CUTTING THE CORD - WIRELESS COILS FOR MRI

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Introduction

The utility of MRI scanners could be greatly enhanced by removing the requirement for cable connections to patient coils. Significant work flow benefits would arise from eliminating the need to sterilise, connect and disconnect the cables. With no reduction of bore size, enabling technology is under development that could allow increased coil density above the current norms whilst also improving scanner workflow.

Methods & Materials

The cabling to the patient coils is replaced by a single frequency Multiple Input Multiple Output (MIMO) microwave link. This is composed of a frequency upconverter for each patient mat coil and an array of transceivers in the scanner bore. The principle is illustrated in Figure 1.

Transceivers connected to an array of antennas are integrated into the scanner bore. Local oscillator signal generated in the transceivers feeds the antenna array to illuminate the patient coil electronics. The same local oscillator signal in the transceivers converts the microwave signals received from the patient coils back to the original Magnetic Resonance (MR) frequency for input to the image processing system.

The local coil upconverters are based on parametric amplifiers and implement low noise frequency conversion and amplification in simple, low cost circuitry. The parametric amplifiers use the incident local oscillator signal to provide the frequency reference and the power for the upconversion. The MR signals from the coils are thereby converted to microwave frequency and transmitted to the bore transceiver array.

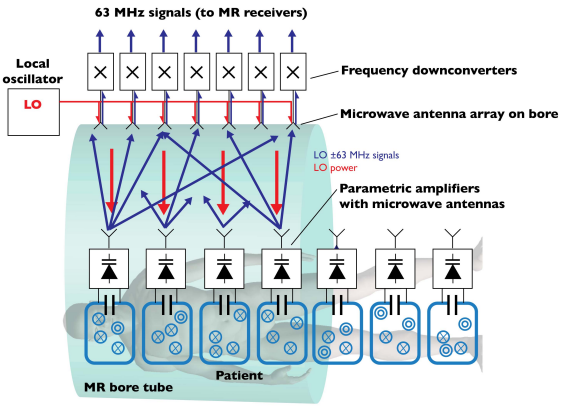

Figure 1: Principle of Wireless Coils

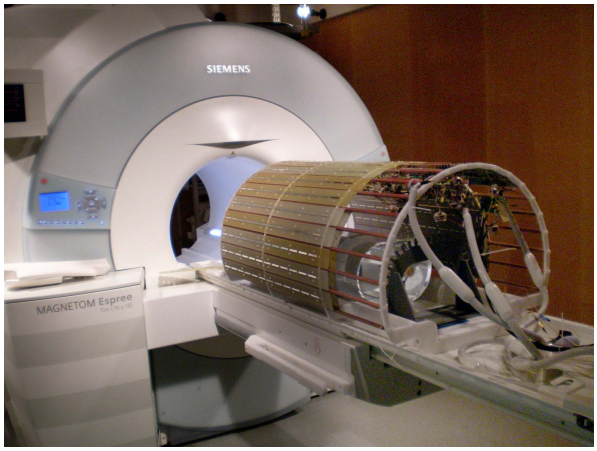

Figure 2: Test Arrangement

Figure 2 shows the implementation of a test arrangement where the array was mounted for convenience on the patient table - in a future developed implementation the array would be integrated into the scanner bore. A patient coil mat, suitably modified with parametric upconverters can be seen on the test 'phantom.' The test arrangement has demonstrated separation of signals so far from two patient coils and produced excellent quality wireless images.

A benefit of the proposed approach is that individual patient coils are only activated when they are physically in the field of view. Patient coils outside the field of view do not receive local oscillator power and so do not generate any interference. There is therefore no need for the operator to keep track of the positions of the patient coils. In principle it would be possible to have a patient blanket extending from the neck to the feet of a patient and perform a whole-body scan by moving the patient table in stages, with no need for operator intervention.

Summary

Replacement of the existing cable connection from patient coils to image processing system with a cordless link will improve MRI scanner workflow. A multiple input multiple output microwave link system is proposed for the cordless link. Parametric upconverters in the patient coils will convert the magnetic resonance signals from the coils to microwave frequency whilst a bore transceiver system will provide the local oscillator and receive functions. Parametric amplifiers implement upconversion with gain in simple and cheap circuits. Since only patient coils in the field of view are active the proposed system is ideally suited to whole body scan.

Reference: Sebastian Martius ISMRM 2009 Abstract