resonance imaging (MRI) uses radiofrequency (RF) electromagnetic fields to excite and detect the signals from which cross-sectional images of the body are reconstructed. Traditionally, the RF fields are produced by resonant structures ("coils") which can only generate near fields that are limited in spatial extent. The resulting images are shaded by these spatial inhomogeneities, and in extreme cases large portions of the anatomy become invisible. A novel solution to this problem combines two recent advances: (1) the development of the traveling-wave technique [1], in which the MRI bore is treated as a circular waveguide excited by external antennas, and (2) metamaterials, which are artificial materials exhibiting properties that are unavailable in nature. Specifically, metamaterials exhibiting certain exotic properties are used to line the interior of the MRI bore [2], which reduces its cutoff frequency enough to permit the propagation of traveling waves. This concept has been proven in theory and simulations, and metamaterial liners have been designed. What remains is the experimental validation, which has several challenges. These include design using commercially available materials and components, and tuning for the sensitive properties being sought. Finally, excitation of these metamaterial-lined MRI bores must be accomplished using circularly polarized antennas tuned to specific frequencies. The proposed experimental validation will be conducted on a model of the 4.7 tesla whole-body scanner currently housed at the P.S. Allen MR Research Centre at the University of Alberta.

[1] Brunner et al. *Nature*, vol. 457(7232), pp. 994-998, 2009.

[2] Pollock et al. *Proc. Int'l Soc. Magnetic Res. Med.*, vol. 20, pp. 2792, 2012.

FACULTY-DEPARTMENT

Engineering- Electrical and Computer Engineering

DESIRED FIELD OF (STUDENT) STUDY

Microwave engineering, electromagnetic theory, advanced circuit theory, experimental methods in microwave engineering (microwave test/lab course), antenna theory (an asset)

INTERNSHIP LOCATION

University of Alberta Main Campus - Edmonton

NUMBER OF INTERNSHIP POSITIONS

2

Contact: Brendan Cavanagh, Internship Coordinator (Inbound)
University of Alberta International
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INTERNSHIP START DATE

Sept 2017, Jan 2018, May 2018

INTERNSHIP END DATE

Dec 2017, Apr 2018, Aug 2018

ARE THE DATES FLEXIBLE?

Yes, I am flexible regarding the internship dates. Selected students can contact me to request a date change.