

Hoseung Cha

PH.D. · POSTDOCTORAL RESEARCHER · BIOSIGNAL/DATA SCIENTIST

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“An expert is a man who has made all the mistakes which can be made, in a narrow field by Niels Bohr”

Summary

Ph.D @ Hanyang university. 7+ years of experience in signal processing/analysis of bio-signals, including EEG (Electroencephalogram), EMG (Electro-oculogram), and EOG (Electro-oculogram). My research topics include myoelectric control, brain-computer interfacing, and computational neuroscience. Skilled in the application of machine learning or deep learning algorithms using Matlab and Python. I have developed various real-time biosignal-based applications such as 1) facial expression recognition system based on EMG [Click], 2) silent speech recognition system based on EMG, 3) lip shape recognition system based on EMG [Click], 4) Triple blink detection system based on EOG [Click], etc.

Experiences

Computational Neuroengineering Lab @ Hanyang University

POSTDOCTORAL RESEARCHER

- Prof. Chang-Hwan Im's Lab [Click]

Seoul, S.Korea

Sep 2020 - Dec 2020

Computational Neuroengineering Lab @ Hanyang University

POSTGRADUATE RESEARCHER

- Prof. Chang-Hwan Im's Lab [Click]

Seoul, S.Korea

Sep 2015 - Feb 2016

Computational Neuroengineering Lab @ Hanyang University

UNDERGRADUATE RESEARCHER

- Prof. Chang-Hwan Im's Lab [Click]

Seoul, S.Korea

Mar 2013 - Aug 2013

Education

Hanyang University

PH.D. IN BIOMEDICAL ENGINEERING, GPA: 98.9/100

- Thesis: Development of Face-Machine Interfaces Using Facial Electromyogram for Interactive Virtual Reality Applications

Seoul, S.Korea

Mar 2016 - Aug 2020

Hanyang University

M.S. IN BIOMEDICAL ENGINEERING, GPA: 98.2/100

- Thesis: Development of a transient visual evoked potential (tVEP)-based brain switch system [Click]

Seoul, S.Korea

Sep 2013 - Aug 2015

Yonsei University

B.S. IN BIOMEDICAL ENGINEERING, GPA: 95/100

- Received four scholarships for excellence in grades in 2009 and 2010 (total four semesters)

Wonju, S.Korea

Mar 2008 - Aug 2013

Honors & Awards

- 2019 **Best Paper Award**, 55th Korean Society of Medical & Biological Engineering [Click]
- 2019 **Best Poster Paper Award**, 54th Korean Society of Medical & Biological Engineering [Click]
- 2018 **Young Investigator Award**, SMIT2018-IBEC2018 Joint Conference [Click]
- 2018 **Young Investigator Travel Award**, SMIT2018-IBEC2018 Joint Conference [Click]
- 2016 **Best Poster Award**, International Biomedical Engineering Conference [Click]
- 2015 **Excellence Poster Paper Award**, 50th Korean Society of Medical & Biological Engineering [Click]
- 2010 **Highest honor (top 1% students for 2010 spring semester)**, Yonsei University

