Jiwoon Lee

LinkedIn | GitHub | Google Scholar

Location: Seoul, Republic of Korea
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Education

Kwangwoon University Feb 2019 – Aug 2024
Bachelor of Science in Computer Engineering, Major in Computer Engineering *On-site – Seoul, Republic of Korea*

- Neuromorphic hardware-friendly reward-modulated spike-timing dependent plasticity (STDP)
- Opensource spiking neural network (SNN) accelerator for field programmable gate array (FPGA)
- Text-to-speech using mel-spectrogram and Generative Adversarial Network (GAN)

Advisor: Prof. Cheolsoo Park

Research Interests

Computational neuroscience, signal processing, brain-computer interface, statistical machine learning

PUBLICATIONS

- H. Yu†, S. Baek†, **J. Lee**†, I. Sohn, B. Hwang, C. Park. 2024. "Deep Neural Network-based Empirical Mode Decomposition for Motor Imagery EEG Classification." *IEEE Transactions on Neural Systems and Rehabilitation Engineering* (early-access). (**SCIE, Co-first author: IF = 4.8, JCR Top 2.9%**) [LINK]
- J. Yang, J. Kim, H. Ryu, **J. Lee**, C. Park. 2024. "Predicting Car Rental Prices: A Comparative Analysis of Machine Learning Models" *Electronics* 13, no. 12: 2345 . (SCIE, Co-author: IF = 2.9, JCR Top 49.6%) [LINK]
- C. Lee†, Y. Park†, S. Yoon†, **J Lee**†, Y. Cho, C. Park (under-review). "Brain-Inspired Learning Rules for Spiking Neural Network-based Control: A Tutorial." (**Co-first author**)

Experience

Undergraduate Research Assistant Jan 2022 – Present
Bio Computing and Machine Learning (BCML) Lab, Kwangwoon University *On-site – Seoul, Republic of Korea*
Advisor: Prof. Cheolsoo Park

- Robot arm control using electromyogram (EMG) and SNN
- Reconstruction method for missing electrocardiogram (ECG) using denoising diffusion probabilistic model (DDPM)
- Motor imagery classification via multivariate empirical mode decomposition (EMD)
- Classification of arrhythmias via 1D-2D transformation
- Detection of abnormal walking based on sensor data

Research Intern Jul 2022 – Aug 2022
Qualcomm Institute, University of California, San Diego *On-site – San Diego, California, United States*
Advisor: Prof. Justin Seokheon Cho

- Analysis of disease classification model using local interpretable model-agnostic explanation (LIME) method
- Classification of breast tumors using support vector machine (SVM)

Fire Direction Specialist, Squad Leader, Sergeant Jun 2020 – Dec 2021
Capital Defense Command, Republic of Korea Army *On-site – Seoul, Republic of Korea*

- Mathematical computations to determine artillery firing angles
- Training new recruits in these mathematical calculations
- Squad management tasks

PROJECTS

EMG-based robotic arm control using neuromorphic processor Jan 2024 – Present

- Classified of six arm movements and controlled robotic arm using EMG signals and dynamic vision sensor (DVS)
- Received an Excellence Award at the world embedded software contest 2023
- Developing a quantized SNN and reward-modulated STDP algorithm for neuromorphic processors
- Developing an algorithm based on a reinforcement learning framework for continuous real-time robot arm control

Opensource SNN Accelerator for FPGA Jan 2023 – Present
GitHub

- Implemented SNN on FPGA in Verilog
- Implementing in high level synthesis (HLS) for scalability
- Development Environment: Intel Quartus (in Verilog), Cyclone V, Xilinx Vivado (in HLS), Artix 7

Prediction of Car Rental Prices with Machine Learning approach Jan 2023 – Jun 2024
Publication

- Developed a vehicle rental price prediction model using time series prediction algorithms such as autoregressive and moving average, recurrent neural network, and foundation model

Analysis of SVM-based breast tumor classification model using LIME method Jul 2022 – Aug 2022
Presentation

- Developed a SVM breast tumor classification model with a classification accuracy of 98.2%
- Analyzed the SVM-based model with LIME method, which is an algorithm for explainable artificial intelligence
- The experimental results confirmed that the concave poit, area, perimeter, texture, and radius of the cell affected the classification of benign and malignant

Restoration and interpolation of ECG using generative model Jun 2022 – Oct 2022
Proceedings

- Developed conditional DDPM for ECG interpolation and restoration
- Experimental results show that up to 50% of random missing data can be restored, and interpolation after undersampling, successfully achieves up to 70% despite the Nyquist sampling theory
- Received a Best Paper Award (Bronze) at 2022 IEEE ICCE-Asia

Generalization of multivariate EMD using Neural Networks for Motor Imagery EEG Oct 2021 – Oct 2023
Publication

- Generalized the model-free algorithm multivariate EMD using deep neural network
- Effectively solved the mode mixing problem, which is a problem of existing EMD-based algorithms
- Our proposed method showed better motor imagery classification results than other EMD-based algorithms

Real-Time matchmaking system with Queue and Nearest Neighbor algorithm Jun 2021 – Apr 2022

