Specialty Area & Title: Nuts & Bolts of Advanced Imaging - Parallel Imaging

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Highlights:

- Practical details of modern parallel imaging reconstruction algorithms.
- Real-world performance-limiting problems in parallel imaging reconstruction.
- Parallel imaging algorithms robustness.

Target audience: Anybody with an interest in Parallel Imaging (PI) beyond theoretical principles and who would like the tools to implement practical, production-level parallel imaging reconstruction algorithms.
Objectives: We will focus on moving from the basic pedagogical description of parallel imaging algorithms to studying how these algorithms are implemented in practice. This will help attendees select appropriate PI reconstruction algorithms for specific applications.
PURPOSE: Parallel Imaging techniques such as SENSE [1], GRAPPA [2], and related techniques serve a key role in most clinical applications today. The theoretical background and reconstruction principles are frequently covered in introductory courses on the topic, but these high-level treatments of the topic often lack much of the practical information needed to implement robust versions of the techniques in practice. In this course, we will assume a basic familiarity with parallel imaging techniques and build on this to include practical aspects of the reconstruction algorithms.
METHODS: We will take the attendees through a stepwise process to create, optimize, and evaluate parallel imaging reconstruction algorithms. Recognizing that the performance of a given algorithm is affected by the quality of calibration data and by the calibration procedure, we will discuss various calibration approaches. We will show that the calibration results from both SENSE and GRAPPA techniques can be used to find a set of image based unaliasing or unmixing coefficients. We will use these coefficients to study both the aliasing artifact suppression and noise enhancement characteristics of various algorithms. Additionally, the noise correlation properties of the receiver array play a critical role. We discuss noise prewhitening as an approach to mitigating issues with faulty array elements and noise correlation. This course covers the practical steps of this procedure and we demonstrate the consequences of poor noise calibration.
CONCLUSION: Parallel imaging reconstruction algorithms include several performance critical steps such as coil calibration and noise prewhitening, which are rarely covered in detail in introductory course. This course demonstrates the importance of such steps and provides the attendees with the tools needed to implement them in practice.
REFERENCES: [1] Pruessmann et al., SENSE: Sensitivity encoding for fast MRI. Magn Reson Med, 42(5):952–62, Nov 1999. [2] Griswold et al., Generalized autocalibrating partially parallel acquisitions (GRAPPA). Magn Reson Med, 47(6):1202–10, Jun 2002.