

Rapid, Efficient, and Robust Neuroimage Analysis with Deep Neural Networks

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3/23/2018 at 02:00 pm
CBIM 22

Abstract

Neuroimaging is entering a new era of unprecedented scale and complexity. Soon, we will have datasets including brain images from more than 100,000 individuals. The fundamental challenges in analyzing and exploiting these data are going to be computational. Today, widely-used traditional neuroimage analysis tools, such as FreeSurfer or FSL, are computationally demanding and offer limited flexibility, while cutting-edge tools based on modern machine learning techniques require large amounts of annotated training data, and/or are untested at scale. In this talk, I will present our recent work on two fundamental image analysis problems: registration and segmentation. In image registration, I will introduce a novel framework that allows us to train a neural network that rapidly computes a smooth and invertible nonlinear (diffeomorphic) deformation that aligns two input images, in an unsupervised fashion (i.e. without using ground-truth registrations). I will show experiments on 7000+ brain MRI scans with state-of-the-art results. In the second part, I will present a new segmentation framework that flexibly handles multiple labeling protocols, and generalizes well to new datasets and new segmentation labels, with little additional training.

Bio

Mert R. Sabuncu is a faculty member of Cornell School of Electrical and Computer Engineering. At Cornell, Mert directs a lab that focuses on biomedical image analysis - for scientific (e.g. brain mapping) and clinical (e.g., computer-aided diagnosis) applications. Merts research employs and contributes to the toolkits of machine learning, image processing, computer vision, and other modern computational methods. Mert has a PhD from Princeton Electrical Engineering, and was a post-doc at MIT, where he worked with Polina Golland. Before joining Cornell, he was a faculty member

at the A.A. Martinos Center for Biomedical Imaging (Harvard Medical School and Massachusetts General Hospital).

Faculty Host: Dimitris Metaxas