

# Curriculum Vitae

## Heegyu Kim, Ph.D. student

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### **Personal Information**

Name: Heegyu Kim

Citizenship: South Korea

### **Education**

Mar. 2019	Ph.D. student	School of Electrical engineering and Computer science
~ Feb. 2026	(Integrated course)	Gwangju Institute of Science and technology (GIST), Gwangju, South Korea
		Thesis: Study for estimating group social cognition from neural activity (proposal thesis)
Mar. 2015	B.S.	Engineering of Electronic & Electrical
~ Feb. 2019		Hongik University, Seoul, South Korea
		Thesis: DNA sequence estimation from set of sub-sequence using Good-Toulmin Estimator

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### **Summary**

I am researching the application of deep learning techniques to enhance real-world accuracy in brain-computer interfaces and to extract inter-brain connectivity features through hyperscanning. Research on BCI was studied to explore brain switch methodologies suitable for a user-friendly BCI speller. Hyperscanning study was proposed to construct a connectivity network using a multilayer network approach for social brain networks to extract inter-brain synchrony from multiple interactions efficiently. Hyperscanning research is also focused on estimating cognitive duration during social decision-making processes using an RNN-based sequential pattern prediction model. I have implemented and conducted cognitive experiments involving over 200 participants during my Ph.D. program. To date, I have published two journal papers, nine conference papers, and two preprints.

### **Research Interests**

Brain-Computer Interface, Human-Computer Interface, Cognitive Neuroscience, Social Cognitive Neuroscience, Neuroergonomics,

### **Research experience**

Biocomputing Lab., Gwangju Institute of Science and Technology (GIST)

Jan 2019 - Present

Research Assistance, Advisor: Sung Chan Jun

#### **Research Topics:**

##### **- Hyperscanning for social decision making**

- Measurement of groups interactions from synchronization of neural activity using network analysis.
- Development of social interactions prediction and detection technology using Recurrent Neural Network (RNN) model.

##### **- Practical BCI system**

- Built Multi-user EEG acquisition system for Brain-Computer Interface (BCI) game.
- EEG data collection in noisy external environments.
- Built massive class Speller for high transfer information in BCI Speller.
- Large-scale EEG data collection for Steady State Visual Evoked Potential (SSVEP) and Motor Imagery (MI) paradigms.
- Research of user cognitive detection for self-paced BCI system.

#### - Data acquisition Experience

- SSVEP BCI Game in Real – Exhibition Environment, **Participants (N=71)**, 2019
  - Development of zero-training-based multi and single-user BCI games operable in noisy external environments.
  - Implementation of real-time EEG analysis systems using OpenViBE and Matlab.
  - Development of Unity-based games and a high-versatility of Unity to EEG acquisition framework using Lab Streaming Layers (LSL).
  - Link: <http://deepbci.korea.ac.kropensource/opendb/>
- EEG Dataset for 9-class SSVEP Based BCI Speller, **Participants (N=23)**, 2020
  - Development of a high-speed, real-time BCI Speller.
  - Conducted EEG measurement experiments flexibly using Unity-based devices and corresponding dry electrodes.
  - Link: <http://deepbci.korea.ac.kropensource/opendb/>
- EEG Dataset for 40-class SSVEP Based BCI Speller, **Participants (N=40)**, 2023
  - Development of a high-speed and information transferring real-time BCI Speller.
  - High spatial resolution and massive class and participants.
  - Related result: Comparison of recognition methods for an asynchronous (un-cued) BCI system: an investigation with 40-class SSVEP dataset (DOI: 10.1007/s13534-024-00357-4)
- EEG Dataset for Motor Imagery and to enhance the performance using Stimulation, **Participants (N=44)**, 2022
  - Experiments aimed at enhancing MI performance through electrical and tactile stimulation.
  - Utilizing a target stimulation system with real-time synchronization of acquisition and stimulus presentation.
  - Related result: Can Vibrotactile Stimulation and tDCS Help Inefficient BCI Users? (DOI: 10.1186/s12984-023-01181-0)
- EEG dataset for Quantification of thermal pain and Thermal Grill Illusion stimulation, **Participants (N=43)**, 2023
  - Experiments aimed at quantification of pain level using EEG.
  - Developing biomarker associated with pain and pain illusion.
  - Related result: Pain Classification using Evoked EEG Induced by Thermal Grill Illusion – Deep Neural Network Approach (DOI: 10.1109/EMBC40787.2023.10340391)

