Undersampling in Fourier Space for Parallel Reconstruction in MR Imaging

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Motivation

MRI relies on parallel imaging techniques (GRAPPA/SENSE) to accelerate image acquisition through undersampling in Fourier space
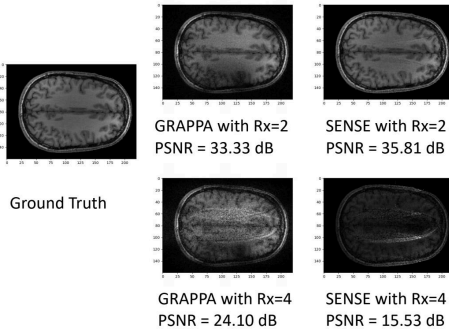
GRAPPA: Preferred for its robustness in noisy or low-signal environments
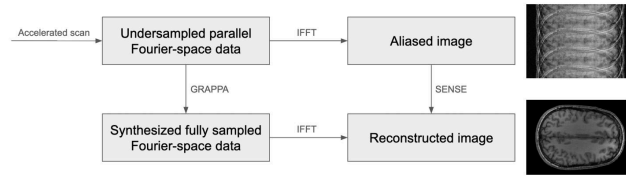- Cannot optimize SNR or incorporate image priors

SENSE: Used for SNR optimization and allows image prior incorporation
- Less robust in noisy environments and prone to artifacts

Technique

GRAPPA model
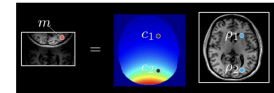

$$k_{ACS} = Aw$$

$$k_{GRAPPA} = conv2d(w, k_{acc})$$

SENSE model

$$m_{aliased} = Cp$$

Experimental Results

Ground Truth

GRAPPA with Rx=2
PSNR = 33.33 dB

SENSE with Rx=2
PSNR = 35.81 dB

GRAPPA with Rx=4
PSNR = 24.10 dB

SENSE with Rx=4
PSNR = 15.53 dB

Next Steps

- Incorporating prior information into GRAPPA reconstruction can improve robustness and image quality
- Combining GRAPPA and SENSE with priors from k-space reduces aliasing and artifacts
- Generative priors improve image quality by reducing artifacts in undersampled MRI data

References

[1] Lin, F-H, Prior-regularized GRAPPA Reconstruction
[2] Sakitis, C., Rowe, D., Bayesian merged utilization of GRAPPA and SENSE (BMUGS) for in-plane accelerated reconstruction increases fMRI detection power
[3] Juo, G, et al. GenerativePriors for MRI Reconstruction Trained from Magnitude-Only Images Using Phase Augmentation