

## EDUCATION

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**Doctor of Philosophy (PhD) in Electrical Engineering** | **May 2026**  
University of Kentucky, USA | GPA: 4.00/4.00  
Thesis Title: Goal-driven Shared Control in EEG-based Brain Machine Interface for Freewill Reaching and Grasping with Movement Intention Detection and Goal Position Decoding.

**Bachelor of Electronics & Communication Engineering** | **Sep 2014 - Sep 2018**  
Nepal Engineering College, Nepal | GPA: 3.21/4.00  
Thesis Title: Classification of EEG signal before epileptic seizure to detect its onset for a patient-specific case.

## WORK/RESEARCH EXPERIENCE

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**Postdoctoral Scholar** | University of California at Davis, USA | **2026 July – Present**

- Investigate neuromuscular and cortical responses to transcutaneous spinal cord stimulation (tSCS) in spinal cord injury using EEG and multichannel EMG, including experimental design, signal preprocessing, feature extraction, and recruitment-curve analysis.
- Develop reproducible signal-processing and machine-learning workflows and contribute to manuscripts, grant proposals, scientific presentations, and a VA-sponsored spinal cord injury research project.

**Graduate Research Assistant** | University of Kentucky, USA | **2021 Aug – 2022 Dec & Summer 2024**

- Developed and evaluated a transformer-based deep-learning model using EEG for seizure onset zone localization.
- Recorded EEG data for freewill reaching and grasping tasks from 23 subjects, and performed EEG feature extraction and analysis for optimal window size for real-time brain-machine interfaces.
- Assisted in EEG data recording for an EEG-fMRI-based inter-ictal clinical epilepsy research study for 2 patients, contributing to critical insights in inter-ictal clinical research and potential treatment avenues.
- Analyzed EEG data for pre-movement motor imagery using temporal and spectral feature analysis for a Kernel Temporal (KT)-based reinforcement learning algorithm, to improve movement decoding.
- Developed a simple and effective algorithm to detect the heartbeats in real-time using the ECG signal.
- Mentored 8 students on research fundamentals, including literature review, signal processing and machine learning methods, MATLAB/Python programming, and experimental design.

**Research Assistant** | Kathmandu Institute of Applied Sciences, Nepal | **Aug 2019 – Dec 2019**

- Designed and developed a low-cost mobile weather station using Arduino for real-time environmental data monitoring, which is currently sold as a commercially available system.
- Led and mentored an intern to successfully deliver the low-cost mobile weather station on time and with high quality.

**Undergraduate Research Assistant** | Nepal Engineering College, Nepal | **Jan 2019 – Apr 2019**

- Developed and applied an advanced multi-resolution analysis framework, integrating wavelet transforms and PCA with a feedforward neural network, to accurately detect early signs of epilepsy in EEG signal, enhancing predictive diagnostic methodologies.

**Internet of Things Designer Intern** | Engineering ADDA, Nepal | **Nov 2017 – May 2018**

- Designed and developed 555 Timer IC Projects and Arduino-based Projects: Security Lock System, LED Clock, Path follower robot, and smart traffic lights.

## TEACHING & MENTORSHIP EXPERIENCE

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**Graduate Teaching Assistant** | University of Kentucky, USA | **Aug 2021 – Present**

- EE 421G: Signals and Systems – Supported over 200 students across 9 semesters by grading assignments and providing 1:1 mentorship to 100+ students during office hours to improve their grasp of signals and systems concepts.
- EE 422G: Signals and Systems Lab – Verified lab equipment functionality and assisted students during lab sessions with MATLAB and LabView-focused assignments across 5 semesters. Provided individualized support to 20+ students during office hours, enhancing their practical understanding of signals and systems.

- Supervised and mentored final-year Electronics and Communication Engineering students, providing academic and technical guidance throughout project planning, implementation, problem-solving, progress monitoring, and successful project completion.

#### **Workshops and Lectures |**

- Independently led a workshop for 8 new Teaching Assistants at the University of Kentucky in Fall 2024, providing guidance on effective teaching and offering insights into TA responsibilities.
- Delivered a guest lecture on “*Application of Fourier Transform in Digital Signal Processing*” for an undergraduate class (EE 421G) at the University of Kentucky at the request of the primary instructor.

#### **Outreach Engagement and Mentorships|**

- Presented demonstrations about ‘*Brain-machine interfaces*’ to researchers, graduate students, undergraduate students, and high school students in 2 Engineering Day Fairs and 1 Curiosity Fair at the University of Kentucky.