#### - Software(S/W) Developments

- Mind Mole Catching (2019), C-2019-029998
  - SSVEP based BCI game using Unity Engine and communication protocol using Lab Streaming Layers (LSL).
  - Implementation of Single and Dyad Player mode.
  - Link: [https://github.com/DeepBCI/Deep-BCI/tree/master/4\\_Zero-Training\\_BCI/SSVEP\\_based\\_Mind\\_Mole\\_Catching](https://github.com/DeepBCI/Deep-BCI/tree/master/4_Zero-Training_BCI/SSVEP_based_Mind_Mole_Catching)
- SSVEP Number Speller (2020), C-2020-024758

- High speed and Real-Time SSVEP based BCI Speller using Unity Engine and communication protocol using Lab Streaming Layers (LSL).
  - Link: [https://github.com/DeepBCI/Deep-BCI/tree/master/4\\_Zero-Training\\_BCI/SSVEP\\_based\\_BCI\\_speller](https://github.com/DeepBCI/Deep-BCI/tree/master/4_Zero-Training_BCI/SSVEP_based_BCI_speller).

- SSVEP based Multi-user Running action game (2020), C-2020-043917
  - SSVEP based BCI game using Unity Engine and communication protocol using Lab Streaming Layers (LSL).
  - Measuring inter-brain synchronization through competition from three players.
- SSVEP Multi user Othello Game (2021), C-2021-043891
  - SSVEP based BCI game using Unity Engine and communication protocol using Lab Streaming Layers (LSL).
  - Comparing the differences between AI vs. human and human vs. human interactions in a two-player turn-taking game.
  - Link: [https://github.com/DeepBCI/Deep-BCI/tree/master/4\\_Zero-Training\\_BCI/SSVEP\\_based\\_Othello](https://github.com/DeepBCI/Deep-BCI/tree/master/4_Zero-Training_BCI/SSVEP_based_Othello)
- SSVEP Speller using user Cognition (2022), C-2022-052961
  - SSVEP based BCI Speller using Psychophysics Toolbox-3.
  - Real-time Asynchronous BCI Speller, which detect the user intention (called as Brain Switch)
- EEG Automated Detector of Artifacts (2023), C-2023-062051
  - EEG artifact removal utilizing vision-based information.
  - To reduce EEG distortion by targeting and removing specific artifacts in real-time.

## Award &scholarships

Korean Government Scholarships, in GIST	2019~2025 (14 semesters)
Scholarship of tutoring, in Hongik Univ.	2016~2018 (5 semesters)
Admission Excellence Scholarship, in Hongik Univ.	2015~2018 (8 semesters)
IEEE Brain Best Student Paper Award, Conference on Systems, Man, and Cybernetics (SMC)	2023

## Skills

- Machine learning & Deep learning for Time Series
- Scientific/Technical Project Management and Coordination
- Cognitive Neuroscience and Engineering
- Social Cognitive Neuroscience

## Program Languages

- Working Knowledge of: Python (based on Pytorch, Tensorflow), MATLAB
- Familiar with: C/C#/C++
- Basic Knowledge of: Lua

## Brain Signal Acquisition

- Hardware: BioSemi-active two, DSI-24, Emotiv-epoch, Neuroscan, Dizitizer-Fastrak, Star-stim 8
- Acquisition Software: Actiview, OpenViBE, DSI streamer, Neuroelectrics, Matlab
- Communication protocol: Lab streaming layer(LSL), TCP/IP, UDP

- Signal Processing Toolbox and Library: EEGLAB, FieldTrip, MNE, Chronux
- Designed experiments:
  - SSVEP based BCI games (Multi user Othello, Mind Mole Catching, Multi-user Running)
  - BCI Spellers (9-class and 40-class Speller)
  - Iterated Prisoner's Dilemma game for triad players
  - Thermal Grill Illusion for pain quantifying
  - Real-time EEG artifact detection and reconstruction frameworks

## Teaching experience

### Mentoring Experience

For academic warning student, in Hongik Univ.

