Ping-Ju Lin

Research Area: Deep Learning (AI), Neuroscience, Biomedical signal processing

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Education

Tsinghua University, Beijing 08/2020-06/2024

Doctor of Philosophy, Mechanical Engineering, Department of Mechanical Engineering

- Advisor: Prof. Linhong Ji; Research Area: Rehabilitation engineering, Intelligent and Biomimetic Machinery

Harvard Medical School and Mass General Hospital, MA 09/2022-03/2023

Visiting Scholar, Department of Neurology, laboratory for Translational Neurorecovery

- Advisor: Prof. David Lin; Research Area: Neurorecovery, Neurology, Neuroscience

George Washington University, DC 09/2018-06/2020

Master of Science, Electrical Engineering, School of Engineering & Applied Science

- Advisor: Prof. Murray H. Loew; Research Area: Medical Image & Image Analysis

Feng Chia University, Taiwan 09/2014-06/2018

Bachelor of Science, Electrical Engineering, Department of Electrical Engineering

Skills

- Profession knowledge in Deep Learning, Brain-computer interface, and Neuroscience; Skilled in Brain signal processing (EEG, MRI, fNIRS), Deep Learning model architecture in stroke patient recovery, and Stroke patient motor recovery prediction.
- Software: Python, Tensorflow, Keras, Pytorch, MATLAB, EEGLab, C++, ZEMAX, Layout, Verilog, Altera, Quartus
- Languages: Chinese (Native), English (Fluent)

Publication

1. **P. -J. Lin** et al., "Explainable deep-learning prediction for brain-computer interfaces supported lower extremity motor gains based on multi-state fusion*," in IEEE Transactions on Neural Systems and Rehabilitation Engineering,* vol. 32, pp. 1546-1555, 2024, doi: 10.1109/TNSRE.2024.3384498.
2. **P. -J. Lin** et al., "AM-EEGNet An Advanced Multi-input deep learning framework for EEG-based classification tasks," in *Neurocomputing*, vol. 585(127622), 2024
3. **P. -J. Lin** et al., "A transferable deep learning prognosis model for predicting stroke patients' recovery in different rehabilitation trainings," in *IEEE Journal of Biomedical and Health Informatics*, vol. 26, no. 12, pp. 6003-6011, Dec. 2022, doi: 10.1109/JBHI.2022.3205436.
4. **P. -J. Lin** et al., “CNN-Based Prognosis of BCI Rehabilitation Using EEG From First Session BCI Training,” in *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, vol. 29, pp. 1936-1943, 2021, doi: 10.1109/TNSRE.2021.3112167.
5. J. Sun, T. Jia, **P. -J. Lin**, Z. Li, L. Ji and C. Li, "Multiscale Canonical Coherence for Functional Corticomuscular Coupling Analysis," in *IEEE Journal of Biomedical and Health Informatics*, doi: 10.1109/JBHI.2023.3332657
6. Li, W., Li, C., Liu, A., **Lin, P. J.**, Mo, L., Zhao, H., Xu., Q., Meng., X., Ji, L. "Lesion-specific cortical activation following sensory stimulation in patients with subacute stroke. " *Journal of NeuroEngineering and Rehabi*litation. 2023, 20(155). doi: 10.1186/s12984-023-01276-8
7. Li, Zhibin., Li, Wei., **Lin, Ping-ju**., Jia, Tianyu., Ji, Linhong., Li, Chong. "Motor-Respiratory Coupling Improves Endurance Performance during Rhythmic Isometric Handgrip Exercise. *Medicine & Science in Sports & Exercise 2023*. doi: 10.1249/MSS.0000000000003329
8. Qian C, Li W, Jia T, Li C, **Lin PJ**, Yang Y, Ji L. Quantitative Assessment of Motor Function by an End-Effector Upper Limb Rehabilitation Robot Based on Admittance Control. *Applied Sciences*. 2021; 11(15):6854. https://doi.org/10.3390/app11156854

