Towards high performance and efficient brain computer interface character speller : convolutional neural network based methods

Shan, H.

Author: Shan, H.
Title: Towards high performance and efficient brain computer interface character speller : convolutional neural network based methods
Issue Date: 2020-02-25

Towards High Performance and Efficient Brain Computer Interface Character Speller: Convolutional Neural Network based Methods

Hongchang Shan

Towards High Performance and Efficient Brain Computer Interface Character Speller: Convolutional Neural Network based Methods

PROEFSCHRIFT

ter verkrijging van
de graad van Doctor aan de Universiteit Leiden,
op gezag van Rector Magnificus Prof.mr. C.J.J.M. Stolker,
volgens besluit van het College voor Promoties
te verdedigen op woensdag 25 februari 2020
klokke 16:15 uur

door

Hongchang Shan
geboren te Heilongjiang, China
in 1989

Promotors:	Dr. Todor P. Stefanov	Universiteit Leiden
	Prof. Dr. Aske Plaat	Universiteit Leiden
Promotion Committee:	Prof. Dr. Tom Heskes	Radboud Universitiet
	Prof. Dr. Shaowei Cai	Chinese Academy of Sciences
	Prof. Dr. Holger Hoos	Universiteit Leiden
	Prof. Dr. Fons Verbeek	Universiteit Leiden
	Dr. Wojtek Kowalczyk	Universiteit Leiden

Towards High Performance and Efficient
Brain Computer Interface Character Speller:
Convolutional Neural Network based Methods
Hongchang Shan. -
Dissertation Universiteit Leiden. - With ref. - With summary in Dutch.

This dissertation was typeset using LaTeX in Linux and version controlled using Git.

Contents

List of Tables

List of Figures

List of Abbreviations

ALS	Amyotrophic Lateral Sclerosis
AP	Action Potential
AUC	Area Under the Receiver Operating Characteristic
BCI	Brain Computer Interface
CNN	Convolutional Neural Network
CWT	Continuous Wavelet Transform
DWT	Discrete Wavelet Transform
ECoG	Electrocorticography
EEG	Electroencephalography
EoCNN	Ensemble of Convolutional Neural Networks
ERD	Event Related Desynchronization
ERP	Event-Related Potential
FLD	Fisher's Linear Discriminants
ITR	Information Transfer Rate
LDA	Linear Discriminant Analysis
LFP	Local Field Potential
max-ITR	maximum ITR
MSE	Mean Squared Error
NN	Neural Network
OCLNN	One Convolution Layer Neural Network
OSLN	One Spatial Layer Network
OTLN	One Temporal Layer Network
PEoCNN	EoCNN with parameterized ensemble processing
ReLU	Rectified Linear Unit

SAE	Stacked Autoencoder
SGD	Stochastic Gradient Descent
SLES	Spatial Learning based Elimination Selection
SMAC	Sequential Model-based Algorithm Configuration
SNR	Signal to Noise Ratio
SSNR	Signal to Signal and Noise Ratio
SSVEP	Steady State Visual Evoked Potential
SVM	Support Vector Machine
SWLDA	Stepwise Linear Discriminant Analysis
II	BCI Competition II - Data set IIb
III-A	BCI Competition III - Data set II Subject A
III-B	BCI Competition III - Data set II Subject B