

2020 8th International Winter Conference on Brain-Computer Interface (BCI 2020)

**Gangwon, South Korea
26 – 28 February 2020**



**IEEE Catalog Number: CFP20BCI-POD
ISBN: 978-1-7281-4708-6**

**Copyright © 2020 by the Institute of Electrical and Electronics Engineers, Inc.
All Rights Reserved**

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

****** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

| | |
|-------------------------|-------------------|
| IEEE Catalog Number: | CFP20BCI-POD |
| ISBN (Print-On-Demand): | 978-1-7281-4708-6 |
| ISBN (Online): | 978-1-7281-4707-9 |
| ISSN: | 2572-7680 |

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: (845) 758-0400
Fax: (845) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

Oral Session

- 1 **Analysing the Changing Brain: Immediate Brain Plasticity After One Hour of Brain-computer Interface** 1
K.-R. Müller
- 2 **Brain-computer Interface for the Epileptic Seizures Prediction and Prevention** 3
V. Maksimenko, A. Lüttjohann, S. van Heukelum, J. Kelderhuis, V. Makarov, A. Hramov, A. Koronovskii, G. van Luijtelaar
- 3 **Eigen Vector Method with Swarm and Non Swarm Intelligence Techniques for Epileptic Seizure Classification** 8
S. K. Prabhakar, H. Rajaguru, S.-W. Lee
- 4 **Altered Cortical Activation and Functional Network in Post-traumatic Stress Disorder (PTSD) During an Auditory Cognitive Processing** 14
M. Shim, S.-H. Lee, H.-J. Hwang
- 5 **Probe Configuration Design for Closed-loop Multi-Channel fNIRS-tDCS BCI** 18
J. Yang, S. Cha, D. Yun, J. An
- 6 **BCI Facilitates the Improvement of Cognitive Functions in Children and Elderly** 21
C. Guan, C. G. Lim, D. Fung, H. J. Zhou, R. Krishnan, T. S. Lee
- 7 **Real-time predictive analytics in postoperative critical care** 23
A. Meyer
- 8 **A Novel Approach to Classify Natural Grasp Actions by Estimating Muscle Activity Patterns from EEG Signals** 24
J.-H. Cho, J.-H. Jeong, D.-J. Kim, and S.-W. Lee
- 9 **Deep Learning for Channel-Agnostic Brain Decoding across Multiple Subjects** 28
H. Date, K. Kawasaki, I. Hasegawa, T. Okatani
- 10 **VIGNet: A Deep Convolutional Neural Network for EEG-based Driver Vigilance Estimation** 34
W. Ko, K. Oh, E. Jeon, H.-I. Suk
- 11 **Reducing Stimulation Intensity in a Visual ERP BCI to Approach Gaze-independent Spelling** 37
A. Kübler, Z.Rezazadeh, M. Eidel, S. Kleih, L. Botrel
- 12 **Decoding Auditory and Tactile Attention for Use in an EEG-based Brain-computer Interface** 42

