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"—Niels Bohr

Summary

Ph.D @ Hanyang university. 7+ years of experience in signal processing/analysis of bio-signals, including EEG (Electroenchpahlogram), 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 — *Seoul, S.Korea*

Postdoctoral Researcher — *Sep 2020 - Dec 2020*

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

Computational Neuroengineering Lab @ Hanyang University — *Seoul, S.Korea*

Postgraduate Researcher — *Sep 2015 - Feb 2016*

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

Computational Neuroengineering Lab @ Hanyang University — *Seoul, S.Korea*

Undergraduate Researcher — *Mar 2013 - Aug 2013*

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

Education

Hanyang University — *Seoul, S.Korea*

Ph.D. in Biomedical Engineering, GPA: 98.9/100 — *Mar 2016 - Aug 2020*

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

Hanyang University — *Seoul, S.Korea*

M.S. in Biomedical Engineering, GPA: 98.2/100 — *Sep 2013 - Aug 2015*

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

Yonsei University — *Wonju, S.Korea*

B.S. in Biomedical Engineering, GPA: 95/100 — *Mar 2008 - Aug 2013*

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

Honors & Awards

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

Papers

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

Conferences

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

36th Annual International Conference of the IEEE EMBS, Chicago, Illinois USA, Aug 2014.

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), Inchon, 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), Inchon, 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), Inchon, 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), Inchon, 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), Chenbuk 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), Inchon, 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

Samsung Science & Technology Foundation @ Samsung Electronics

Participating Researcher

Sep 2017 - Aug 2020

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

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

Korea Institute of Science and Technology (KIST)

Participating Researcher

Apr 2017 - Dec 2023

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

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

Information & Communication Technology Promotion (IITP)

Participating Researcher

May 2013 - Feb 2017

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

Development of Bio-Signal Analysis Algorithm for Wearable Devices

Samsung Electronics

Participating Researcher

Oct 2016 - Dec 2016

- 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]

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

National Research Foundation (NRF)

Participating Researcher

May 2015 - Apr 2017

- 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

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

Korea Institute of Industrial Technology (KITECH)

Participating Researcher

May 2013 - Feb 2016

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

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

Ministry of Science, ICT and Future Planning

Research Assistant

Oct 2013 - July 2014

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

Personal projects

Personal homepage

Administrator

Sep 2020 -

- create personal homepage using GitHub page [Click]

Key board-based braille input system for visually impaired

Yonsei University

Developer

Sep 2010 - Dec 2010

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

Skills

Data analysis experiences	Bio-electric signals (EEG/EMG/EOG) · 3D motion data
Research techniques	Signal Processing · Data mining(Machine/Deep learning) · Real-time signal processing
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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