Institute of
Biomedical
Imaging
Stremayrgasse
16/3
8010 Graz

Master's Thesis:
Deep reinforcement learning designed radio frequency pulses for chemical exchange saturation transfer in MRI

Overview

We aim to extend recent research on the use of deep reinforcement learning for designing radio frequency pulses in MRI. Specifically, we will focus on designing saturation pulses for chemical exchange saturation transfer imaging (CEST) [1]. This project will involve modifying a simulation environment to incorporate Bloch-McConnell simulations and training a Recurrent Neural Network (RNN) using Proximal Policy Optimization (PPO) within the OpenAI Gym framework. The newly designed pulses will be compared to state-of-the-art pulses through measurements conducted on the institute's MRI scanner.

Recently, a paper was published in "Nature Machine Intelligence" that utilized deep reinforcement learning for designing radio frequency pulses for various tasks in MRI, such as slice-selective or adiabatic excitation/inversion pulses [2]. The neural network-designed pulses yielded results comparable to state-of-the-art pulses, while exhibiting novel behaviors and minimizing energy consumption. The newly designed pulses will be compared to state-of-the-art pulses through measurements conducted on the institute's MRI scanner.

Literature

[1] Wu, B., et al. "An overview of CEST MRI for non-MR physicists." EJNMMI physics 3 (2016): 1-21.
[2] Shin, Dongmyung, et al. "Deep reinforcement learning-designed radiofrequency waveform in MRI." Nature Machine Intelligence 3.11 (2021): 985-994.

Specific tasks

- Investigation and adaption of existing code base
- Training an RNN with PPO in OpenAI Gym with TensorFlow
- Bloch McConnell simulations and comparison to existing method
- MRI phantom measurements and quantification of measurement data

Recommended Knowledge and Interests

- Python/NumPy and possibly Matlab
- Interest in optimization algorithms
- MRI basics
- Training and handling of (R)NNs
- Working with numerical simulations in an MRI context

Payment

6 months research stipend for student employees (FWF)

Application

Please apply with transcript of records

Contact

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