University Ph.D. Dissertation Defense
Department of Electrical Engineering

Mark Nishimura

Algorithms for Efficient Constrained Reconstruction of Non-Cartesian Spatiotemporal MRI with Low-Rank Priors
Advisor: Kawin Setsompop, John Pauly

Date: Friday, December 13, 2024
Time: 1:00 pm
Location: Gates 403
Zoom Link: https://stanford.zoom.us/j/95602642113?pwd=4DCdxEmKZa1nF3ACb08LqmhZXvLeVY.1

While MRI offers unique benefits over other imaging modalities, its long scan times are a key shortcoming. Modern pulse sequences shorten scans by rapidly traversing k-space with efficient, non-Cartesian gradient waveforms, and strategically undersampling k-space to promote incoherent aliasing over time. However, the associated reconstruction algorithms require slow, non-uniform FFTs (NUFFTs) to model the non-Cartesian trajectories, as well as expensive low-rank spatiotemporal image priors to mitigate aliasing.

In the first part of the talk, an implicit neural representation is used to model image phase. This enables the conversion of non-Cartesian trajectories and data into Cartesian ones, speeding up the reconstruction process by eliminating the NUFFT. In the second part, this modeling approach is combined with a matrix-free preconditioner that helps the reconstruction to converge in fewer iterations, therefore requiring fewer proximal operator evaluations. Finally, evaluations on spatiotemporal MRI applications are presented, showing that the approach dramatically improves reconstruction time while maintaining image quality.

Kawin Setsompop, Ph.D.
Associate Professor of Radiology
and by courtesy Electrical Engineering,
Associate Chair of Research Strategic Development,