ROI-Specific k-space Reconstruction

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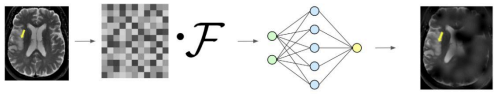
Motivation

- In MRI and related applications, acquiring an entire image might not be necessary if we only care about a specific region
- Can smartly subsample in k-space (Fourier domain) and reconstruct for a specific region



Related Work

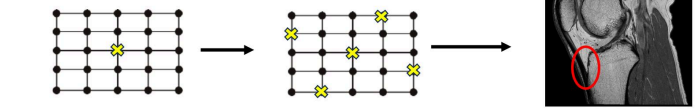
- Previous work showed sequential forward selection for k-space samples for least-squares reconstruction [1]
  - Additionally showed number of points needed to construct ROI is equal to area of ROI
- Previous work finds optimal sampling patterns for MR reconstruction, but not ROI-specific

References

[1] Y. Gao and S.J. Reeves. Optimal k-space sampling in MRSI for images with a limited region of support. IEEE Transactions on Medical Imaging,, December 2000.
[2] Cagla Deniz Bahadir, Adrian V. Dalca, and Mert R. Sabuncu. Learning-based Optimization of the Under-sampling Pattern in MRI, April 2019.

Methodology

- Choosing our forward operator as the Fourier transform, columns subsampled for our region of interest (ROI)
- Iteratively choose rows of A to minimize error criteria ($\mathrm{tr}(A^T A)$)
- Used unrolled conjugate gradient network to solve for image within ROI or globally, with fast computation



Start at DC (center of k-space) | Iteratively select other points | Use selected points for reconstruction within ROI

Experimental Results

- Generated Shepp-Logan phantom image, masked at specified ROI
- Selected 771 points using error criteria and used to reconstruct
- Compared conjugate gradient with least-squares method from [1]