ELECTRICAL & COMPUTER ENGINEERING
UNIVERSITY OF MICHIGAN

Electrical and Computer Engineering

ECE Final PhD Defense

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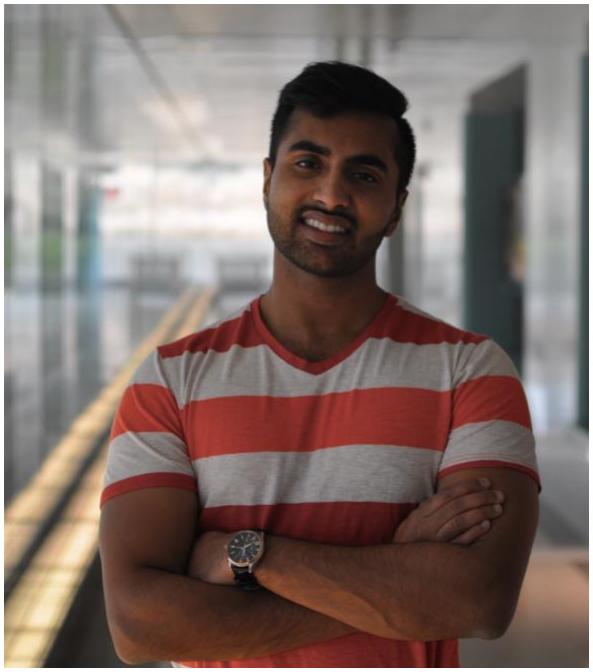

Advances in Quantitative MRI: Acquisition, Estimation, and Application

Friday, March 23, 2018
10:00 am – 12:00 pm •
GM Conference Room, 4th floor,
Lurie Engineering Center

Chairs: Professor Jeffrey A. Fessler
Associate Research Scientist Jon-Fredrik Nielsen

Abstract:

Quantitative magnetic resonance imaging (QMRI) produces images of MR biomarkers, or measurable tissue properties that are indicative of physiological processes that characterize the onset and progression of specific disorders. (For example, MR elasticity imaging is indicative of the abnormal tissue hardening that characterizes sclerosis.) QMRI has potential to be more informative than conventional qualitative MRI but poses challenges beyond those of conventional MRI that currently limit its feasibility for routine clinical use.

This thesis develops tools to address two key QMRI challenges and applies these tools to develop a new method for myelin water imaging, a challenging application that may be indicative of certain demyelinating conditions such as multiple sclerosis. To address long QMRI scan times, this thesis first develops a method to assemble fast, statistically informative acquisitions that enable min-max optimally precise biomarker estimation. To address the challenges of estimating biomarkers from highly nonlinear and possibly unavailable MR signal models, this thesis next develops a method to "learn" a very efficient biomarker estimator purely from simulated training data. The tools developed in this thesis enable whole-brain high-resolution in vivo myelin water imaging in about 10 minutes of scan time, whereas state-of-the-art methods require 30 minutes or more.