| | | |
|-----------|--|-----------|
| | W. An, H. Si-Mohammed, N. Huang, H. Gamper, A. Lee, C. Holz, D. Johnston, M. Jalobeanu, D. Emmanouilidou, E. Cutrell, A. Wilson, I. Tashev | |
| 13 | Robust Semi-synchronous BCI Controller for Brain-Actuated Exoskeleton System | 48 |
| | J. Choi, K.-T. Kim, J. Lee, S. J. Lee, H. Kim | |
| 14 | Decoding Semantic Categories from EEG Activity in Object-Based Decision Tasks | 51 |
| | M. Rekrut, M. Sharma, M. Schmitt, J. Alexandersson, A. Krüger | |
| 15 | Prediction Error Negativity in Physical Human-Robot Collaboration | 58 |
| | A. K. Singh, S. Aldini, D. Leong, Y.-K. Wang, M. G. Carmichael, D. Liu, C.-T. Lin | |
| 16 | Sources of linear and non-linear synchrony between brain and muscles: Linear and non-linear CMC sources | 64 |
| | C. Vidaurre, M. Gómez, G. Nolte, A. Villringer, K. von Carlowitz-Ghori, V. Nikulin | |
| 17 | Sensory and Motor Information in Primary Motor Cortical Neurons During Arm Reaching To a Moving Target | 69 |
| | S.-P. Kim, S. Chae, T. Kim, S.-M. Kim, J.-W. Sohn | |
| 18 | Deep Learning Classification Features Visualization for Arm Movement Brain-computer Interface | 72 |
| | D. P. Jang, S. Lim, H. Choi | |
| 19 | Macroscopic Aspects of Bi-directional BCI in Human | 75 |
| | S. Ryun, Y. J. Yang, Jii Kwon, J. S. Kim, C. K. Chung | |
| 20 | Human Cognitive Aging: Maintenance Versus Dedifferentiation | 79 |
| | U. Lindenberger | |
| 21 | An Ear-EEG-based Brain-Computer Interface using Concentration Level for Control | 81 |
| | N. Kaongoen, S. Jo | |
| 22 | The Design of an Algorithmic Modal Music Platform for Eliciting and Detecting Emotion | 85 |
| | K. McMullen, E. González | |
| 23 | Mechanical Suitability of an Endovascular Brain-Computer Interface | 88 |
| | N. Opie, S. Ronayne, G. Rind, P. Yoo, T. Oxley | |

Spotlight 1

- 1 **Development of an Online Home Appliance Control System using Augmented Reality and an SSVEP-Based Brain-Computer Interface** 94
S. Park, H.-S. Cha, J. Kwon, H. Kim, C.-H. Im
- 2 **Implementation of Hardware-based Neural Network using Memristors with Abrupt SET and Gradual RESET Characteristics** 96
Y. Pyo, J. Shin, S. Nahm, J. Jeong
- 3 **Subject-Independent EEG-based Emotion Recognition using Adversarial Learning** 99
S. Hwang, M. Ki, K. Hong, H. Byun
- 4 **3D CNN based Multilevel Feature Fusion for Workload Estimation** 103
Y. Kwak, W.-J. Song, B. -K. Min, S.-E. Kim
- 5 **Application of Hybrid Brain-Computer Interface with Augmented Reality on Quadcopter Control** 107
J. H. Choi, S. Jo
- 6 **Data Augmentation Effects using Borderline-SMOTE on Classification of a P300-based BCI** 112
T. Lee, M. Kim, S.-P. Kim
- 7 **Spatio-Temporal Dynamics of Visual Imagery for Intuitive Brain-Computer Interface** 116
S.-H. Lee, M. Lee
- 8 **Classification of Selective Attention based on Steady-State Somatosensory Evoked Potentials using High-Frequency Vibration Stimuli** 121
K.-T. Kim, J. Lee, H. Kim, S. J. Lee
- 9 **Neural Oscillations for Encoding and Decoding Declarative Memory using EEG Signals** 124
J. Kalafatovich, M. Lee
- 10 **Decoding Prefrontal Cognitive States from Electroencephalography in Virtual-reality Environment** 129
D. Kim, J. Hwang, J. Park, W. H. Cho, S. W. Lee
- 11 **Prediction of Visual Memorability with EEG Signals using Deep Neural Networks** 132
S.-Y. Jo, J.-W. Jeong

