



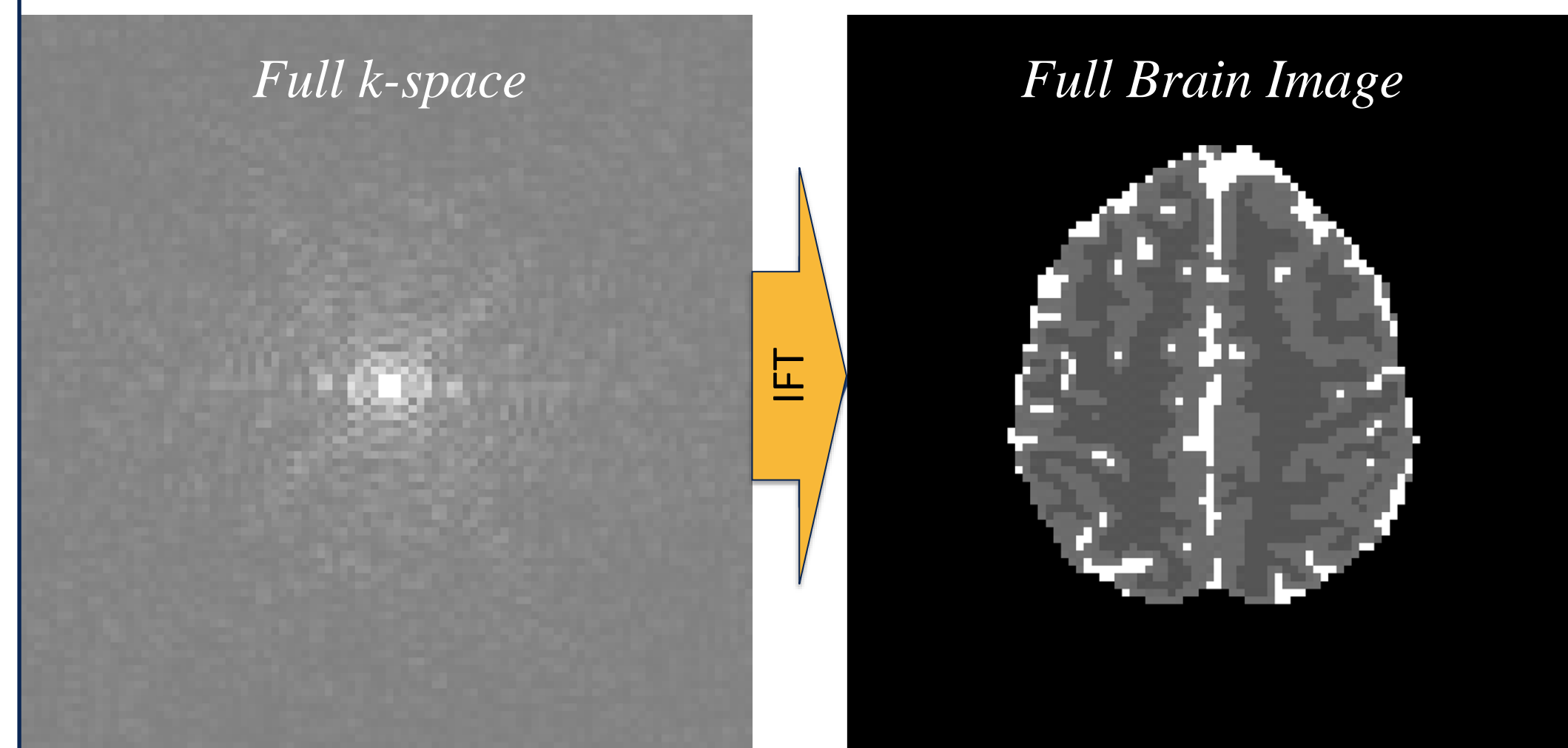
A Full Bayesian Approach to GRAPPA Reduces Noise In fMRI Image Reconstruction

