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Image processing technique for improved MRI image fidelity

A novel technique to improve MRI image fidelity via the combination of a denoising and deep learning-based reconstruction.

IP Status: PCT Pending: Application #: PCT/US2022/052876 ; US Pending Application No.: 18/720,261

Applications

- Functional and structural imaging

Technology Overview

The conventional computational imaging pipeline in magnetic resonance imaging (MRI) either involves a linear reconstruction followed by denoising or a non-linear reconstruction that "jointly" denoises and reconstructs from sub-sampled datasets, e.g. based on deep learning (DL). The former offers interpretability about noise components that have been removed following linear reconstructions, for which noise distributions are well-characterized. However, the overall performance is inherently tied to the linear reconstruction, which limits the acceleration rates that can be achieved, compared to state-of-the-art physics-driven DL (PD-DL) techniques. On the other hand, the latter approach of using non-linear reconstruction combines denoising and reconstruction, and offers little interpretability into what components have been removed and also has potential to over-regularize, especially for low-SNR acquisitions, leading to blurring and a loss of fine details. Thus, a synergistic combination of conventional denoising algorithms with interpretability and non-linear reconstruction methods with superior artifact reduction is desirable. To tackle this challenge, we reimagine this computational imaging pipeline to perform denoising on the acquired undersampled images for commonly used undersampling patterns and then perform non-linear PD-DL reconstruction on these data with improved and more uniform SNR. The demonstration of this idea on high-resolution 7T 0.5mm isotropic functional MRI (fMRI) data shows substantial improvement over existing computational MRI approaches. This invention offers improved reconstruction and denoising quality over what deep learning reconstruction or state-of-the-art denoising methods can offer alone.

Phase of Development

TRL: 4-5
Proof of concept demonstrated on 7T brain data.

Desired Partnerships

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Technology ID
2022-104

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Researchers

- **Steen Moeller, PhD** Associate Professor, Department of Radiology
- **Mehmet Akçakaya, PhD** Jim and Sara Anderson Associate Professor, Department of Electrical and Computer Engineeringt
- **Kamil Ugurbil, PhD** Professor, Department of Radiology

References

1. Omer Burak Demirel, Steen Moeller, Luca Vizioli, Burhaneddin Yaman, Logan Dowdle, Essa Yacoub, Kamil Ugurbil, and Mehmet Akçakaya(2023) , https://ieeexplore.ieee.org/document/10123799, 2023 11th International IEEE/EMBS Conference on Neural Engineering (NER)