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Wolfson Brain Imaging Centre

Simulation tool for non-Fourier MRSI reconstruction

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GOAL

To implement a **simple**, **from-scratch**

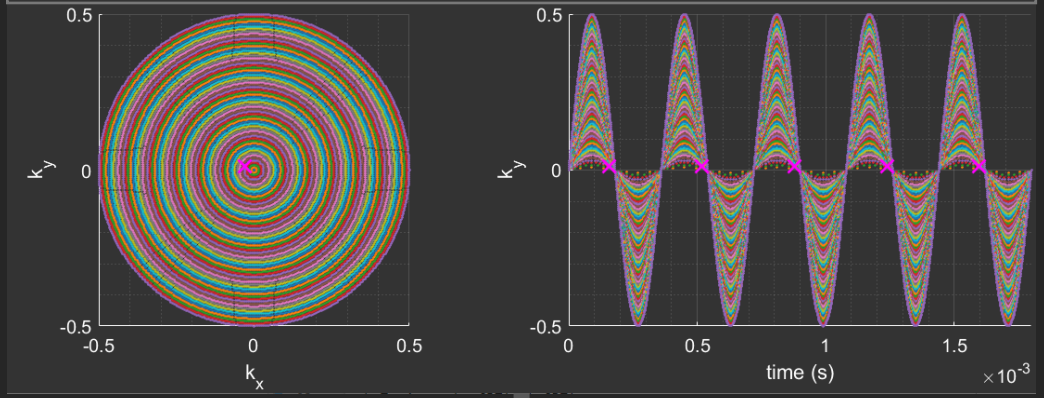
simulation and reconstruction method

which can be used for

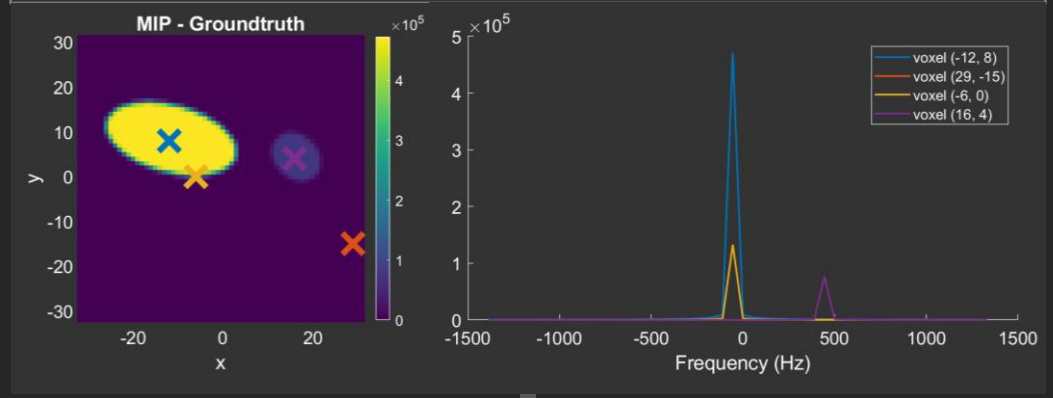
non-uniformly sampled k-space trajectories

Simulation Framework

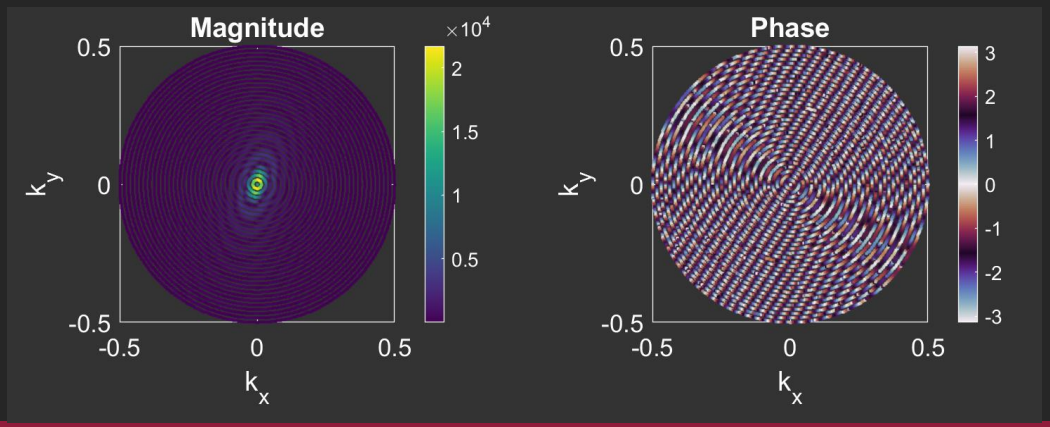
(A) 2D-concentric Ring Trajectory: (k_x, k_y, t)



