Ho-Seung **Cha**

Ph.D. Candidate · Biosignal/Data Scientist

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"The first step is to establish that something is possible; then probability will occur."

Summary

Ph.D @ Hanyang university. 7+ years of experience analyzing in biosignal/data such as electromyogram (EMG), electrooculogram (EOG), electroenchpahlogram (EEG), etc. 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

Bio-Interfaced Translational Nanoengineering Group @ Georgia Tech — *Atlanta, GA, USA*

Postdoctoral Researcher Candidate — *(Projected) Jan 2021 - Jan 2022*

- Prof. Woon-Hong Yeo's Lab [Click]

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

Postdoctoral Researcher — *Sep 2020 - (Projected) 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]

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]

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]

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]

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]

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]

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]

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]

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]

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]

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]

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, 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, December 6, 2020

13. **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 Engineering in Medicine and Biology (IEEE EMBC), Berlin, Germany, July 26, 2019

12. **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.

11. 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

10. **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

9. **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

8. **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

7. 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

6. **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

5. 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

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, Illinois USA, Aug 2014

3. Won-Du Chang, **Ho-Seung Cha**, and Chang-Hwan Im*, Enhanced Template Matching Using Dynamic Positional Warping for Pattern Recongnition 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)

11. **Ho-Seung Cha** and Chang-Hwan Im, development of sislent speech recognition system based on facial electromyogram recorded around eyes for hands-free interactions in virtual environments.

    55th Korean Society of Medical & Biological Engineering (KOSOMBE), Inchon, Korea, Nov 7, 2019

10. 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

    55th Korean Society of Medical & Biological Engineering (KOSOMBE), Inchon, Korea, Nov 7, 2019

9. 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

    55th Korean Society of Medical & Biological Engineering (KOSOMBE), Inchon, Korea, Nov 7, 2019

8. 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

    54th Korean Society of Medical & Biological Engineering (KOSOMBE), Inchon, Korea, Nov 7, 2019

7. **Ho-Seung Cha**, and Chang-Hwan Im, Development of avatar expressing emotions in real time using facial electromyogram-based facial expression in virtual environment

    54th Korean Society of Medical & Biological Engineering (KOSOMBE), Yeosu, S. Korea, May 9, 2019

6. **Ho-Seung Cha**, Seong-Jun Choi, Hodam Kim, and Chang-Hwan Im, Classificaion performance comparison for facial expression recognition based on surface electromyogram

    52th Korean Society of Medical & Biological Engineering (KOSOMBE), Chenbuk university, Cheonbuk, S. Korea, Nov 11 2017

5. **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

    51th Korean Society of Medical & Biological Engineering (KOSOMBE), Bukyeong University, Pusan, S. Korea, May 13 2016

4. Jeong-Hwan Lim, Yong-Wook Kim, Jun-Hak Lee, **Ho-Seung Cha**, and Chang-Hwan Im, Development of less-stimulating brain-switch system using chromatic stimulus-induced steady-state state visual evoked potential

    50th Korean Society of Medical & Biological Engineering (KOSOMBE), Daegu, S. Korea, May 8, 2015

3. **Ho-Seung Cha**, JongYoep Lim, Da-sol Jeon, Won-Du Chang, and Chang-Hwan Im, ▨▨▨▨▨ ▨▨▨ ▨▨▨ ▨▨ ▨▨▨▨

    50th Korean Society of Medical & Biological Engineering (KOSOMBE), Daegu, S. Korea, May 8, 2015

2. **Ho-Seung Cha**, Jeong-Hwan Lim, Han-Jeong Hwang, Chang-Hee Han, and Chang-Hwan Im, Development of CTVEP-based brain switch system

    49th Korean Society of Medical & Biological Engineering (KOSOMBE), Osong, S. Korea, Nov 9 2013

1. **Ho-Seung Cha**, Jeong-Hwan Lim, Han-Jeong Hwang, Chang-Hee Han, and Chang-Hwan Im, Development of transient visual evoked potential-based brain switch system

    48th Korean Society of Medical & Biological Engineering (KOSOMBE), Inchon, S. Korea, 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. [Link]

Domestic (S. Korea)

8. 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. [Link]

7. Chang-Hwan Im and **Ho-Seung Cha**, Emotion Recognition Method and Device Using Electromyogram Signal

   Issued, *KR 10-2018-0080953*, Jan 2020. [Link]

6. 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. [Link]

5. 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. [Link]

4. 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 10-2018-0031888*, Mar 2018. [Link]

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. [Link]

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. [Link]

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*, vol. 2(4), Jul 2015. [Link]

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 basedon 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 2020

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

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]

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 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 news article]

Personal projects

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) · GSR · 3D motion data · Images
Research techniques	Machine learning · Deep learning · Time-frequency signal analysis · 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*

Professor, Chair | Department of Biomedical Engineering @ Hanyang university

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Won-Du Chang (Ph.D.) *Pusan, S. Korea*

Assistant Professor | Department of Computer Engineering @ Pukyong national university

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