Magnetic Resonance Imaging II – Reconstruction and quantitative methods

Learning Outcomes

This course is geared towards master students and PhD students who have visited the magnetic resonance imaging (MRI) course or have basic knowledge of MRI. The participants will learn concepts of advanced MRI encoding and decoding strategies. In particular the mathematical frameworks are developed to solve the inverse problem of fast acquisition strategies. The participants will also learn about quantitative MRI techniques and related data analysis techniques. Matlab exercises and homework are used to deepen the understanding of the concepts.

Content

MRI signal equation, direct Fourier reconstruction, advanced k-space trajectories and gridding reconstruction, parallel imaging, compressed sensing, RF-pulse design and two-dimensional excitation, quantitative MRI (flow, diffusion, relaxation time mapping), motion, cardiac MRI.

Lecture Schedule (20.04.2019 - 13.07.2020)

1	Tobias Schaeffter	06.5	L	Introduction – Recap NMR, Bloch equations
2	Tobias Schaeffter	13.5	L	Advanced RF-pulses: adiabatic excitation, small-tip-angle approximation, 2D Excitation, Spatial-Spectral RF-pulses
3	Tobias Schaeffter,	20.5	L	Advanced Imaging, Recap Imaging and gradient echo, SSFP-Imaging, radial and spiral MRI
4	Christoph Kolbitsch	27.5	L	Reconstruction 1: Recap k-space, FOV, resolution, gridding reconstruction (radial, spiral)
5	Christoph Kolbitsch	03.6	L	Reconstruction 2: parallel imaging,
6	Christoph Kolbitsch	10.6	L	Reconstruction 3: compressed sensing,
7	Christoph Kolbitsch	17.6	E	Reconstruction Lab
8	Tobias Schaeffter	24.6	L	Quantitative MRI: Relaxation time mapping, T1 and T2 mapping, T2* mapping
9	Sebastian Schmitter	03.7	L	Flow MRI, Principles, gradient moments, velocity and acceleration encoding, aliasing
10	Tobias Schaeffter	10.7	L	Diffusion MRI, Steyskal Tanner experiment, b-value, diffusion tensor
11	Tobias Schaeffter, Christoph Kolbitsch	17.7	L	Motion in MRI, rigid, affine motion, effect in k-space, artefacts, motion compensation
12	Tobias Schaeffter	24.7	L	Cardiac MRI: motion synchronisation. sequences cine, perfusion, late enhancement
13	Tobias Schaeffter	31.7	E	Exercises and Q/A

For each lecture questions and short exercises will be given and need to be answered as part of a weekly homework. The submitted homework will be marked and will contribute 25% to final mark.