(B) 2D Geometric Phantom (x, y , f)



(C) Analytical non-cartesian k-space Samples (k_x, k_y, t)



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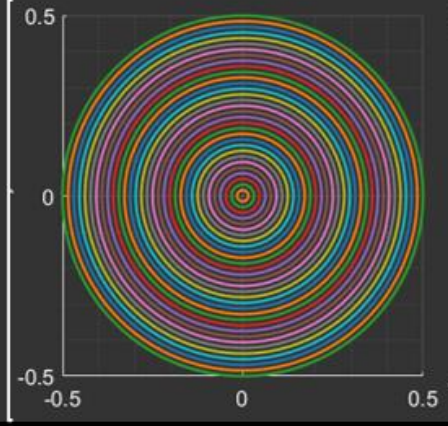
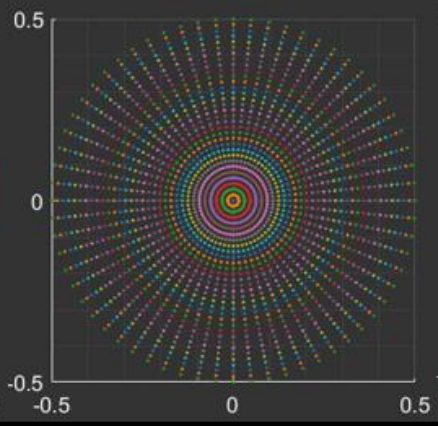
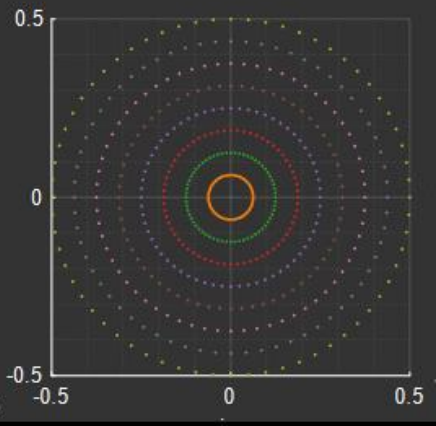
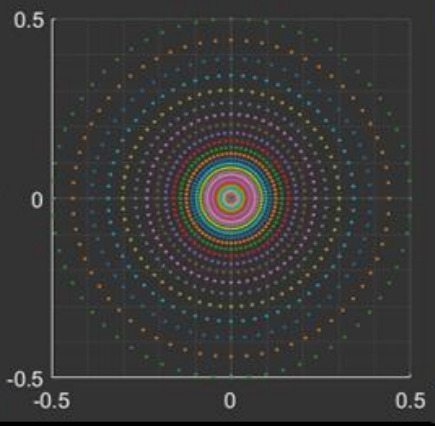
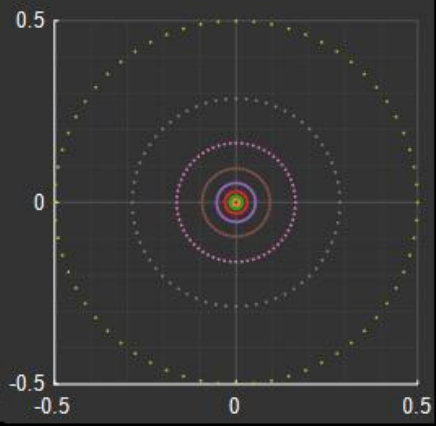
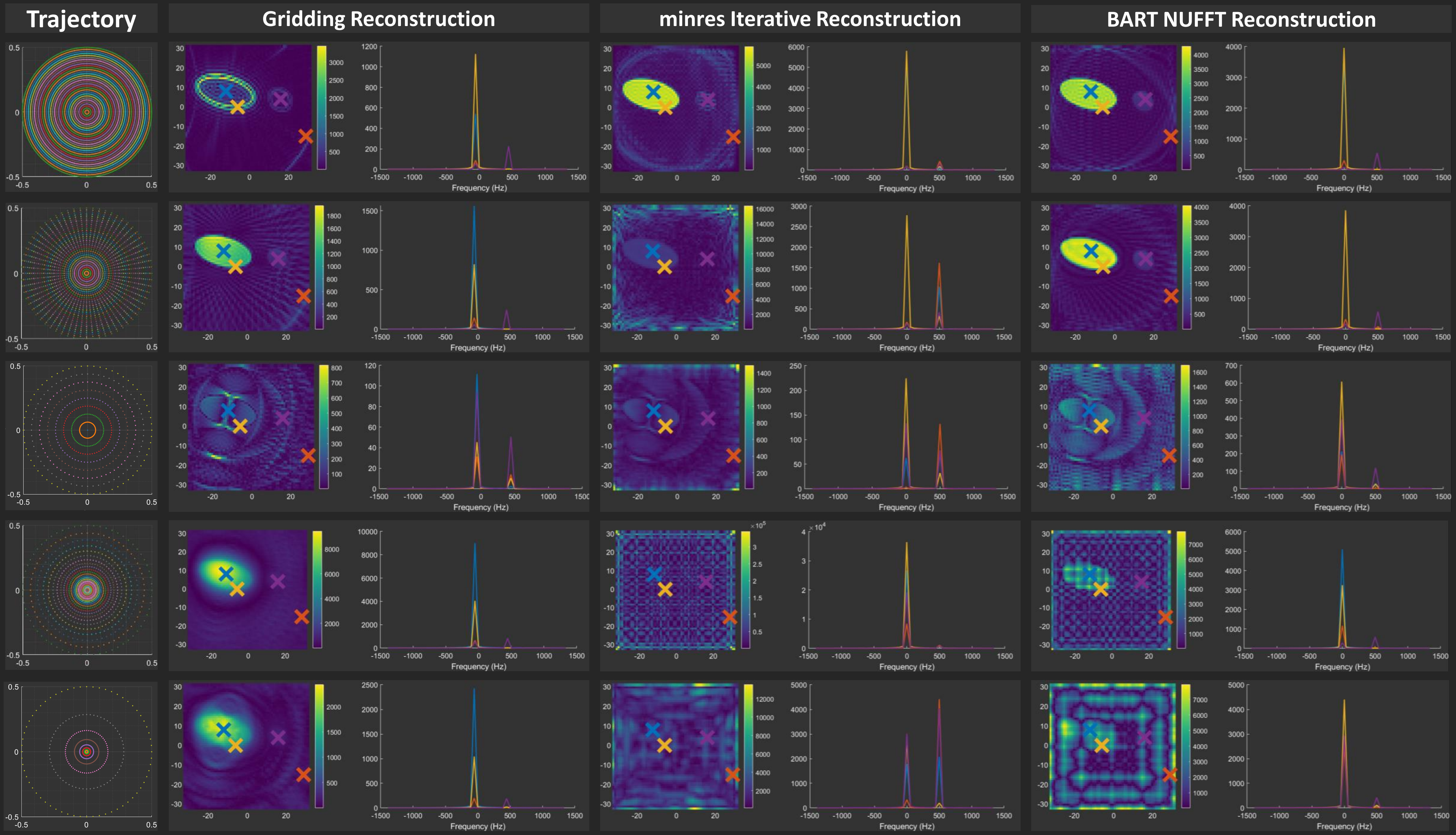
Example Usage

