Magnetic Resonance Imaging (MRI) is a well-established technique for the diagnosis of pathologies, like cancer. Conventionally such pathologies are assessed in a qualitative way by obtaining T1, T2 and T2* weighted images. These MR-images can be enhanced by contrast agents that locally influence the T1 and or the T2/T2* relaxation times. Recently an adaptive MR-technique has been proposed that allows the measurement of the temporal and spatial uptake [1]. A more quantitative oriented diagnosis can be achieved by pixel-wise measurement of relaxation times, also called relaxation time mapping [2,3] allowing the assessment of tissue characteristics and changes due to contrast agent uptake. Recently, the calculation of the extracellular volume fraction of the contrast agent distribution has been proposed using relaxation time mapping before and after contrast agent administration [4]. However, relaxation time mapping techniques result in rather long scan times and are influenced by physiological motion.

Over the last years 3D imaging of larger volumes has become the preferred way to obtain data to simplify the acquisition process. Again the major challenge of such acquisition is to cope with the artefacts caused by respiratory motion. Until now, the preferred respiratory compensation method has been to acquire MR data during multiple breath-holds, but this often very challenging for the patient. Furthermore, navigator techniques have been proposed that measure the position of the diaphragm and use this one-dimensional motion signal for respiratory gating. However, the position of the diaphragm does sometimes not correlate to displacements in other parts of the abdomen, since the motion in this region could be complex [5]. Recently, image based navigators have been proposed to measure these effects [6]. However, this requires the acquisition of an additional image, which needs to be interleaved into the 3D acquisition. A more ideal approach would be to estimate motion from the data itself [7] and using it in a motion compensated image reconstruction [8].

**Project**

The purpose of this PhD project is to investigate new strategies for a) data-driven respiratory motion correction for 3D MRI of the abdomen and b) fast quantitative MRI for assessment of contrast agent uptake. The project is divided into following parts

1. Investigation of 3D acquisition strategies that allow the reconstruction of intermediate time-resolved low-resolution images for motion estimation
2. Non rigid motion estimation from intermediate image data and motion modelling and motion compensated reconstruction
3. Investigation novel reconstruction techniques to estimate MR parameters (e.g. relaxation time mapping and/or pharmacokinetic modelling).
4. Test these new methods in clinical applications.

The project is funded through a joint grant between KCL, UCL and imperial College. For further information please contact Tobias Schaeffter (tobias.schaeffter@kcl.ac.uk). To apply, please send a copy of the following items

1) A CV, including full details of university course grades to date.
2) Contact details for two academic or professional referees.
3) A short description (750 words maximum) outlining why you think you are suitable for this project and what you hope to achieve from the PhD.

**References**