Incheon, S. Korea

Yeosu, S. Korea

Seoul, S. Korea

Seoul, S. Korea

Seoul, S. Korea

Daegu, S. Korea

Wonju, S.Korea

PUBLISHED

11. **Ho-Seung Cha**, Seong-Jun Choi, and Chang-Hwan Im*, Real-time Recognition of Facial Expressions using Facial Electromyograms Recorded around the Eyes for Social Virtual Reality Applications
IEEE Access, vol. 8, pp. 62065-62075, Mar. 2020. [Link] [pdf]
10. **Ho-Seung Cha**, Chang-Hee Han, and Chang-Hwan Im*, Prediction of Individual User's Dynamic Ranges of EEG Features from Resting-State EEG Data for Evaluating Their Suitability for Passive Brain-Computer Interface Applications
Sensors, vol. 20(4), pp. 988, Feb. 2020. [Link] [pdf]
9. Seonghun Park, **Ho-Seung Cha**, and Chang-Hwan Im*, Development of an Online Home Appliance Control System Using Augmented Reality and an SSVEP-Based Brain-Computer Interface
IEEE Access, vol. 7, pp. 163604-163614, Nov. 2019. [Link] [pdf]
8. Do Yeon Kim, Jinuk Kwon, Joo-Young Kim, **Ho-Seung Cha**, Yong-Wook Kim, In Young Kim, and Chang-Hwan Im*, New Method for Pure-Tone Audiometry Using Electrooculogram: A Proof-of-Concept Study
Sensors, vol. 18, Art.No.3651, Oct. 2018. [Link] [pdf]
7. Jeong-Hwan Lim, Yong-Wook Kim, Jun-Hak Lee, Kwang-Ok An, Han-Jeong Hwang, **Ho-Seung Cha**, Chang-Hee Han, and Chang-Hwan Im, An emergency call system for patients in locked-in state using an SSVEP-based brain switch
Psychophysiology, vol. 54, pp. 1632-1634, May 2017. [Link] [pdf]
6. Han-Jeong Hwang, Chang-Hee Han, Jeong-Hwan Lim, Yong-Wook Kim, Soo-In Choi, Kwang-Ok An, Jun-Hak Lee, **Ho-Seung Cha**, Seung Hyun Kim, and Chang-Hwan Im*, Clinical Feasibility of Brain-Computer Interface Based on Steady-State Visual Evoked Potential in Patients with Locked-in Syndrome: Case Studies
Psychophysiology, vol. 54, pp. 444-451, Dec. 2016. [Link] [pdf]
5. Won-Du Chang, **Ho-Seung Cha**, Do Yeon Kim, Seung Hyun Kim, Chang-Hwan Im*, Development of an electrooculogram-based eye-computer interface for communication of individuals with amyotrophic lateral sclerosis
Journal of NeuroEngineering and Rehabilitation, vol. 14, Art. ID 89, Sep. 2017. [Link] [pdf]
4. Won-Du Chang, **Ho-Seung Cha**, Chany Lee, Hoon-Chul Kang, and Chang-Hwan Im*, Automatic Identification of Interictal Epileptiform Discharges in Secondary Generalized Epilepsy
Computational and Mathematical Methods in Medicine, vol. 2016, Art. ID 8701973, Jun. 2016. [Link] [pdf]
3. Won-Du Chang, **Ho-Seung Cha**, Kiwoong Kim, Chang-Hwan Im*, Detection of eye blink artifacts from single prefrontal channel electroencephalogram
Sensors, vol. 124, pp. 19-30, Feb. 2016. [Link] [pdf]
2. Won-Du Chang, **Ho-Seung Cha**, Chang-Hwan Im*, Removing the Interdependency between Horizontal and Vertical Eye-Movement Components in Electrooculograms
Sensors, vol. 16(2), pp. 227, Feb. 2016. [Link] [pdf]
1. **Ho-Seung Cha**, Won-Du Chang, YoungSeok Shin, and Chang-Hwan Im*, EEG-based Neurocinematics: Challenges and Prospects
Brain-Computer Interfaces, vol. 2(4), pp. 186-192, Feb. 2016. [Link] [pdf]

SUBMITTED

2. **Ho-Seung Cha** and Chang-Hwan Im*, Performance Enhancement of Facial Electromyogram-based Facial-expression Recognition for Social Virtual Reality Applications Using Linear Discriminant Analysis Adaptation
Virtual Reality, Submitted
1. **Ho-Seung Cha**, Won-Du Chang, and Chang-Hwan Im*, Deep-Learning-Based Real-Time Silent Speech Recognition using Facial Electromyogram Recorded Around Eyes for Hands-Free Interfacing in Virtual Reality Environment
IEEE Transactions on Emerging Topics in Computing, Under review