Fall, 2016 ~ Fall, 2018  
(5 Semesters)

For high school student, in Gwangju Institute of Science and technology (GIST)

Summer, 2020

### Teaching Assistant

Random Process, in Gwangju Institute of Science and Technology (GIST)

Spring, 2020

Introduction to Electrical Engineering and Computer Science, in Gwangju Institute of Science and Technology (GIST)

Fall, 2020

Discrete Mathematics, in Gwangju Institute of Science and Technology (GIST)

Spring, 2021

## Language Skill

English (Intermediate, TOEIC 800 at 2019), Korean (Native)

## Publication

1. Won. K., **Kim H.**, Gwon D., Ahn M., Nam Chang S., Jun S.C. (2022) Can Vibrotactile Stimulation and tDCS Help Inefficient BCI Users?, Journal of Neuro Engineering and Rehabilitation
2. **Kim H.**, Won K., Ahn M., Jun S.C. (2024). Comparison of recognition methods for an asynchronous (un-cued) BCI system: an investigation with 40-class SSVEP dataset. Biomedical Engineering Letters
3. **Kim H.**, Kim S., Jun S. C., Nam Chang S. (2025). Is what I think what you think? Multilayer network-based group synchrony approach. Social Cognitive and Affective Neuroscience
4. **Kim, H.**, Won, K., Ahn, M., & Jun, S. C. (2025). A 40-Class SSVEP Speller Dataset: Beta Range Stimulation for Low-Fatigue BCI Applications. Scientific Data, 12(1), 1751.

## Conference

1. **Kim H.**, Won K., Jun S. C., (2020), “Multi-User SSVEP based BCI game: SSVEP running”, 2021 HCI Korea
2. **Kim H.**, Won K., Jun S. C., (2021), “EEG channel selection for SSVEP BCI Speller”, 2021 Society of Neuroscience
3. Won. K., **Kim H.**, Gwon D., Ahn M., Nam Chang S., Jun S.C., (2022) “May Tactile Stimulation and Electrical Brain Stimulation be Helpful to the BCI-unable?”, 2022 Joint meeting of Neuroergonomics & NYC Neuromodulation
4. **Kim H.**, Won K., Ahn M., Jun S.C. (2023). “Cognitive-Switch detection for Un-cued SSVEP BCI Speller”, 2023 11th international BCI conference.
5. Baek J., Won K., **Kim H.**, Lee S., An J., Jun S. C., (2023) “Feasibility Study for Pain Classification using EEG induced by Thermal Grill Illusion – Deep Neural Network Approach”, 45th Annual International Conference of the IEEE EMBC
6. Kang S., Won K., **Kim H.**, Baek J., Ahn M., Jun S. C. (2023), “Targeted Physiological Artifact Reduction in EEG Based on

Image Information”, 45th Annual International Conference of the IEEE EMBC

7. Kang S., Won K., **Kim H.**, Baek J., Ahn M., Jun S. C., (2023) “Achieving effective artifact subspace reconstruction in EEG using real-time video-based artifact identification”, The 2023 IEEE Conference on SMC \* **IEEE Brain Best Student Paper Award**
  8. Lee C., **Kim H.**, Jun S. C (2024), “Validation of single channel EEG augmentation using GAN - P300 Speller data”, 2023 IBEC
  9. **Kim H.**, Kim S., Jun S. C., Nam Chang S., (2024), “Multilayer network approach to EEG based inter-brain synchrony in Group”, 22<sup>nd</sup> the international ergonomics association (IEA)
  10. **Kim, H.**, Ahn, M., & Jun, S. C. (2025, July). A Brain Switch for SSVEP-Based BCI Speller Using an RNN-Based Detection Approach. In 2025 47th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC). IEEE.
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