## ECE Communications and Signal Processing

CSP SEMINAR SERIES

## Beyond Supervised Learning for Biomedical Imaging

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## THURSDAY, SEPTEMBER 12, 2019 4:00 pm – 5:00 pm 1005 EECS

**ABSTRACT**: Many biomedical imaging tasks, such as 3D reconstruction, denoising, detection, registration, and segmentation, are ill-posed inverse problems. In this talk, I will present a flexible machine learning-based framework that has allowed us to derive efficient solutions for a variety of such problems, without relying on heavy supervision. I will primarily employ image registration as a concrete application and present the details of VoxelMorph, our unsupervised learning-based image registration tool. I will show empirical results obtained by co-registering thousands of brain MRI scans where VoxelMorph has yielded state-of-the-art accuracy with runtimes that are orders of magnitude faster than conventional tools. Finally, I will present some recent results where we used VoxelMorph to learn conditional deformable templates that can reveal population variation as a function of factors of interest, such as aging or genetics. Our code is freely available at https://github.com/voxelmorph/voxelmorph.

**BIO:** Mert R. Sabuncu received a PhD degree in Electrical Engineering from Princeton University, where his dissertation dealt with the problem of establishing spatial correspondence across multiple images, such as MRI scans. Mert then moved to Massachusetts Institute of Technology for a post-doc at the Computer Science and Artificial Intelligence Lab, where he worked on various biomedical image analysis problems, including the segmentation of brain MRI scans. Next, Mert spent a few years at the A.A Martinos Center for Biomedical Imaging (Massachusetts General Hospital and Harvard Medical School) as a junior faculty member. Today, Mert is an Assistant Professor at Cornell's School of Electrical and Computer Engineering, and Meinig School of Biomedical Engineering. His research group develops computational tools for biomedical imaging applications.



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