INTERNATIONAL

14. **Ho-Seung Cha**, Seongjun Choi, and Chang-Hwan Im, Real-Time Electromyogram-Based Facial Expression Recognition Using Riemannian Geometry Features for VR Applications
41st International Conference of the IEEE EMBS, Berlin, Germany, July 26, 2019
13. **Ho-Seung Cha** and Chang-Hwan Im*, New Strategy for Minimizing Training Time In EMG-Based Facial Expression Recognition for Virtual Reality Applications
SMIT2018-IBEC2018 Joint Conference, Seoul, South Korea, November 9, 2018.
12. Seongjun Choi, **Ho-Seung Cha**, and Chang-Hwan Im, User Authentication for Virtual Reality Applications Based on Facial EMG Induced by Facial Expression Changes
40th International Conference of the IEEE EMBS, Honolulu, USA, July 18, 2018
11. **Ho-Seung Cha** and Chang-Hwan Im, Prediction of individual user's suitability for passive BCI applications using short resting EEG recordings
7th International BCI Meeting, Pacific Grove, California, USA, May 22, 2018
10. **Ho-Seung Cha**, Won-Du Chang and Chang-Hwan Im, Real-time Recognition of Lip Gestures Based on Facial EMG
3rd Annual International Biomedical Engineering Conference, Seoul, Korea, November 11, 2016
9. **Ho-Seung Cha**, Won-Du Chang and Chang-Hwan Im, A Real-Time Lip Gesture Recognition System using Facial EMG
38th Annual International Conference of the IEEE EMBS, Orlando, Florida, USA, August 19, 2016
8. Won-Du Chang, **Ho-Seung Cha**, and Chang-Hwan Im, Improved Electrooculogram-based Eye-writing Recognition Using a New Feature Extraction Method
2nd Annual International Biomedical Engineering Conference, Gyeongju, Korea, November 12, 2015
7. **Ho-Seung Cha** and Won-Du Chang, Young-Seok Shin, Dongpyo Jang and Chang-Hwan Im, EEG-Based Neurocinematics: Potential Brain Indices for Rating Films
37th Annual International Conference of the IEEE EMBS, Milano, Italy, Aug 25 - 29, 2015
6. Jeong-Hwan Lim, Yong-Wook Kim, Chang-Hee Han, **Ho-Seung Cha**, and Chang-Hwan Im, An Emergency Call System for Patients with Severe ALS Using Less-Stimulating SSVEP-Based Brain Switch
37th Annual International Conference of the IEEE EMBS, Milano, Italy, Aug 2015
5. Won-Du Chang, **Ho-Seung Cha**, and Chang-Hwan Im, A Novel Method to Detect Eye Blink Artifacts from a Frontal Single-Channel Electroencephalogram
International Biomedical Engineering Conference (IBEC) 2014, Gwangju, Nov 20, 2014
4. Won-Du Chang, **Ho-Seung Cha** and Chang-Hwan Im Kang, and Chang-Hwan Im*, A New Method for Detecting Eye-Blink Artifacts from a single-Channel Electroencephalogram
36th Annual International Conference of the IEEE EMBS, Chicago, Illinois USA, Aug 2014
3. Won-Du Chang, **Ho-Seung Cha**, and Chang-Hwan Im*, Enhanced Template Matching Using Dynamic Positional Warping for Pattern Recognition in Electroencephalogram
36th Annual International Conference of the IEEE EMBS, Chicago, Illinois USA, August 2014
2. Jeong-Hwan Lim, Jun-Hak Lee, Yong-Wook Kim, Han Choi, Chang-Hee Han, **Ho-Seung Cha**, and Chang-Hwan Im*, Implementation of a Steady State Visual Evoked Potential (SSVEP)-Based Online Brain-Switch System Using a Chromatic Stimulus
36th Annual International Conference of the IEEE EMBS, Chicago, Illinois USA, Aug 2014.
1. **Ho-Seung Cha**, Jeong-Hwan Lim, Chang-Hee Han, Han-Jeong Hwang, Won-Du Chang and Chang-Hwan Im*, A Transient Visual Evoked Potential (tVEP)-based Brain Switch System

DOMESTIC (S. KOREA)

