Bachelor's Thesis:
Loss Functions and Ground Truth Reference for Deep-Learning Based MRI Reconstruction

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Overview

In recent years, deep-learning has become an integral part of MR image reconstruction. Neural networks are trained to reconstruct high-quality images $\mathbf{x}$ from few k-space data $\mathbf{y}$ and thereby reduce the scanning time. Supervised training of a neural network `Net` corresponds to an optimization of the network parameters θ with respect to some loss function L, i.e.

$$\theta^* = \text{argmin}_\theta \sum_i L(\mathbf{x}_i, \texttt{Net}(\mathbf{y}_i; \theta)) \,.$$

Usually, fully sampled k-space data is acquired to obtain a high-quality reference reconstructions $\mathbf{x}_i$ and the same data is retrospectively undersampled to simulate the k-space data $\mathbf{y}$ from a corresponding accelerated MRI scan. Clearly, the choice of the loss function and the reference reconstruction is a crucial choice for training neural networks. In parallel imaging, the reference reconstruction $\mathbf{x}_i$ itself is not uniquely defined but depends on the estimation of coil-sensitivity maps.

The aim of this bachelor thesis is to investigate the effect of the choice of different loss functions and reference reconstructions on the performance of trained neural networks. The recently added deep-learning framework in the Berkeley Advanced Reconstruction Toolbox (BART) will be basis of this work.

Specific tasks

- Literature review
- Investigation of existing code base
- Training neural networks with BART
- Experimenting with different loss functions and reference reconstructions
- Documentation and illustration of the results

Recommended Knowledge

- Basic programming experience
- Interest in deep-learning with application to MRI

Contact

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