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学位の種類	博士(工学)		
学位記番号	甲第410号		
学位授与年月日	令和5年9月20日		
学位授与の要件	学位規則第4条第2項		
研究科・専攻名	工学研究科・基盤工学専攻		
学位論文題目	A Study on Deep Learning Algorithms for Electroencephalography (EEG) and Functional Magnetic Resonance Imaging (fMRI) Signal Processing (脳波 EEG および機能的磁気共鳴画像 fMRI 信号のための深層学習アルゴリズムに関する研究)		
論文審査	(主査) 高知工科大学	教授	岩田 誠
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審査結果の要旨

1. 論文の評価

His dissertation describes a study of deep learning algorithms for noisy brain signal processing, especially focusing on non-invasively measured brain signals such as electroencephalography (EEG) and functional magnetic resonance imaging (fMRI).

Firstly, he proposed a spatial-temporal neural network (STNN) for P300 EEG classification. STNN achieved the highest accuracy with less repeated stimuli in the world. This is because STNN is skilled at decoding temporal activities of EEG signals and EEG channel generalization in the space domain at the same time.

Secondly, he proposed a multi-module neural network (MMNN) for EEG signal denoising due to human's ocular and myogenic artifacts. MMNN achieved the highest denoising performance with less learning convergence. This is because the multiple denoising modules in MMNN purify noisy input EEG signals by continuously removing artifacts in the forward propagation. Furthermore, the parallel architecture allows the parameters of each denoising module to be updated concurrently in the backpropagation.

Lastly, he proposed a multi-pooling 3D convolutional neural network for fMRI classification of visual brain state, which achieved higher classification accuracy rather than previous model. This is because the proposed model employs multiple pooling functions with some residual network pass improving the learning capacity.

All his Ph.D. works were challenging topics to cope with heavily noisy brain signals and he contributed to improve those signal processing quality with novel deep learning models. His proposals were approved in two journal papers in IEEE access and one conference paper in 2023 IEEE conference on AI. Therefore, his doctoral dissertation is worthy of Doctor of Engineering.

2.審査の経過と結果

- (1) 令和5年6月28日 5名の審査委員のもと協議され、博士後期課程委員会で学位論文の受理を決定した。
- (2) 令和5年8月22日 公開論文審査発表会及び最終試験を実施した。
- (3) 令和5年9月1日 博士後期課程委員会で学位授与を可とし、教育研究審議会で承認された。