18. Chunghwan Kim, **Ho-Seung Cha**, and Chang-Hwan Im, Development of facial recognition system using facial electromyogram measured around the eyes and its application to social virtual reality services
The Institute of Electronics and Information Engineers, Jeju, S. Korea, July 19-21, 2020
17. Kang-min Choi, **Ho-Seung Cha**, Sangjun Lee, Jimin Park, and Chang-Hwan Im, Implementation of a Silent Speech Interface based on Acceleration Sensors
The Institute of Electronics and Information Engineers, Jeju, S. Korea, July 19-21, 2020
16. Seonghun Park, **Ho-Seung Cha**, and Chang-Hwan Im, New Method for Estimating Emotion Arousal Changes of a Group of Individuals During Movie Screening Using SSVEP
Korean Society for EEG and Neurophysiology, Seoul, South Korea, Dec 7, 2019
15. Seonghun Park, **Ho-Seung Cha**, and Chang-Hwan Im, New Method for Estimating Emotion Arousal Changes of a Group of Individuals During Movie Screening Using SSVEP
Korean Society for EEG and Neurophysiology, Seoul, South Korea, Dec 7, 2019
14. **Ho-Seung Cha**, Seongjun Choi, Chunghwan Kim, and Chang-Hwan Im, Real-time Electromyogram-Based Facial Expression Recognition Using Riemannian Geometry Features for VR application
Engineering in circadian rhythm and ubiquitous healthcare (Uhealthcare), Seoul, South Korea, Dec 5, 2019
13. **Ho-Seung Cha** and Chang-Hwan Im, Development of Silent Speech Recognition System Based on Facial Electromyogram Recorded around Eyes for Hands-free Interactions in Virtual Environments
Korean Society of Medical & Biological Engineering (KOSOMBE), Incheon, Nov 7, 2019
12. Kang-min Choi, **Ho-Seung Cha**, and Chang-Hwan Im, Real-time Eye Gaze Tracking Method Using Electrooculogram Signals Recorded around Eyes in Virtual Environments
Korean Society of Medical & Biological Engineering (KOSOMBE), Incheon, Nov 7, 2019
11. Jung-Hwan Kim, **Ho-Seung Cha**, Seoungjae Lee, Chuljin Park, In Young Kim, Se-Keun Park, and Chang-Hwan Im, Development of Dyslexia Diagnosis System Using Electrooculogram: a Proof-of-concept Study
Korean Society of Medical & Biological Engineering (KOSOMBE), Incheon, Nov 7, 2019
10. Seong-Jun Choi, Chunghwan Kim, **Ho-Seung Cha**, and Chang-Hwan Im, Development of Facial Motion Capture Technology Based on Facial Electromyogram Using Deep Learning
Korean Society of Medical & Biological Engineering (KOSOMBE), Incheon, Nov 7, 2019
9. **Ho-Seung Cha**, and Chang-Hwan Im, Development of Avatar Expressing Emotions in Real Time Using Facial Electromyogram-based Facial Expression in Virtual Environment
Korean Society of Medical & Biological Engineering (KOSOMBE), Yeosu, May 9, 2019
8. **Ho-Seung Cha**, Seong-Jun Choi, Hodam Kim, and Chang-Hwan Im, Performance Comparison of Classification Techniques for the Facial Expression Recognition Based on Surface EMG
Korean Society of Medical & Biological Engineering (KOSOMBE), Cheonbuk university, Cheonbuk, Nov 11 2017
7. **Ho-Seung Cha**, Won-Du Chang, Young Seok Shin, Dong Pyo Jang, and Chang-Hwan Im, Neurocinematics: Development of Indices of Evaluating Cinematic Using EEG
Korean Society of Medical & Biological Engineering (KOSOMBE), Pusan, May 13, 2016
6. Jeong-Hwan Lim, Yong-Wook Kim, **Ho-Seung Cha**, Chang-Hee Han, and Chang-Hwan Im, An Emergency Call System for Patients with Severe ALS Using Less-Stimulating SSVEP-Based Brain Switch
Korean Society for Computational Neuroscience, Seoul, August 19, 2015

