Educational Lecture

Low Noise Amplifiers and Receive Chain Architectures for MRI Systems

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ISMRM Educational Session, MR Systems Engineering,

The lecture on low noise RF preamplifiers and receive chain architectures will give a general overview on the design of receiver systems and the special requirements for their application in MRI.

Target Audience
Physicists, engineers and Ph.D. students interested in RF design of coils and receiver chains, Application engineers, hardware developers

Objectives
- Understand the basic principles and figures of merit to describe a receive chain.
- Get insight into radio frequency technologies used in MRI
- Understand the interface between patient, antenna and receiver from and RF point of view

Content
Special emphasis will be given to the role of preamps as the interfacing component between the antenna and the receiver system of an MRI. The integration of preamps in close vicinity to the antenna elements can become a major difficulty because parasitic coupling between the output of the preamp and the antenna input often causes the antenna structures to oscillate. This is complicated with the increase of antenna element count and the need to integrate electronics as well as cabling very close to the antenna. Major topics to be discussed are:
- Power matching versus noise matching
- Preamp decoupling
- Antenna and preamp noise figure
- System noise figure
- The role of cabling between antenna and analog to digital converter
- How to deal with ever increasing element counts of local coil arrays
- Special requirements for electronics in MRI: B0 field / B1 field compatibility

The lecture will give both an introduction to these topics as well as cover a brief outlook to the latest scientific results related to receiver technology for MRI.

Conclusion
It will be shown how appropriate coil-design, preamp-design and receiver design can impact the SNR in MRI and how this can be quantified. The participants can also learn where the major potential for SNR improvement in the receive chain of an MRI system can be found.