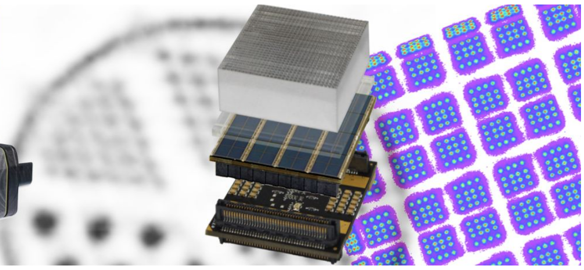
PMI PHYSICS OF MOLECULAR IMAGING SYSTEMS | RWTH AACHEN UNIVERSITY



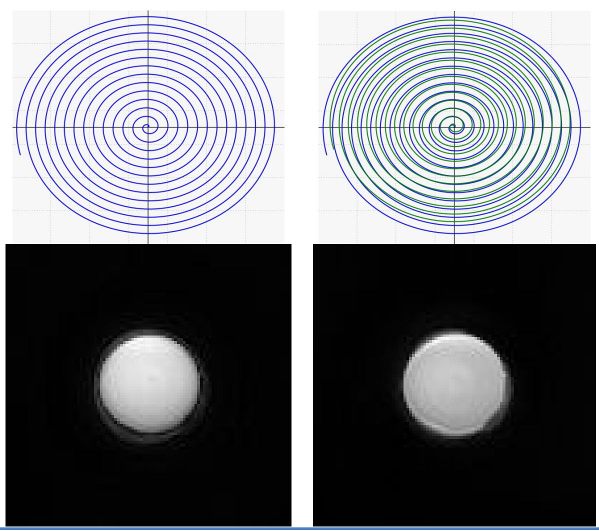
Research focus of the department of "Physics of Molecular Imaging Systems" (**PMI**) is on exploring the physical limits of current and future molecular imaging technologies. These areas range from simulations of new detector concepts, hardware prototypes, high speed data processing, image reconstruction algorithms and applications using our research imaging prototypes. Our group consists of students and researchers from different disciplines: physics, engineering, computer science and medicine. PMI is part of a large international network with a close link to industry, especially Philips Research.

MR image correction for spiral acquisitions

In magnetic resonance imaging (MRI), the data acquisition is done in the frequency space. Images are derived from the so-called k-space by applying a Fourier transform. For cartesian data sampling, this can be conveniently executed by employing a 2D FFT. In spiral MRI the data points are interpolated onto the underlying Cartesian grid. For this purpose, the spiral trajectory needs to be precisely known. Usually, it is calculated from the nominal gradient shapes. However, distortions such as eddy current induced magnetic fields cause deviations of the nominal gradient shape resulting in a wrong k-space trajectory. Therefore, artifacts are often visible in the images. The k-space trajectory can be corrected by measuring the actual gradient shape at different positions in the MR scanner [1,2] (similar method shown in the figures below). However, these measurements are very time consuming and additional hardware is needed. In this thesis, an alternative approach is chosen: The k-space trajectory is estimated by optimizing the reconstructed image with respect to the presence of image distortions.

Your Thesis

Develop an MRI phantom to analyze geometric distortions, e.g. a 3D printed grid. Scan the phantom and optimize the reconstructed image by varying the spiral trajectory shape. Use the final trajectory which results in an undistorted phantom image to reconstruct further images of different phantoms.
Basic reconstruction methods (FFT, spiral gridding and correction) have already been implemented in Python and available as a starting point of your work. We are looking for a highly motivated student with an interest in MRI physics and improving data treatment methods. Programming skills in Python/C++ are advantageous.



[1] Barmet et al., "Spatiotemporal magnetic field monitoring for MR." *Magnetic Resonance in Medicine* 60.1 (2008): 187-197.
[2] Vannesjo et al. "Gradient system characterization by impulse response measurements with a dynamic field camera." *Magnetic resonance in medicine* 69.2 (2013): 583-593.

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