Neural Nets to Neural Nets: Deep Learning Approaches to Neuroimaging

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Brain imaging provides a unique view of brain function albeit via indirect measurements that complicate the interpretation. Traditional approaches cope with this complication by fitting parameters of a model to observed data but such models of how the brain works are far from perfect. In this situation, researchers are left with studying interactions among many indirectly observed variables: a problem similar to representation learning in the fields of natural data processing that include speech, images, video and time series analysis. All of these fields have recently been disrupted by successes made possible thanks to deep learning approaches. Historically neuroimaging has benefitted greatly from the introduction of analysis and acquisition approaches borrowed from other disciplines to examine brain function in new ways. It is clear that a similar adoption is about to happen with deep learning approaches and this process can potentially affect multiple areas of brain imaging that rely on pattern analysis in high-dimensional data. In this symposium, we have asked the speakers to discuss deep learning approaches that are new to the brain imaging community and show their benefits in practical application to different modalities and their combinations. A particular focus is on differences in the main question of the already traditional application domains of deep learning (prediction) and brain imaging (understanding).

Deep learning: an introduction
Ruslan Salakhutdinov, Computer Science and Statistics, University of Toronto, Canada

Recurrent neural networks for decoding, diagnosis and dynamic functional connectivity estimation from fMRI data.
Orhan Firat, Department of Computer Engineering, Middle East Technical University, Turkey

Deep feature learning for EEG recordings
Sebastian Stober, Research Focus Cognitive Sciences University of Potsdam, Potsdam, Germany

A deep-learning approach to translate between brain structure and functional connectivity
Devon Hjelm, The Mind Research Network, Albuquerque, NM, United States