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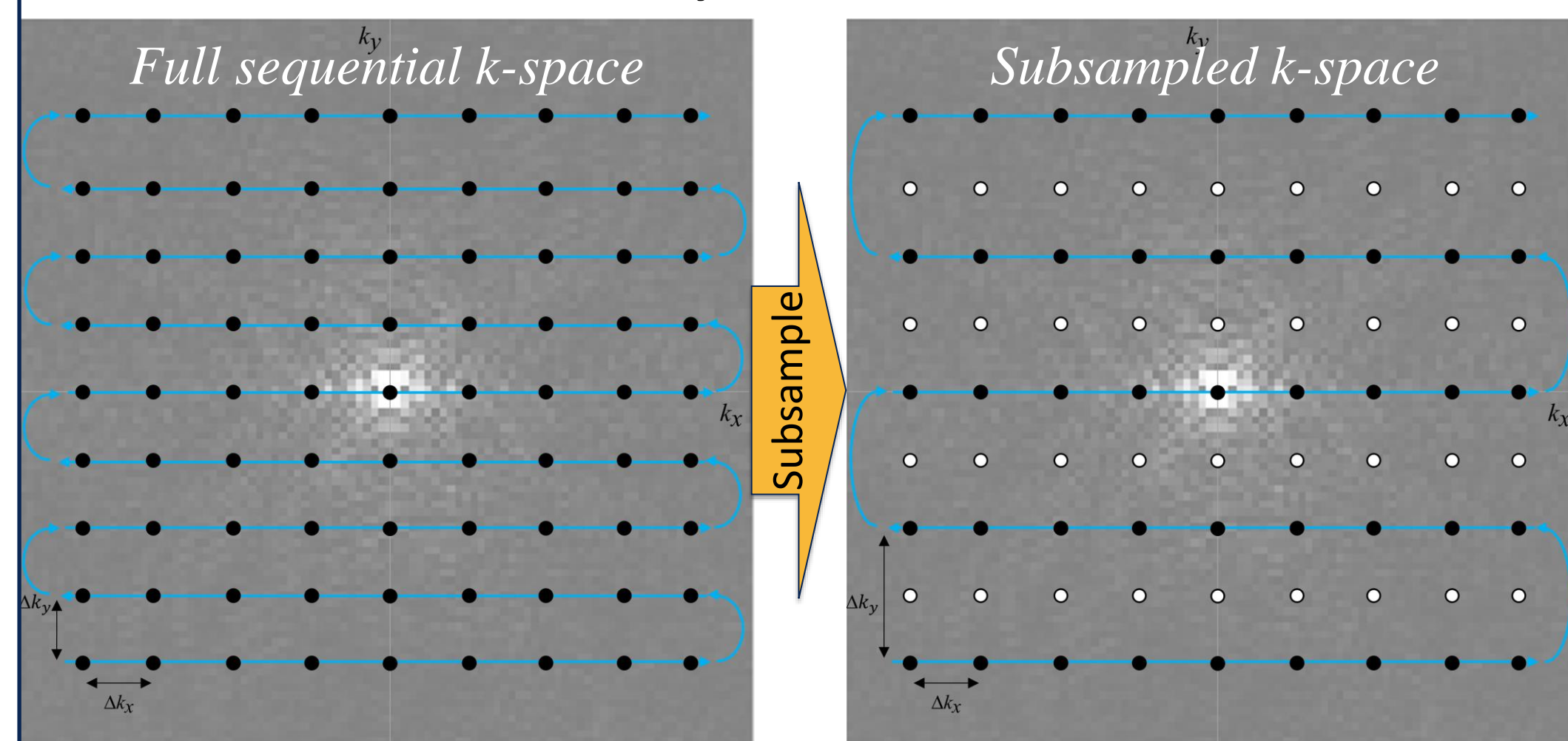