5. **Ho-Seung Cha**, JongYoep Lim, Da-sol Jeon, Won-Du Chang, and Chang-Hwan Im, Electrooculogram-based Real-time Digit Input System
Korean Society of Medical & Biological Engineering (KOSOMBE), Daegu, S. Korea, May 8, 2015
4. Jeong-Hwan Lim, Yong-Wook Kim, Jun-Hak Lee, **Ho-Seung Cha**, and Chang-Hwan Im, Implementation of a Steady State Visual Evoked Potential-based “Less Stimulating” Brain Switch System Using a Chromatic Stimulus
Korean Society of Medical & Biological Engineering (KOSOMBE), Daegu, May 8, 2015
3. **Ho-Seung Cha**, Jeong-Hwan Lim, Han-Jeong Hwang, Chang-Hee Han, and Chang-Hwan Im, Development of the Brain Switch System Using CTVEP
Korean Society of Medical & Biological Engineering (KOSOMBE), Osong, May 9, 2014
2. Won-Du Chang, **Ho-Seung Cha**, and Chang-Hwan Im, A Study on Automatic Detection of Spikes from a Single-Channel Electroencephalogram
Korean Society of Medical & Biological Engineering (KOSOMBE), Osong, May 9, 2014
1. **Ho-Seung Cha**, Jeong-Hwan Lim, Han-Jeong Hwang, Chang-Hee Han, and Chang-Hwan Im, Development of a VEP-based brain switch system
Korean Society of Medical & Biological Engineering (KOSOMBE), Incheon, Nov 8, 2013

Patents

INTERNATIONAL

1. Chang-Hwan Im, **Ho-Seung Cha**, Seong-Jun Choi, Electronic Device, Avatar Facial Expression System and Controlling Method Thereof
Filed, *US 16/534,579*, Aug 2019. [pdf]

DOMESTIC (S. KOREA)

9. Chang-Hwan Im and **Ho-Seung Cha**, Apparatus and Method for User Authentication Using Facial EMG by Measuring Changes of Facial Expression of HMD User
Issued, *KR 1020944880000*, Mar 2020. [pdf]
8. Won-Du Chang, Chang-Hwan Im, **Ho-Seung Cha**, Asynchronous Eye-Character Recognition Method and Apparatus Using Electromyogram Data
Issued, *KR 10-2019-0124660*, vol. 54, pp. 1632-1634, Oct 2019. [pdf]
7. Chang-Hwan Im, Kang-Min Choi, **Ho-Seung Cha**, Method for Tracking Eye of HMD User and HMD for Tracking Eye of User
Issued, *KR 10-2019-0117185*, Sep 2019. [pdf]
6. Chang-Hwan Im, **Ho-Seung Cha**, Seong-Jun Choi, Learning Method and Apparatus for Facial Expression Recognition, Facial Expression Recognition Method Using Electromyogram Data
Filed, *KR 10-2019-0023580*, Mar 2018. [pdf]
5. Chang-Hwan Im, **Ho-Seung Cha**, Seong-Jun Choi, Facial Expression Registration Method for Facial Expression Recognition and Facial Expression Recognition Method Using the same
Filed, *KR 10-2018-0031888*, Mar 2018. [pdf]
4. Chang-Hwan Im, **Ho-Seung Cha**, Emotion Recognition Method and Device Using Electromyogram Signal
Filed, *10-2018-0080953*, Mar 2018. [pdf]
3. Won-Du Chang, Chang-Hwan Im, **Ho-Seung Cha**, Kwang-Ryeol Lee, Method and System for Recognition of Eye-Character based on Tracking Technique of Electro Oculogram Gaze
Issued, *KR 10-2016-0117716*, Jun 2017. [pdf]
2. Chang-Hwan Im, Won-Du Chang, **Ho-Seung Cha**, System and Method for Detecting Spikes Whose Widths Are Within a Certain Range in Time-series Data

Issued, KR 10-2014-0058590, Dec 2015. [pdf]

1. **Ho-Seung Cha**, Chang-Hwan Im, Jeong-Hwan Lim, Han-Jeong Hwang, Chang-Hee Han, Won-Du Chang, Method and apparatus for generating signals using transient visual evoked potential

Issued, KR 10-2013-0168546, Jul 2015. [pdf]

Software

3. Facial electromyogram-based facial expression recognition system

C-2018-036477, Dec 2018. [Click]

