Undersampled Magnetic Resonance Image Reconstruction

Bair Mikhailov
MIPT, Skoltech
Scientific adviser: Ph.D. Dmitry Dylov

14 декабря 2023 г.

Undersampled MRI Reconstruction Task

Problem

Accelerating MRI by taking fewer measurements allows to reduce stress of the patients and medical costs. However, it negatively impacts the quality of the image.

Goal

Develop a method which preserves the quality of the Undersampled MRI.

Formal problem statement

1. $(m, y) \in \mathcal{D}$ – Dataset
2. $m, y \in \mathbb{R}^{k \times k}$, $y = \mathcal{F}(m)$ – MRI image and its inverse Fourier transformation
3. $I : \mathbb{R}^{k \times k} \longrightarrow \mathbb{R}^{n \times l}$ – Filter function, which zeroes some columns and preserve others

The goal is to find function $B^* : \mathbb{R}^{k \times k} \longrightarrow \mathbb{R}^{k \times k}$ which minimizes the risk over the image distribution:

$$B^* = argmin_B R(B)$$

where

$$R(B) = \mathbb{E}_{y,m}[L(B(I(y)), m)]$$

Bibliography

Jure Zbonta, Florian Knoll et al.
fastMRI: A Publicly Available Raw k-Space and DICOM Dataset of Knee Images for Accelerated MR Image Reconstruction Using Machine Learning
Radiology: Artificial Intelligence 2020 2:1.

N. Pezzotti et al.
An Adaptive Intelligence Algorithm for Undersampled Knee MRI Reconstruction
IEEE Access, vol. 8, pp. 204825-204838, 2020.

Xin B. et al.
Fill the K-Space and Refine the Image: Prompting for Dynamic and Multi-Contrast MRI Reconstruction
arXiv e-prints (2023): arXiv-2309.