Patent

1. **P.-J. Lin**. 2022. A method or computer equipment for patients to prognosticate rehabilitation outcome from CN Patent. ZL 2021 1 0593146.1, filed May 28, 2021, and issued August 26, 2022

Projects (Research Experiment)

Tsinghua University 08/2020-Present

- Lab of Intelligent and Bio-mimetic Machinery

1. Brain-Computer Interface upper-limb rehabilitation outcome prediction
   - Developed a convolutional-based model namely the Two-Way CNN model to prognosis upper limb disability patient motor ability gain from the brain-computer interface rehabilitation method.
   - Compared the relationship between the motor recovery and different state signals including the motor state (Event related discrimination) and resting state.
   - Analyzed the model by using a deep learning explanation method (Saliency Map) to visualize the weighing region contributes to a good recovery.
2. Understanding the feature relate with the recovery of Robotic treatment
   - Developed a quantitative assessment method to better understand the recovery of motor function with the use of robotic rehabilitation systems.
   - Found that movement trajectory was closely related to the patient's motor recovery rate.
3. Advanced Multi-inputs Deep learning architecture
   - Developed a multi-input deep learning model architecture based on the EEG feature to improve the prediction accuracy in all kinds of the EEG-based prediction problems.
4. Brain EEG feature explanation with motor recovery
   - Analyze the EEG feature from the deep learning model explanation method to visualize the region and frequency related to stroke patients' motor recovery.

Tsinghua Chang Geng Hospital 09/2021-Present

- Medical Research Center

1. Transfer Learning in different rehabilitation treatment
   - Developed a deep learning model for stroke cause lower extremity disability patients in predicting two different rehabilitation motor ability gain.
   - Validated the potential of transferring a pre-train model in different rehabilitation methods i.e. one robotic and one traditional method.
   - Found the same recovery pattern for post-stroke patients from the power spectrum density and functional connectivity in two different rehabilitation treatments.
2. Explainable deep-learning prediction for BCI-supported lower extremity motor gains
   - Collaborate with medical doctors to undergo post-stroke patients with lower extremity disability to treatment with a specific experimental design.
   - Found the critical factor of brain electrical activity related to the motor recovery of lower limbs stroke causes disability patients.

Massachusetts General Hospital 09/2022-Present

- Laboratory for Translational Neurorecovery

1. Post-Stroke motor recovery prediction based on Magnetic Resonance Imaging (MRI)
   - Developed three different deep learning architectures (CNN, MLP, transformer) on the MRI dataset to predict the recovery gain after three-month rehabilitation training.
   - Analyzed the model using a deep learning explanation method (SHAP value) to visualize how the weighing region relates to motor recovery.

Industry Experiment

National Information Security Standardization Technical Committee 06/2021-12/2021

- Project Consultant

1. Advised the standard in EEG pre-processing procedure. (Brain-Computer Interface)
2. Completed a chapter in the "White paper on the application of brain-computer interface technology in the medical and health field"

Foxconn (Hon Hai Precision Industry) 06/2019-08/2019

- AI/ML Engineer Intern

1. Developed an NLP (Nature language Processing) model to train the dialect language (Min-Nan) model with the data from the Pi-li company. The goal is to alternate the character's voices.
2. Programmed a Web Crawler to grip data from social media such as PTT, Dcard, and Facebook and visualize the public opinion poll.

Teaching Experiment

The George Washington University — Spring 2020

- Teaching Assistant (Electrical Energy Conversion)
  1. Prepared weekly quizzes and graded weekly quizzes.
  2. Solved individual student problems in-class projects.

Award

- Ministry of Education Natioanal Scholarship for PhD (Best honor) — 2022
- Ministry of Education Natioanal Scholarship for PhD (2nd) — 2021
- Ministry of Education Natioanal Scholarship for PhD (3nd) — 2020