UNIVERSITY OF MINNESOTA
Driven to Discover℠

SSDU software for non-Cartesian trajectories- Evaluation License

Non-Cartesian implementation of a self-supervised physics-based deep learning reconstruction without fully-sampled data

Applications

Medical image reconstruction - MRI, CT, etc

Key Benefits & Differentiators

- Unsupervised training when fully-sampled reference data is not available
- Compatible with standard conventional MRI or CT scanners with no changes to data acquisition
- Compatible with any neural network that a company may already use
- 4x better than standard techniques from a noise perspective, which can be exploited via acceleration or improved spatial resolution
- Non-Cartesian implementation potentially accelerates multi-echo spiral fMRI by 10-fold
- Can provide acceleration rates beyond what is specified by the number of coils

Overview

Several machine learning (ML) methods are being developed to improve regularized reconstruction in a multitude of inverse problems, especially in computational medical imaging (e.g. MRI, CT). Some of the most successful methods use a physics-based ML reconstruction approach, wherein the reconstruction is performed by "unrolling" an optimization algorithm into a neural network that alternates between a regularizer unit and a data-consistency unit. However, these networks are typically trained in a supervised manner, requiring a large database of fully-sampled (reference) data at the desired resolution, which is often impossible to acquire. On the other hand, training using lower-resolution reference data has not been effective in reconstructing higher-resolution data.

Researchers at the University of Minnesota have developed a novel approach for self-supervised training for physics-based ML reconstruction in inverse problems, without requiring a database of fully-sampled data. With this approach, algorithms can be trained on existing databases of undersampled images (e.g. as in the case of the Human Connectome Project) or on a scan-specific manner. This novel approach is highly effective in scenarios where acquiring fully-sampled datasets are not available or impossible due to organ motion or physical constraints such as signal decay. When implemented in MRI or CT systems for image reconstruction, the scan time can be significantly reduced while improving the quality of reconstructed images without having to modify acquisition hardware. Additionally, the researchers have implemented this approach using non-cartesian trajectories for denser sampling of echo times. The researchers have shown that the performance of the Cartesian trajectory method to be similar to that of supervised approaches that are trained with fully-

Technology ID

2024-315

Category

All Technologies
Express License
Engineering & Physical Sciences/MRI & Spectroscopy
Life Sciences/Diagnostics & Imaging
Life Sciences/Health IT
Life Sciences/MRI & Spectroscopy
Software & IT/Algorithms
Software & IT/Health IT
Software & IT/Image & Signal Processing

Learn more

sampled reference and the non-Cartesian implementation show high spatiotemporal resolution with meaningful BOLD analysis.

References

1. Burhaneddin Yaman, Seyed Amir Hossein Hosseini, Steen Moeller, Jutta Ellermann, Kâmil Uğurbil, Mehmet Akçakaya(July 2020) , https://onlinelibrary.wiley.com/doi/full/10.1002/mrm.28378, https://onlinelibrary.wiley.com/journal/15222594, 84, 3172-3191
2. Hongyi Gu, Chi Zhang, Zidan Yu, Christoph Rettenmeier, V. Andrew Stenger, Mehmet Akçakaya(Dec 2023) , https://arxiv.org/abs/2312.05707, https://arxiv.org/list/eess/recent