2. F-avatar

C-2018-036476, Dec 2018. [Click]

1. Bio-Control

C-2018-030968, Nov 2018. [Click]

Press

3. VR Avatars Copy Your Facial Expressions. When you smile, they smile with you

News-H, Jan 2019. [Link (Korean)] [Link (English)]

2. VR Avatar looks exactly like me!

Dong-A Ilbo, Dec 2018. [Link] [Click to see the article capture]

1. Why don't we rate movie using "brainwave indices"?

DongaScience, Dec 2014 [Link]

Projects

RESEARCH PROJECTS

Recognizing Facial Expressions Based on Facial Electromyogram for Interactive VR Applications

PARTICIPATING RESEARCHER

- PI: Prof. Chang-Hwan Im
- develop real-time facial expression recognition system [Click to see the paper] [Click to see the video]

*Samsung Science & Technology
Foundation @ Samsung Electronics*

Sep 2017 - Aug 2020

Development of Non-invasive Integrated BCI SW Platform To Control Home Appliance and External Devices By User's Thought Via AR/VR Interface

PARTICIPATING RESEARCHER

- PI: Prof. Chang-Hwan Im
- develop emotion recognition system using facial electromyogram [Click to see the patent]

*Korea Institute of Science and
Technology (KIST)*

Apr 2017 - Dec 2023

Development of Multimodal Brain-Machine Inference System Based on User Intent Recognition

PARTICIPATING RESEARCHER

- PI: Prof. Inyoung Kim
- develop EEG indices for predicting user's BCI application suitability [Click to see the paper]

*Information & Communication
Technology Promotion (IITP)*

May 2013 - Feb 2017

Development of Bio-Signal Analysis Algorithm for Wearable Devices

PARTICIPATING RESEARCHER

- PI: Prof. Chang-Hwan Im
- develop an eye-gaze direction detection system using electrooculogram
- develop an silent speech recognition system using electromyogram
- contribute C-lab team's spin-off (Linkface)[Click to see the article]

Samsung Electronics

Oct 2016 - Dec 2016

Development of Eye Tracking Source Technology Based on Electrooculogram for HCI Application

PARTICIPATING RESEARCHER

- PI: Prof. Won-Du Chang
- design and conduct experiments for recording electrooculogram signals [Click to see the paper]
- conduct EEG data analysis and abnormal EEG data/pattern classification of epilepsy patients

National Research Foundation
(NRF)

May 2015 - Apr 2017

Development of real-time bio-signal-based cultural content evaluation technology focused on large customers

PARTICIPATING RESEARCHER

- PI: Prof. Dong pyo Jang
- develop EEG indices for evaluating cinematics [Click to see the paper] [Click to see the article]

Korea Institute of Industrial
Technology (KITECH)

May 2013 - Feb 2016

Development of original technologies for brain-computer interface based on the spatiotemporospectral analysis of brain activity patterns

RESEARCH ASSISTANT

- PI: Prof. Won-Du Chang
- develop transient visual evoked potential (tVER)-based brain switch system[click to see the patent]

Ministry of Science, ICT and Future
Planning

Oct 2013 - July 2014

PERSONAL PROJECTS

Personal homepage

ADMINISTRATOR

- create personal homepage using GitHub page [Click]

Sep 2020 -

Key board-based braille input system for visually impaired

DEVELOPER

- visual programming class project (A+) @ Yonsei University.

Yonsei University

Sep 2010 - Dec 2010

Skills

Data analysis experiences	Bio-electric signals (EEG/EMG/EOG) · GSR · 3D motion data · Images
Research techniques	Machine learning · Deep learning · Time-frequency signal analysis · Real-time Data Analysis
Programming	Matlab · Python · C++/C
Web/Media	Adobe premiere
Language	Korean · English

References

Chang-Hwan Im (Ph.D.)

Seoul, S. Korea

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Pusan, S. Korea

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Pusan, S. Korea

ASSISTANT PROFESSOR | DEPARTMENT OF RADIOLOGICAL SCIENCE AT HEALTH SCIENCE DIVISION @ DONGSEO UNIVERSITY

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