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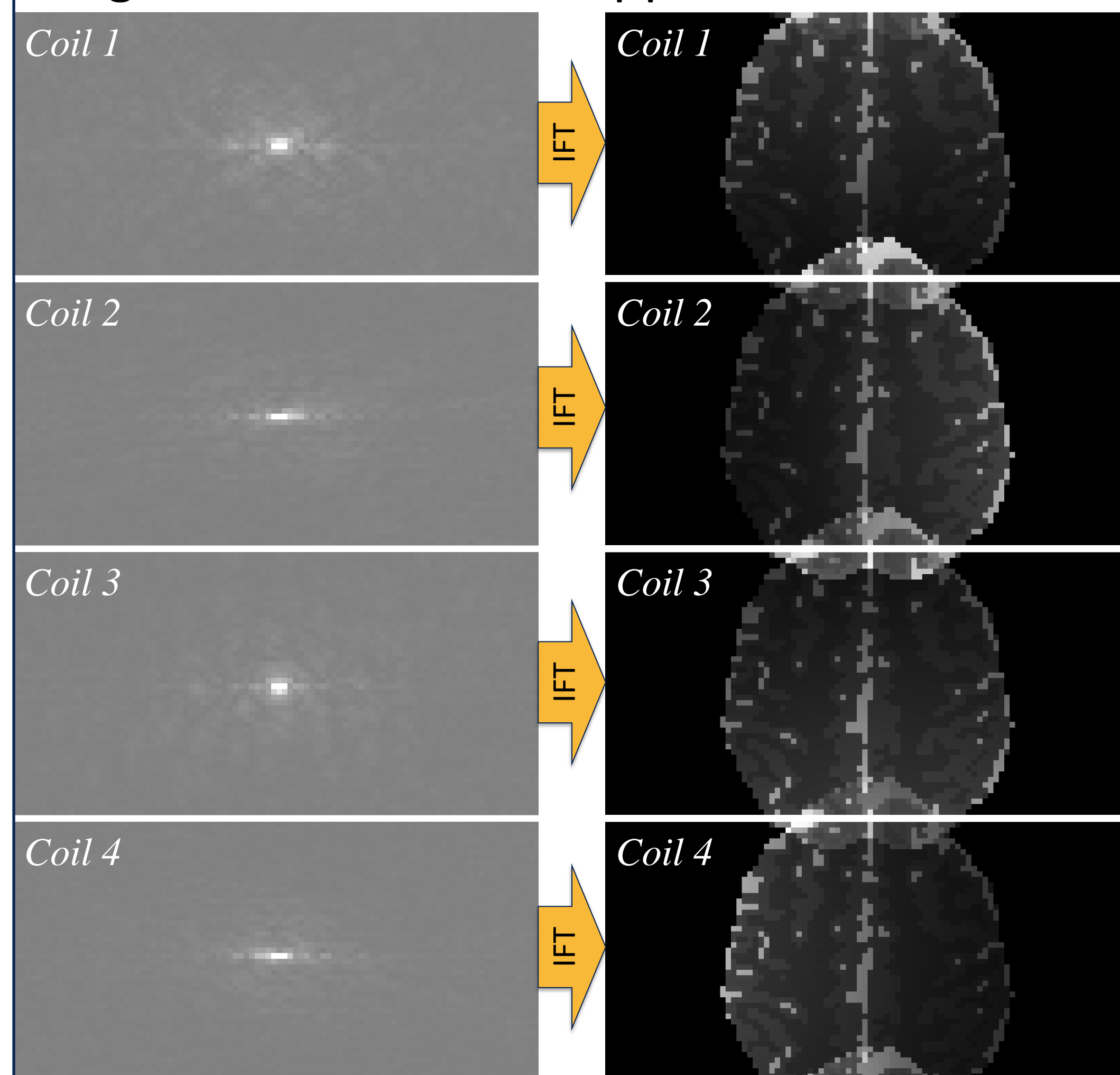
FMRI