- Designed real-time matchmaking system with Queue and Nearest Neighbor algorithm for study stream service
- Received an Excellence Award at Ministry of National Defence Start-Up Challenge
- Qualified for the finals at K-Startup Grand Challenge 2021
- Received KRW 70 million (approximately USD 50,000) in support from the Pre-Startup Package of the Korea Institute of Startup & Entrepreneurship Development

Arrhythmia classification by using Signal to Image method Nov 2019 – Dec 2019
GitHub

- Converted ECG signals into images to classify arrhythmias
- The experimental results showed good classification performance with small data compared to other algorithms

Unsupervised learning based measurement of video liveness Aug 2019 – Sep 2019
GitHub 1, 2

- Analyzed the dynamics of the video using metrics such as pixel error and structural similarity for each frame
- Developed a program that edits videos in high-dynamic sections by dividing the dynamics into three stages

Text-To-Speech using a GAN Jul 2019 – Sep 2019

- Developed a GAN that takes text as input and generates a mel spectrogram for voices
- Received a Grand Prize at 2019 Chambit Design Semester Performance Presentation in Kwangwoon University

Wi-Fi and Beacon based Augmented Reality Navigation System Jan 2016 – Jun 2016
Patent (application)

- Developed an augmented reality navigation system based on Wi-Fi and Beacon
- Developed an indoor positioning system using the triangulation method between the device and sensor

Teaching Experience

Teaching Assistant Mar 2024 – Present
Kwangwoon University *On-site – Seoul, Republic of Korea*

- Mentored 102 students in Computer Architecture (Spring 2024)

Student Mentor Jan 2022 – Present
BCML Lab, Kwangwoon University *Hybrid – Seoul, Republic of Korea*

- Mentored around 50 undergraduate students in BCML lab, in machine learning [LINK]

Honors And Awards

- Excellence Award, "SNN-based arm motion imitation robot arm control algorithm using EMG and DVS", The World Embedded Software Contest 2023, Korea Electronics Technology Institute, 2023
- Software Competence Excellence Scholarship, Kwangwoon University, {2019, 2022, 2023}
- **Best Paper Award (Bronze)**, 2022 IEEE ICCE-Asia 2022, IEEE, 2022 [**LINK**]
- Excellence Award, “SWIM: Study WIth Me, a study stream service”, Ministry of National Defense Start-Up Challange, Republic of Korea Ministry of National Defense, 2021
- Academic Excellence Scholarship, Kwangwoon University, 2019
- Grand Prize, “Text-To-Speech based on Generative Adversarial Network”, 2019 Chambit Design Semester Performance Presentation, Kwangwoon University, 2019
- Microsoft Azure Prize, "Mixed Reality Game", The 1st Welcome to the maker world, Microsoft Korea, 2017

Certifications

- Introduction to Statistical Methods with MATLAB, MATLAB, Feb 2023
- Qualcomm Institute Artificial Intelligence (AI) Development Project, Qualcomm Institute, Aug 2022
- AI Framework Certificate(KNIME Certification: L1 Examination, KNIME, Aug 2022
- Principles of Supercomputer and Supercomputing, Korea Institute of Science and Technology Information, Nov 2016

Communications

- J. Yang, J. Kim, **J. Lee**, H. Ryu, S. Yeo, P. Kim, Y. Kim, J. Lim, H. Yoon, C. Park, “Metaverse: Research Based Prediction Model of the Car Price in view of the Machine-learning Method", In *2023 IEEE International Conference on Metaverse Computing* (IEEE MetaCom 2023), Jun 2023, Kyoto, Japan [LINK]
- Y. Kang, **J. Lee**, C. Park, “Probabilistic Modeling for Multivariate Signal Restoration in PPG and ECG Using Denoising Diffusion", In *The Korean Society of Medical & Biological Engineering Spring Conference 2023*, May 2023, Daegu, South Korea
- **J. Lee**, C. Park, “Denoising Diffusion Probabilistic Model based Time-Series ECG data Interpolation”, In *2022 Korean Society of Medical & Biological Engineering Autumn Conference*, Nov 2022, Incheon, South Korea

- **J. Lee**, C. Park, “Restoration of Time-Series Medical Data with Diffusion Model”, In *2022 IEEE International Conference on Consumer Electronics-Asia* (ICCE-Asia), Oct 2022, Yeosu, South Korea [LINK]
- S. Baek, H. Yu, **J. Lee**, C. Park, “Design of Explainable AI Model with LIME for Single Channel Electroencephalogram”, In *2022 Summer Annual Conference of IEIE*, Jun 2022, Jeju, South Korea
- S. Baek, S. Han, **J. Lee**, C. Park, “Arrhythmia Classification Using 1D-2D Conversion”, In *u-Healthcare 2019*, Dec 2019, Seoul, South Korea

Volunteering

Colorful Happy Classroom After-School Program Apr 2019 – Jul 2019
Korea Foundation for the Advancement of Science and Creativity (KOFAC)

- Programming class for elementary school students
- Scratch programming

2014 Korea Education Fair for Happiness Sep 2014 – Sep 2014
Korea Foundation for the Advancement of Science and Creativity (KOFAC)

- Programming class
- Web programming, C programming

Professional Memberships and Services

Organizer, Google Developer Student Clubs Kwangwoon University Sep 2023 – Aug 2024

Student member, IEEE, Seoul Section Sep 2022 – Feb 2024

Member, IEEE Consumer Technology Society Sep 2022 – Feb 2024