### **PUBLICATIONS**

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#### **Journal Publications:**

- [1] **Thapa, B. R.**, Boggess, J., and Bae, J. “*A large electroencephalogram database of freewill reaching and grasping tasks for brain machine interfaces.*” Scientific Data, 2025. DOI: <https://doi.org/10.1038/s41597-025-06039-9>.
- [2] Bae, J., Clay, J. L., **Thapa, B. R.**, Powell, D., Turpin, H., Partovi, S. T., Ward-Mitchell, R., Krishnan, B., Koupparis, A., and Owen, M. B. “*Equipment Setup and Artifact Removal for Simultaneous Electroencephalogram and Functional Magnetic Resonance Imaging for Clinical Review in Epilepsy.*” Journal of Visualized Experiments (JoVE), 2023. DOI: <https://doi.org/10.3791/64919>.
- [3] Shrestha, S., Shrestha, R. D., and **Thapa, B. R.** “*Implementing Neural Network and Multi resolution Analysis in EEG signal for early detection of epilepsy.*” SCITECH NEPAL, 2019. DOI: <https://doi.org/10.3126/scitech.v14i1.25528>.
- [4] Shrestha, S., Shrestha, R. D., Shah, A., and **Thapa, B. R.** “*Analysis of EEG signal of specific epileptic patient prior to its occurrence.*” SCITECH NEPAL, 2018. DOI: <https://doi.org/10.3126/scitech.v13i1.23497>.

#### **Conference Proceedings:**

- [1] **Thapa, B. R.**, Sanchez, L., and Bae, J. “*Detecting Movement-related Intentions of Freewill Reaching and Grasping Tasks in EEG-based Brain Machine Interfaces.*” 2026 45th Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC), 2026. ([in review](#))
- [2] **Thapa, B. R.**, Parades, J. T., Boggess, J., Shalash, A., and Bae, J. “*Time, Frequency, and Complexity-based Analysis of Error-Related Potentials in EEG-based Brain Machine Interfaces.*” IEEE EMBS Conference on Neural Engineering (NER), 2025. ([in press](#))
- [3] **Thapa, B. R.**, and Bae, J. “*A Window Analysis for the Decoding of Premovement and Movement Intentions in Freewill EEG.*” 2025 44th Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC), 2025. DOI: <https://doi.org/10.1109/embc58623.2025.11253481>.
- [4] McDorman, R., **Thapa, B. R.**, and Bae, J. “*Transfer Learning in EEG-based Reinforcement Learning Brain Machine Interfaces via Q-learning Kernel Temporal Differences.*” 2025 44th Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC), 2025. DOI: <https://doi.org/10.1109/embc58623.2025.11253000>.
- [5] McCubbins, D., **Thapa, B. R.**, and Bae, J. “*Simple and Effective Signal Processing Techniques to Detect Heartbeats from Electrocardiogram.*” IEEE SoutheastCon 2025. DOI: <https://doi.org/10.1109/SoutheastCon56624.2025.10971511>.
- [6] **Thapa, B. R.**, Tangarife, D. R., and Bae, J. “*Kernel Temporal Differences for EEG-based Reinforcement Learning Brain Machine Interfaces.*” 2022 44th Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC), 2022. DOI: <https://doi.org/10.1109/EMBC48229.2022.9871862>.

#### **Abstracts:**

- [1] **Thapa, B. R.**, Menco Mojica, S. E., Poonawala, H. A., and Bae, J. “*A Strategy to Effectively Incorporate Shared Control in EEG-based Brain-Machine Interfaces.*” NSF M3X Principal Investigator’s Meeting, Virginia, USA, May 2026.
- [2] **Thapa, B. R.**, and Bae, J. “*A Window Analysis for the Decoding of Premovement and Movement Intentions in Freewill EEG.*” Electrical Engineering Graduate Research Symposium, University of Kentucky, Kentucky, USA, April 2025.
- [3] Bogges, J., **Thapa, B. R.**, and Bae, J. “*Multichannel Electroencephalogram Database for Freewill Reaching and Grasping Tasks.*” 2023 Neuroscience RPA Clinical-Translational Research Symposium, Kentucky, USA, November 2023.