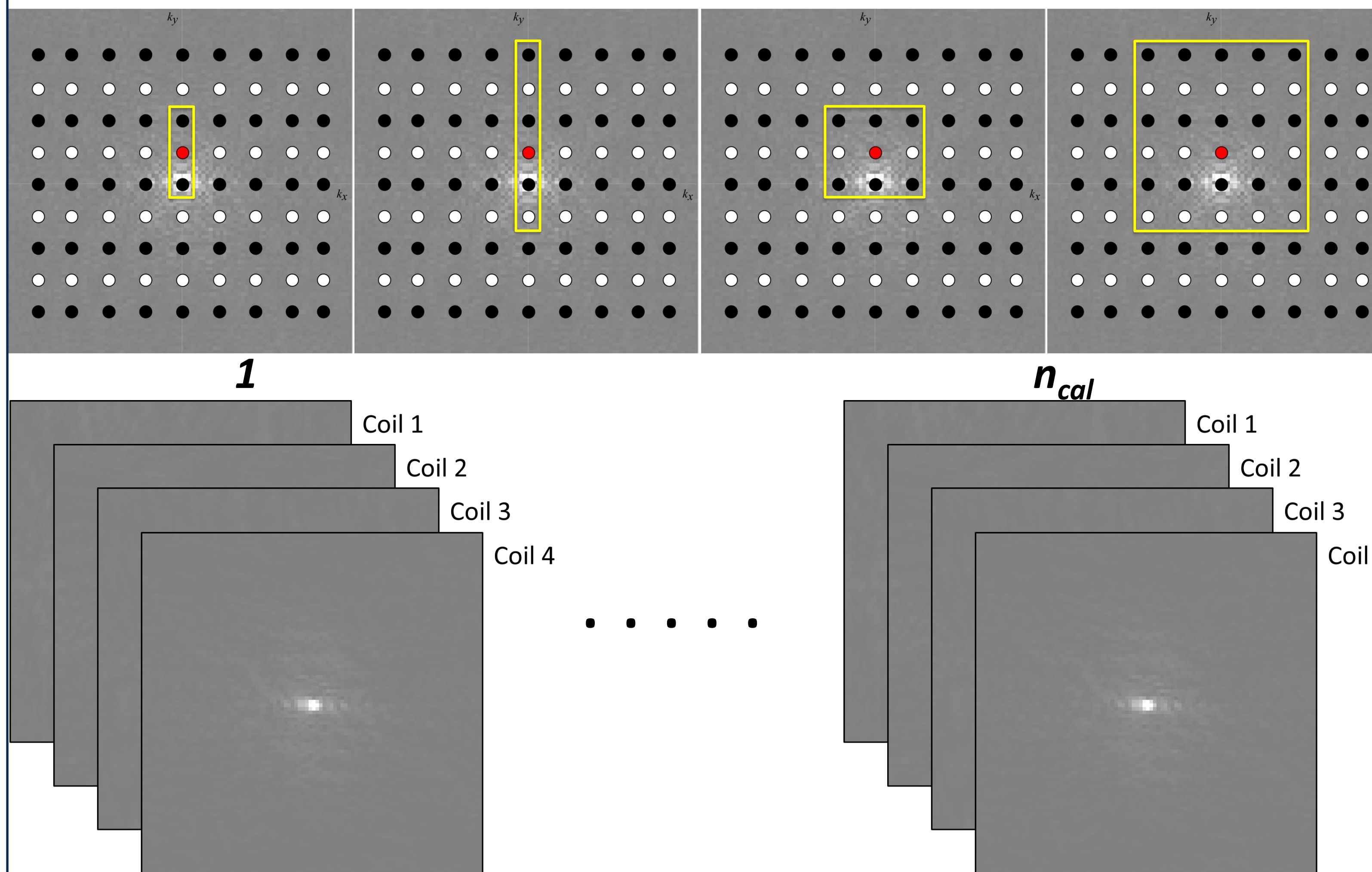
Acquiring full k -space arrays can take a considerable amount of time, being the limiting factor in capturing brain activity. Measuring less data can reduce this time. This can be achieved by skipping lines in k -space which is indicated by the acceleration factor



