# **Bachelor's Thesis:** Gold-Standard Parameter Estimation in Quantitative MRI



## Overview

Magnetic resonance imaging is a flexible and versatile imaging technique. Depending on the program which is executed at the scanner, called sequence, it can provide images with multiple different contrasts for the same measured object. The contrast depends not only on the physical properties of the measured tissue and the hardware characteristics build into the MR system, but also on how sequences are designed and executed. This complexity and high level of freedom during the acquisition makes MRI one of the most versatile imaging techniques, but also leads to complex protocols in the daily clinical routine and difficult interpretation of the resulting images. Quantitative MRI aims for reducing the complexity of the interpretation of the images. It reduces the contrast to depend on single tissue or hardware specific properties. By exploiting sequences designed for being sensitive for individual properties and robust against all others dataset are acquired and intermediate images reconstructed. Afterwards, prior knowledge about the measurement process is exploited to estimate the desired property of the measured object or involved hardware.

The aim of this bachelor thesis is to learn about QMRI in a practical way. A measurement protocol for estimation of various physical and hardware related parameters should be set up and measured at our scanner. The resulting raw dataset are reconstructed with the Berkeley Advanced Reconstruction Toolbox (BART) and analyzed for the underlying physical parameters. Finally, the project aims for creating a fully-automatic shell-based pipeline for the analysis of the raw data measured with the created scanner protocol.

### Specific tasks

- Literature review about various QMRI sequences estimating:  $T_1, T_2, T_2^*, B_1, B_0$
- Creation of measurement protocols at the MRI scanner for the individual parameters
- Measurement of the created protocols together with our MTA at the MRI scanner
- Analysis of the raw datasets using BART and python
- Creation of a Bash workflow for automatic parameter estimation from the acquired raw data

## **Recommended Knowledge**

Experience with Linux, Python, Shell scripting





Figure 1: Figure showing our MRI system on the left and a demonstration of an inversion-recovery sequence for  $T_1$  mapping with its influence on the measured signal and a measured tubes object on the right.

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