## ACHIEVEMENTS & AWARDS

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- 2025 IEEE Engineering in Medicine and Biology Society (EMBS) Travel Award Fellowship (Nov 2025)
- 2026 Lighthouse Beacon Foundation Graduate Fellow Awardee, for advancing brain-machine interface research using signal processing and machine learning at the University of Kentucky. (Jul 2025-Jul 2026)
- Elise White Boyd Graduate Teaching Fellow, for performing excellently as a Teaching Assistant at the University of Kentucky. (Jan 2025-May 2025)
- Faculty of Science & Technology Scholarship, 100% tuition waiver to pursue undergraduate studies. (2014-2018)
- Pre-Engineering Fellowship Awardee, 100% fee waiver for the preparation of the engineering degree. (2012)
- Higher Secondary Education Board (HSEB) Scholarship, 100% tuition waiver to pursue high school studies. (2012-2014).

## RELEVANT TECHNICAL SKILLS

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- **Programming:** MATLAB (7+years), Python (7+years), C/C++ (2+years), Git/Github (5+ years), Shell Scripting (Unix/Linux), LaTeX, Java (Android Studio).
- **Biomedical Signal Processing:** Time series and spectral analysis, spectrogram analysis, digital filter design (IIR/FIR), discrete wavelet transforms, entropy and similarity analysis, event detection (peak/epoch segmentation), artifact removal including baseline correction and EOG correction.
- **Machine Learning & Deep Learning:** Multi-variate regression, k-means/k-means++, support vector machine (SVM), linear discriminant analysis (LDA), logistic regression, extended Kalman filter, multilayer perceptron, convolutional neural network (CNN), principal component analysis (PCA), independent component analysis (ICA), recurrent neural network (RNN) including LSTM, attention weighted transformers, KT-based reinforcement learning.
- **Physiological Signal Analysis:** electroencephalogram (EEG), electrocardiogram (ECG), audio & speech, piezo-electric signal, ultra-sonic sound electrooculogram (EOG), and images.
- **Software & Frameworks:** PyTorch, Tensorflow Keras, scikit-learn, Scipy, MNE, High Performance Computing (HPC) Cluster, BrainStorm, EEGLAB, BrainVision's Recorder, BrainVision's Analyzer, OpenBCI GUI, Robot Operating System (ROS), RViz, MoveIt, Shapr3D (CAD tool), Adobe Premier Pro.
- **Embedded Systems and Internet of Things (IoT):** Raspberry Pi, Arduino, OpenBCI Cyton, 555 Timer IC.

## RELEVANT ADDITIONAL PROJECTS

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1. A transformer-based deep learning model evaluation for seizure detection and localization. (Summer 2024)
2. Aircraft engine performance prediction using the Extended Kalman Filter. (Spring 2024)
3. Human action classification using CNNs: optimized performance through PyTorch, feature extraction, and model tuning on the Stanford 40 Dataset. (Spring 2024)
4. EEG-based pre-movement intention real-time detection for self-paced keystroke tasks: a deep learning approach. (Fall 2023)
5. Cage-floor pressure measurement regression with EEG signals in mice for sleep microstates using CNN and MLP-based models. (Fall 2023)
6. Speaker recognition using acoustic feature classification and signal processing techniques. (Fall 2022)
7. Doppler blood flow analysis for heart rate and velocity estimation using spectral features. (Fall 2022)
8. Movement imagery classification using EEG signals for brain-machine interfaces. (Fall 2021)
9. NFL helmet collision detection for player safety using YOLOv5 and computer vision. (Fall 2021)
10. Low-cost IoT-based mobile weather station using Arduino. (Aug-Dec 2019)
11. Vehicle entry detection system using image processing on Raspberry Pi. (Jun-Sep 2019)
12. Android scientific calculator app development using Java and OOP concepts. (Oct-Nov 2017)

## CAMPUS & OTHER ACTIVITIES

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**IEEE SoutheastCon 2025 Ethics Essay Judge** | SoutheastCon, USA | 2025

**Chess.com College Ambassador** | Chess Club at U. of Kentucky, USA | 2024/2025

**IEEE EMBS Member and IEEE Student Branch Member** | U. of Kentucky, USA | 2023/2024

**Social Media Manager** | Chess Club at U. of Kentucky, USA | 2022/2023

**University Chess Team Member** | Chess Club at U. of Kentucky, USA | 2022

**MoChWo Conference Organizing Member** | Kathmandu Institute of Applied Sciences, Nepal | 2019  
**College Sports Event Referee for Cricket and Kabaddi** | Nepal Engineering College | 2018  
**College Cricket Team Member** | Nepal Engineering College | 2015/2016