Example Trajectories

Case:	1	2	3	4	5
Sampling Pattern Properties	Increasing Angular Density	Equidistant Dense	Equidistant Sparse	Density-weighted Dense	Density-weighted Sparse
K-space Trajectory					


Trajectory
Gridding Reconstruction
minres Iterative Reconstruction
BART NUFFT Reconstruction
Frequency (Hz)

Reconstruction Performance

Example	Sampling Properties	Gridding	*minres* Iterative	BART NUFFT *
1	Increasing Angular Density	0.9962	1.0003	1.0002
2	Equidistant Dense	0.9981	1.0000	1.0000
3	Equidistant Sparse	0.9969	1.0002	1.0000
4	Density-weighted Dense	0.9998	1.0000	1.0000
5	Density-weighted Sparse	0.9851	1.1227	1.0001

Next Steps

- Try it yourself:

We thank our …

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Helpful Resources & References

- Mark Chiew's Demo Code on iterative Reconstruction:
  - http://htmlpreview.github.io/?https://github.com/mchiew/non-cartesian-MRI-tutorial/blob/main/non_cartesian.html
- Lecture Notes "**Non-cartesian Reconstruction**" by John Pauly:
  - https://mri-q.com/uploads/3/4/5/7/34572113/pauly-non-cartesian_recon.pdf
- *BART Toolbox:
  - https://mrirecon.github.io/bart/