AbstractID: 9898 Title: Advances in MRI Equipment Design, Software, and Imaging Procedures

Cardiovascular Magnetic Resonance (CMR) has become accepted as an important clinical tool for non-invasive diagnostic imaging of the heart and great vessels. The ability to see not only the morphology, but also the function of the heart and the ability to perform tissue characterization has been very helpful in the clinical usage of CMR tools. The acceptance of CMR in a clinical setting is mostly based on recent advances in the design of MR equipment (magnet, gradient coil, rf coils, receiver system), imaging sequences, and image acquisition strategies. For example, the development of steady-state free precession sequences (SSFP), such as TrueFISP has changed the way of doing cine imaging in the heart. On the other hand, SSFP sequences rely on fast gradient systems to make sure that the rf pulse repetition times (TR) are sufficiently short to avoid off-resonance artifacts which would otherwise have a negative impact on image quality. This example shows nicely, how clinical applications and advances in imaging hardware are closely correlated.

Another recent example of advances in the area of MRI is described by parallel imaging. What it means is that additional coil information from multiple coil elements is used to calculate additional raw data lines in the images. This way, spatial resolution can be improved, or scan time can be reduced, alternatively. In both ways, however, the signal-to-noise ratio (SNR) drops, and careful optimization of the imaging protocols is required. More recently, MRI systems with a higher magnetic field are available to boost the SNR.

This lecture will provide an overview of the underlying physical principles of cardiovascular MRI techniques. It will show the close relation between the design of the imaging hardware and software capabilities, and how clinical applications will further improve with the advances in imaging technology.

Educational objectives:
1. Understand the physical basis for cardiovascular MRI techniques.
2. Show the effect of hardware improvements on CMR techniques.
3. Understand the issues of new MR imaging strategies, and how they effect clinical applications.
4. Demonstrate the clinical potential of cardiovascular MRI.