To accomplish this, multiple receiver coils are utilized in parallel to obtain the subsampled spatial frequency arrays. However, this causes images to be aliased or appear “folded over.”



Pre-Scan Calibration k -space



BGRAPPA

- Utilizes estimated **weights**, **missing k -space**, **noise variance**, and **number of time points** from calibration k -space information.
- Prior distribution for weights, missing k -space values, and noise variance.
- Estimated using MAP estimate (via ICM) or marginal posterior mean (via Gibbs sampling).

GRAPPA

- Utilizes only the estimated **weights** from calibration k -space information while **disregarding the missing spatial frequency and noise variance information**.
- Weights are **fixed** for every time point in the series of subsampled spatial frequencies to estimate missing k -space values.

Simulated Study

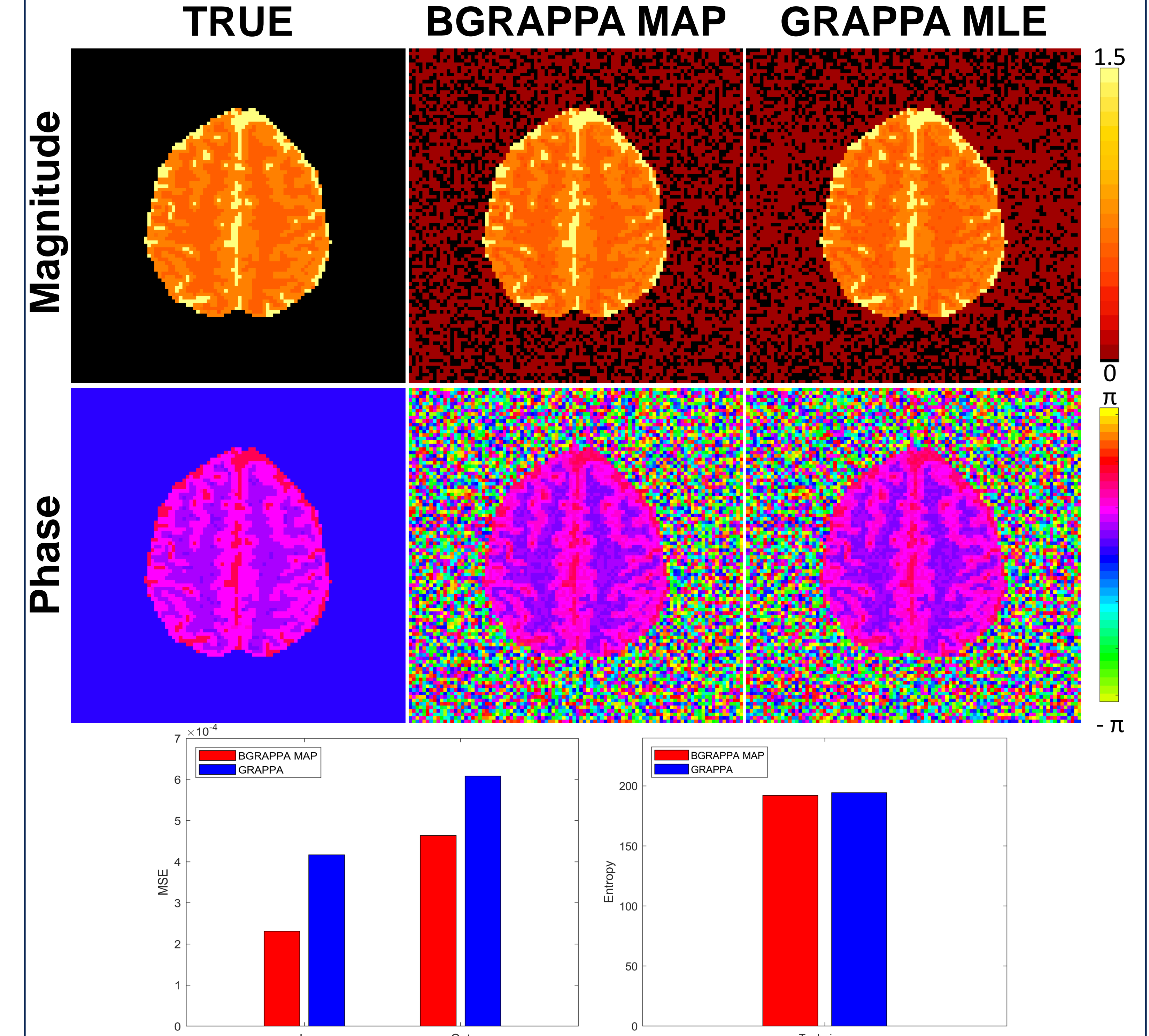
To mimic the real-world experimental data:

- FMRI time series of 510 TRs, discarding the first 20, leaving 490 TR
- Time series (of the 490): 15 off/on, 16 epochs, conclude with 10 off
- 8 coils used for sensitivity map with an acceleration factor of 2
- Utilized 30 calibration time points with a kernel size of 2x1

References

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 (2) Bandettini P, Jesmanowicz A, Wong E, Hyde J. *Processing strategies for time-course data sets in functional MRI of the human brain*. *Mag. Res. Med.* 30:161–173, 1993.
 (3) O’Hagen A. *Kendall’s Advanced Theory of Statistics*, vol. 2B. Bayesian Inference. John Wiley and Sons Inc., New York, 1994.
 (4) Lindley DV, Smith AFM. *Bayes estimates for the linear model*, *J Royal Stat Soc B*, 34:1-18, 1972.
 (5) Geman S, Geman D. *Stochastic Relaxation, Gibbs Distributions, and the Bayesian Restoration of Images*. *IEEE Trans Pattern Anal Mach Intell*, 6:721-41, 1984

Single Time Point Results



FMRI Time Series Results

