

DEEP LEARNING AND ITS APPLICATIONS
PROJECT PRESENTATION ON AUTISM SPECTRUM
DISORDER CLASSIFICATION
GROUP-12

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Overview

- Autism spectrum disorder (ASD) is characterized by qualitative impairment in social reciprocity, and by repetitive, restricted, and stereotyped behaviors/interests.
- ASD is recognized to occur in more than 1% of children. Despite continuing research advances, their pace and clinical impact have not kept up with the urgency to identify ways of determining the diagnosis at earlier ages, selecting optimal treatments, and predicting outcomes. For the most part this is due to the complexity and heterogeneity of ASD.

Problem Statement

- Applying Deep Learning to identify Autism Spectrum Disorder (ASD) patients from large brain imaging dataset(ABIDE-I and II).

Motivation

- ① Autism Spectrum Disorder (ASD) is due to impairments in social deficits and communication.
- ② ASD is highly heritable and the diagnosis is vital
- ③ As of 2015, autism is estimated to affect 24.8 million people
- ④ The traditional diagnosis methods are based on clinical interviews and behavior observation
- ⑤ Use of deep learning algorithm can improve the accuracy of diagnosis based on previous experiences.
- ⑥ The algorithm can detect signs of autism before they are diagnosed.

Challenges

- ① Dataset is small
- ② There is very less inter-class variation
- ③ Difficulty in extraction of useful component from 4D data
- ④ Difficulty in identification of network used for autism
- ⑤ Preprocessing takes a lot of time

Work done

- Identification of autism spectrum disorder using deep learning and the ABIDE dataset

Anibal Slon Heinsfeld, Alexandre Rosa Franco, R. Cameron Craddock, Augusto Buchweitz, Felipe Meneguzzi
NeuroImage: Clinical Volume 17, 2018, Pages 16-23

[Link to Paper](#)

- ① Applied Deep Learning to classify ASD and controls using ABIDE data.
- ② They extracted patterns of brain function in rs-fMRI and showed anterior-posterior underconnectivity in the autistic brain
- ③ Under connected areas in ASD rs-fMRI data: Paracingulate Gyrus, Supramarginal Gyrus and Middle Temporal Gyrus
- ④ This model surpass the state-of-the-art in deep learning classification of brain activation by achieving 70% accuracy

Work done

- A Novel Transfer Learning Approach to Enhance Deep Neural Network Classification of Brain Functional Connectomes

Hailong Li¹, Nehal A. Parikh^{1,2} and Lili He^{1,2*} Front. Neurosci., 24 July 2018

[Link to Paper](#)

- ① Used deep transfer learning neural network(DTL-NN) on ABIDE dataset from the USM site.
- ② Performance: 70.4% accuracy, 72.5% sensitivity, 67.0% specificity and 0.7 AUC.
- ③ This is comparable to a recent ASD study (Heinsfeld et al., 2018) using a deep learning algorithm. The difference is that DTL-NN model was able to achieve similar performance by using only a modest size of samples, while previous work required a large number of data for model training.

Dataset

Autism Brain Imaging Data Exchange (ABIDE) offers two large-scale collections: ABIDE I and ABIDE II. The model will be employed so as to focus on the combination of resting-state fMRI (rs-fMRI), gray matter (GM), and white matter (WM) data.

ABIDE-I Collection

- Total Number of Subjects : 1112
- Affected : 539
- Normal : 573

ABIDE-II Collection

- Total Number of Subjects : 1114
- Affected : 521
- Normal : 593

Proposed Methodology

- Preprocessing of Data

- ① Using FSL Tool to perform brain extraction, slice timing correction, motion correction
- ② Using GIFT tool to extract components, which would serve as **features** for the model

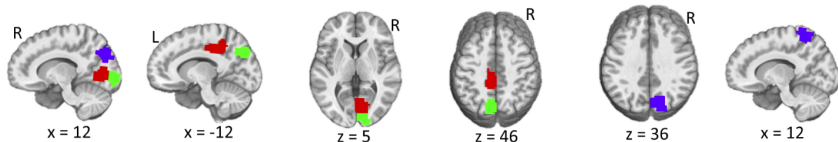


Figure: Figure showing highly correlated areas for ASD subjects

Proposed Methodology

- Classification of network (for instance, Default Mode Network)
- 3D CNN: Classification by using the components
- Autoencoder : Data is not sufficient for training. Data representation has to be learned (abstract features) to get better performance in classification.
- Siamese Network Classification : Data has a lot of similarity, also the data is very less. To learn the intraclass similarity, this network will be used.