Stanford University Ph.D. Dissertation Defense
Department of Bioengineering

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Getting to the Heart of It:
Robust Data Acquisition and Analysis
for Cardiac Diffusion Tensor Imaging
Advisor: Daniel B. Ennis

Date: Thursday, May 29th, 2025
Time: 8:30 am (PDT)
Location: Packard 202
Hybrid Viewing: Zoom Link

Cardiac diffusion tensor imaging (cDTI) is an emerging method that enables the *in vivo* characterization of cardiac mesostructure. Biomarkers derived from cDTI, such as mean diffusivity and fractional anisotropy provide insights into the magnitude of diffusion and anisotropy in the beating heart. Additionally, cDTI enables the estimation of transmural changes in aggregate cardiomyocyte orientation, known as the helix angle, which plays an important role in constructing accurate computational models of the heart.

cDTI is a technically challenging modality for *in vivo* imaging due to inherently low signal-to-noise ratio, image distortion, tissue motion (cardiac and respiratory), and prolonged scan times. If unaddressed these limitations contribute inaccuracies and high uncertainties in cDTI metrics. Therefore, developing robust data acquisition and analysis methods are essential for advancing cDTI research.

In my defense, I will share three contributions from my doctoral research aimed at enhancing both cDTI data acquisition and analysis:

(1) The evaluation of Cardiac Diffusion in Python (CarDpy), an open-source, data analysis toolbox for cDTI.
(2) The adaptation of echo planar imaging distortion correction techniques widely used in neurological diffusion tensor imaging for more robust cDTI.
(3) A study identifying robust diffusion encoding schemes (i.e. combinations of encoding directions and averages) given a fixed number of diffusion-weighted images.

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