Takahiro Manabe

Curriculum Vitae

tmanabe@u.northwestern.edu
(224) 382-2091
Chicago, Illinois

Education

Northwestern University   **Evanston, Illinois**
M.S., Biomedical Engineering - GPA: 3.933/4.000   September 2023 – Expected June 2025

Meiji University   **Kanagawa, Japan**
B.Eng., Electronics and Bioinformatics - GPA: 3.78/4.00 (*Top 2% in the department*)   April 2019 – March 2023

The State University of New York at Buffalo (SUNY Buffalo)   **Buffalo, New York**
Non-Degree/Major (One-Year Exchange Program) - GPA: 3.733/4.000   August 2021 – May 2022

Publications

Book Chapter

1. **Manabe, T.,** & Dutta, A. November 2024. Machine Learning Brain Activation Topography for Individual Skill Classification – Need for Leave One Subject Out (LOSO) Cross Validation. In F. Iqbal, P. Gupta, V. Kumar, & D.K. Pratihar (Eds.), ***Biomedical Robots and Devices in Healthcare: Opportunities and Challenges for Future Applications***. Elsevier Academic Press.

Journal Article (Peer-Reviewed)

2. **Manabe, T.**, Rahul, F.N.U., Fu, Y., Intes, X., Schwaitzberg, S.D., De, S., Cavuoto, L., & Dutta, A. 2023. Distinguishing Laparoscopic Surgery Experts from Novices Using EEG Topographic Features. ***Brain Sciences***, *13*(12), p.1706. DOI: 10.3390/brainsci13121706.

Conference Papers (Peer-Reviewed)

3. Kanaizuka, Y., **Manabe, T.**, Huang, J.J., Hung, J.W., & Ono, Y. October 2023. Directional Neural Connectivity during Robot Mirror Therapy in Patients with Stroke. In ***2023 APSIPA ASC*** (pp. 199-205). IEEE. DOI: 10.1109/APSIPAASC58517.2023.10317207.

4. **Manabe, T.**, Walia, P., Fu, Y., Intes, X., Schwaitzberg, S.D., De, S., Cavuoto, L., & Dutta, A. December 2022. EEG topographic features for assessing skill levels during laparoscopic surgical training. In ***I/ITSEC 2022***.

Conference Presentation

Abstract & Talk

1. **Manabe, T.**, Kanaizuka, Y., Huang, J.J., Hung, J.W., & Ono, Y. January 2023. Changes in directional neural connectivity during different types of hand motor rehabilitation in post-stroke patients. In **35*th* Conference on Multimodal Brain Information Technology** *[Maruchi-mōdaru nō jōhō kenkyū-kai], Japanese Society for Medical and Biological Engineering*.

Research Experience

"Decoding Speech Intent from Temporoparietal Neural Activity"   **Chicago, Illinois**
Slutzky Neuroprosthetics Laboratory, Northwestern University   February 2024 – Present
Master's Research Advised by Dr. Marc Slutzky and Dr. Joshua Glaser

- Investigating neural features of speech intent by analyzing electrocorticography (ECoG) signals from temporal and parietal regions.

- Designing a data analysis pipeline leveraging a dimensionality reduction technique to extract phoneme-related neural patterns from high-gamma activity (HGA).
- Decoding distinct phonemes by applying advanced multi-task machine learning methods, emphasizing specific articulatory features.

"Brain Connectivity Investigation through Stroke Motor Rehabilitation"   **Kanagawa, Japan**
Health Science and Medical Engineering Laboratory, Meiji University   May 2022 – March 2023
Undergraduate Research Advised by Dr. Yumie Ono
- Investigated the synergistic effect of combined neurorehabilitation methods for stroke hemiplegia patients by analyzing electroencephalography (EEG) signals.
- Modeled interhemispheric directional connectivity using multivariate autoregressive models and a customized partial directed coherence approach to effectively suppress volume conduction effects.
- Evaluated and identified the most effective therapy combinations by quantifying connectivity improvements following neurorehabilitation methods.

