

ATTENTION-DEFICIT/HYPERACTIVITY DISORDER DIAGNOSIS WITH TEMPORAL DIFFUSION CONVOLUTIONAL RECURRENT NEURAL NETWORKS

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ABSTRACT

Attention-deficit/hyperactivity disorder (ADHD) is one of the most common neuro-developmental disorders among children. This disorder is recognized by an occurrence of inattention and hyperactivity impulsivity that interferes with functioning. Brain network pro-vides a mathematical description of the complex connections and interactions among neurons in brain. In this paper, we propose a graph deep learning method to classify ADHD using time series brain resting-state functional magnetic resonance imaging (rs-fMRI) data. A graph diffusion convolutional recurrent network (GDCRN) architecture is implemented for the time series graph-structured ADHD classification. Correlation matrices at different time stamps are constructed based on the fMRI acquisition repetition time (TR), which are converted to mul-tiple adjacency matrices for brain network as the model input. Various training scenarios are designed for the experimental test. GDCRN has been compared with conventional diffusion convolutional neural network (DCNN). The experimental results have demonstrated that our model is able to classify ADHD and non-ADHD patients. The outcome of this research is ex-pected to promote the implementation of deep learning for ADHD detection as well as brain network analysis in the computer-aided diagnosis field.

INTRODUCTION

Attention-deficit/hyperactivity disorder (ADHD) is characterized by symptoms of impulsiv-ity, inattention and hyperactivity, which can cause learning, emotional, social relationship and adaptation disorder of children. Inattentive and impulsive children will have trouble in focusing their attention and impulsively act immediately without thinking. Furthermore, this has a wide range of negative effects on the academic achievements, careers and quality of life of patients, as well as a heavy burden on their families and society [1]. Therefore, there is a high risk of developing these behaviors and symptoms into ADHD with lack of detection, identification and proper treatments [2].

The human brain can be envisioned as a large and complicated network efficiently controlling the complex systems of the body. Related researches mentioned that abnormalities in different brain areas such as the anterior cingulate, posterior cingulate cortex and ventromedial prefrontal cortex as the main factors for this disorder [3]. Brain network provides a mathematical descrip-tion of the complex connections and interactions among neurons in brain. Correlation is one of the popular methods to calculate function connectivity and different correlation methods have been employed to compute the functional connectivity of the brain. Because well-defined tech-niques to diagnose ADHD in clinical practice are lacked, researches are motivated to conduct accurate identification of ADHD using time series resting-state functional magnetic resonance imaging (rs-fMRI) data to