Spotlight 2

- 1 **Filter-bank Local Region Complex-valued Common Spatial Pattern for Motor Imagery Classification** 138
Y. Park, W. Chung
- 2 **Transform based Feature Construction utilizing Magnitude and Phase for Convolutional Neural Network in EEG Signal Classification** 143
J. Kim, Y. Park, W. Chung
- 3 **Towards Paradigm-Independent Brain Computer Interfaces** 147
A. Li, K. Alimanov, S. Fazli, S.-W. Lee, M.-H. Lee
- 4 **Decoding Visual Responses based on Deep Neural Networks with Ear-EEG Signals** 153
Y. E. Lee, M. Lee
- 5 **Design and Optimization of a Real-Time Asynchronous BCI Control Strategy for Robotic Manipulator Assistance** 159
B. Saduanov, D. Tokmurzina, K. Kunanbayev, B. Abibullaev
- 6 **Motor Hotspot Identification Based on Electroencephalography** 164
G.-Y. Choi, M. Shim, H.-J. Hwang
- 7 **Implementation of Multi-connected Single-channel Functional Near-infrared Spectroscopy System for Hyperscanning study** 168
J. Park, J. Jeong, J. Shin
- 8 **Importance of Reliable EEG Data in Motor Imagery Classification: Attention Level-based Approach** 170
S. Lee, Y.-T. Kim, S.-O. Hwang, H. Kim, D.-J. Kim
- 9 **Comparative Analysis of NIRS-EEG Motor Imagery Data using Features from Spatial, Spectral and Temporal Domain** 174
H.-J. K, I.-N. Wang, Y.-T. Kim, H. Kim, D.-J. Kim
- 10 **A Convolutional Neural Network Model for Decoding EEG Signals in a Hand-Squeeze Task** 178
A. Partovi, F. Goodarzy, E. S. Nurse, P. Karoly, M. Cook, D. Freeston, A. Burkitt, D. Grayden
- 11 **Identifying Error Features in a MI-BCI System using Microstates** 184
S.-K. Kim, L. Kim

Poster Session

- 1 **Brain-Computer Interface Based on Magnetic Particle Imaging For Diagnostic and Neurological Rehabilitation in Multiple Sclerosis** 187
T. C. Miller
- 2 **Multi-Class Classification of Motor Imagery EEG Signals Using Image-based Recurrent Convolutional Neural Network** 193
W. Fadel, C. Kollod, M. Wahdow, Y. Ibrahim, I. Ulbert
- 3 **Towards Brain-Computer Interfaces for Drone Swarm Control** 197
J.-H. Jeong, D.-H. Lee, H.-J. Ahn, S.-W. Lee
- 4 **Deep Learning Solutions for Motor Imagery Classification: A Comparison Study** 201
N. Lu, T. Yin, X. Jing
- 5 **A Maximum Fitting-based TrAdaBoost Method for Detecting Multiple Subjects P300 Potentials** 207
M. Li, F. Lin, G. Xu
- 6 **Remote Control System of Spherical Robot based on Silent Speech Recognition** 212
X. Guan, M. Zhang, R. Wu, H. Gao, Q. Ai, S. Jin, Y. Wang, G. Li
- 7 **A semi-supervised classification approach based on restricted Boltzmann machine for fMRI data** 218
N. Liu, Li Yao, X. Zhao
- 8 **Motor Imagery Classification of Single-Arm Tasks Using Convolutional Neural Network based on Feature Refining** 222
B.-H. Lee, J.-H. Jeong, K.-H. Shim, D.-J. Kim
- 9 **Classification of Upper Limb Movements Using Convolutional Neural Network with 3-D Inception Block** 227
D.-Y. Lee, J.-H. Jeong, K.-H. Shim, D.-J. Kim
- 10 **A Novel Framework for Visual Motion Imagery Classification Using 3D Virtual BCI Platform** 232
B.-H. Kwon, J.-H. Jeong, D.-J. Kim
- 11 **Prediction of Individual Propofol Requirement based on Preoperative EEG Signals** 237
Y.-S. Kweon, M. Lee, D.-O. Won, K.-S. Seo
- 12 **Effective Correlates of Motor Imagery Performance based on Default Mode Network in Resting-State** 242
J.-G. Yoon, M. Lee

13 A BCI based Smart Home System Combined with Event-related Potentials and Speech Imagery Task 247
H.-J. Kim, M.-H. Lee, M. Lee