Department of Computer Science

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Presents

Functional Alignment of fMRI Datasets Based on Optimal Transportation

by

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M.Sc. Thesis Proposal Presentation
Time: Apr 8, 2022 02:00 PM Halifax
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The activation of the human brain is highly variable between people. Although the basic anatomical circuitry of human brains is similar, the specific patterns of neuron connections and interactions differ greatly from person to person. In this thesis, we aim to apply a new approach using Optimal Transport (OT) to find a shared space in which we can decode the neural activity of different individuals.

The OT transportation plan is used to map subjects' Ventral Temporal Cortex responses to visual stimuli, measured with Functional Magnetic Resonance Imaging (fMRI) into a common space. This method provides an optimal solution to align multiple fMRI datasets, as well as a context in which we can compare those datasets geometrically. The alignment of fMRI data in a group brain study reduces the limitations caused by individual differences, which allows us to make a better prediction of the distinct individuals' mental functions.

Most studies comparing fMRI data between individuals consider mapping subjects' brains anatomically. Here, we align brains functionally using a mathematical approach via the transportation theorem. We believe that the proposed method will result in a better alignment that minimizes the differences between subjects' fMRI datasets. Further, with this new method, the brain activity between subjects can be more accurately analyzed, and this will improve studies that involve populations with highly different brain structures. For example, the brain structure of those individuals having brain injuries, degenerative brain disease, dementia, cerebral palsy, or mental illnesses vary significantly from healthy ones which makes it difficult to analyze and compare the brain activation among them. Finally, we will apply some Machine Learning techniques, namely classification and representational similarity analysis, to show the validity of the proposed method by comparing the obtained result with some existing approaches.