"Deep Learning-Driven Analysis and Visualization of Surgical Expertise"   **Buffalo, New York**
Surgery Ergonomics and Human Factors (SurgE) Laboratory, SUNY Buffalo   January 2022 – November 2023
Undergraduate Research Advised by Dr. Anirban Dutta
- Investigated neural mechanisms underlying training performance in the Fundamental of Laparoscopic Surgery (FLS) tasks.
- Transformed EEG signals into dynamic, movie-like representations by projecting them onto a two-dimensional scalp map, preserving spatiotemporal information.
- Implemented a three-dimensional convolutional neural network (3D CNN) with spatiotemporal-compressing layers to classify skill levels (experts vs. novices), achieving significant performance improvements over previous models.
- Visualized model layer outputs to identify activation patterns associated with expertise levels.

"Topographic Assessment of Surgical Skill with Microstate Segmentation"   **Buffalo, New York**
Surgery Ergonomics and Human Factors (SurgE) Laboratory, SUNY Buffalo   September 2021 – June 2022
Undergraduate Research Advised by Dr. Anirban Dutta
- Developed an EEG-based objective framework to assess performance in the FLS complex surgical tasks.
- Assembled the microstate-based Common Spatial Pattern (CSP) method, combining semi-stable pattern clustering with spatial filtering to analyze EEG topographic dynamics.
- Analyzed microstate dynamics during the initial ten seconds of task performance, revealing distinct patterns of neural activity associated with a cognitive-perceptual model in novices.
- Classified expert surgeons from novices by applying linear discriminant analysis (LDA) to microstate-CSP features, demonstrating superior performance compared to a conventional CSP-based classifier.

Professional Experience

Full-time Internship as a Research Assistant   **Lincoln, United Kingdom**
College of Health and Science, University of Lincoln   July 2023 – August 2023
- Advanced the research on surgical skill assessment by re-analyzing data and investigating individual neural variability to evaluate subject-specific brain states.
- Contributed to several research projects, including analyzing the brain states of coma patients and developing a multi-feedback motor rehabilitation system integrating brain stimulation (BrainPatch) with exoskeletal robots.

Part-time as a Research Assistant   **Kanagawa, Japan**
Health Science and Medical Engineering Laboratory, Meiji University   April 2023 – June 2023
- Investigated causal brain networks in healthy subjects and hemiplegic stroke patients, analyzing connectivity dynamics across eyes-open and eyes-closed states.

Part-time as a Cram School Tutor   **Tokyo, Japan**
Eisai Kobetsu Gakuin   September 2019 – February 2020
- Led instruction for high school students in English, Japanese, mathematics, physics, biology, and chemistry to prepare them for university entrance examinations. Retired earlier due to the pandemic.

Awards & Honors

Fellowship for a Research Internship   **Lincoln, United Kingdom**
College of Health and Science, University of Lincoln   July 2023
- Awarded 2,500 GBP (roughly 3,200 USD in July 2023).

Scholarship for an Undergraduate Exchange Program   **Tokyo, Japan**
Gyōmu Super Japan Dream Foundation   August 2021
- Awarded 1,350,000 JPY (roughly 12,300 USD in August 2021).

Exchange Student Selection - SUNY Buffalo   **Tokyo, Japan**
International Collaboration Office, Meiji University   December 2020
- Success ratio ~10%. Granted based on outstanding academic performance.

Skills

Programming	*(Proficient)*	Python (TensorFlow, PyTorch, scikit-learn, NumPy, Matplotlib, SciPy, OpenCV, MNE-Python), MATLAB, C
	(Basic)	R, HTML, CSS, JavaScript, Swift, Objective-C, LaTeX, Git
Tools		EEGLAB, BCILAB, MATLAB Deep Learning Toolbox, MATLAB Statistics and Machine Learning Toolbox, BrainNet Viewer, MRIcroGL
Laboratory	*(Measurements)*	Functional near-infrared spectroscopy (fNIRS), EEG, Electromyography (EMG), Electrooculography (EOG), Electrocardiography (ECG)
	(Devices)	Transcranial direct current stimulation (tDCS), OpenBCI