Mohammad Rezaei

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Education

Master's student in Sport Engineering, University of Tehran   *September 2024 - Present*
B.S. Biomedical Engineering, Azad Tehran University of Medical Sciences   *September 2019 - July 2024*
High School Diploma, Mathematics and Physics   *September 2016 - July 2019*

Research Projects

- **Early Diagnosis of Alzheimer's Disease Based on Brain Morphological Changes: A Deep Learning Approach**
  Description: Led a study on T1-weighted MRI scans that integrated voxel-based morphometry with biologically motivated biomarkers, transformed into multi-bit heatmaps for convolutional and fully convolutional neural networks. This approach achieved up to 96 percent accuracy in distinguishing normal aging, early and late MCI, and Alzheimer's disease, while providing interpretable structural indicators of disease progression.

- **Simulation Study of Neural Network Criticality: Critical Avalanches and Bifurcations***:*
  Description: Developed and executed simulations of an excitation–inhibition neural network using Izhikevich neuron models. Focused on exploring critical neuronal avalanches through bifurcation analysis of the corresponding mean-field model. This project examined both spike and burst firing patterns to elucidate transitions between asynchronous and synchronous neural activity. The results were validated against theoretical predictions and are detailed in the attached reference paper.

- **Python-Based Image-Processing Toolkit**
  Description: Built a comprehensive Python framework from the ground up, integrating Prewitt and Sobel edge detection, Otsu thresholding with region merging, histogram equalization and adaptive CLAHE for contrast enhancement, bilinear and bicubic interpolation for reconstruction, block-DCT compression with PSNR-based quality assessment, and an automated cell-segmentation pipeline with connected-component labeling and feature extraction for quantitative biomedical analysis.

- **Investigated inter-individual variability and pattern recognition of surface electromyography in front-crawl swimming**
  Description: Analyzed EMG signals from the rectus abdominis and deltoideus medialis of competitive swimmers, applying Butterworth band-pass filtering and MVIC normalization, extracting key metrics—coefficient of variation, variance ratio and mean deviation—and leveraging k-means clustering alongside statistical parametric mapping to uncover distinct activation sub-patterns and inform personalized training strategies.

- **In-Depth Analysis of Electrocardiograph (ECG) Systems and Cardiac Electrophysiology:**
  Description: Conducted a comprehensive research project on the engineering intricacies of Electrocardiograph (ECG) machines, with a specific focus on their functionality in the context of cardiac physiology. Explored the circuitry and components of ECG devices, gaining insights into how they capture and analyze the heart's electrical signals to produce ECG waveforms. This study also involved a deep dive into the physiological aspects of the heart, including cardiac electrical conduction, ECG waveforms' interpretation, and their significance in diagnosing various heart conditions.

- **Presentation of "Low-Level Laser Therapy as a Modality to Attenuate Cytokine Storm at Multiple Levels, Enhance Recovery, and Reduce the Use of Ventilators in COVID-19":**
  Description: Presented the article titled "Low-Level Laser Therapy as a Modality to Attenuate Cytokine Storm at Multiple Levels, Enhance Recovery, and Reduce the Use of Ventilators in COVID-19."

- **Presentation of "The Potential Role of Photo-biomodulation in Long COVID-19 Patients' Rehabilitation":**
  Description: Presented the article titled "The Potential Role of Photo-biomodulation in Long COVID-19 Patients' Rehabilitation."

- **Translation and Presentation of "Nuclear Medicine, Computers in":**
  Description: Translated and presented the article titled "Nuclear Medicine, Computers in."

- **Laboratory Spectrophotometer and Optical Laser Presentation:**
  Description: Conducted comprehensive research and delivered presentations on laboratory spectrophotometers, optical lasers, and various laboratory instruments. Explored the operational principles, design, and working mechanisms of spectrophotometers.

Notable Courses:

- **Dynamical Systems in Neuroscience**
- **Statistical Data Analysis and Linear Algebra**
- **Electrical Circuits 1,2 and Electronics 1,2**
- **Linear Control Systems**
- **Machine Learning**
- **Engineering Mathematics**
- **Signal and System Analysis**
- **Physiology**

Internship

Omid Hospital, Tehran   *12/2022 – 06/2023*
Biomedical Engineering Assistant

- Inspecting and ensuring the health and functionality of medical equipment.
- Assisting in the maintenance and repair of medical devices.
- Conducting monthly preventive maintenance (PM) on equipment.
- Generating reports on the performance of medical equipment.
- Conducted research on medical equipment.
- Studied design, operation, and maintenance of medical devices.
- Collaborated with a team to evaluate safety and efficiency.
- Researched and analyzed robotic surgical systems.
- Studied the applications and benefits of robotic surgery.
- Collaborated with seasoned hospital biomedical engineers to troubleshoot and service medical devices.
- Independently diagnosed and rectified minor issues in various medical equipment.

Skills

- **Programming:** Proficient in Python and MATLAB for advanced data analysis, modeling, Machine Learning, Deep Learning, and neuroimaging applications.
- **Software Tools:** Familiar with Proteus for electrical design, FSL, and Freesurfer for neuroimaging and analysis.
- **Computer Literacy:** Proficient with productivity software, communication tools, presentation software, database management, and project management software.
- **Teamwork:** Collaborated with cross-functional teams to deliver projects on time and under budget.
- **Communication:** Proficient in technical writing, creating presentations, and managing documentation.
- **Project Management:** Skilled in leading projects to successful completion with effective team collaboration.
- **Advanced Research Tools:** Experienced in utilizing cutting-edge research tools.
- **Multitasking:** Able to handle multiple tasks efficiently and effectively.
- **Attention to Detail:** Meticulous attention to detail to ensure accuracy and precision.
- **Analytical and Critical Thinking:** Strong capabilities in analytical and critical thinking for problem-solving and decision-making.
- **Remote Work:** Experienced in working effectively in remote settings.

Certifications

- **Calibration of Medical Equipment |** *2023*
  Azad University, Science and Research Branch

- **Neuroscience and Neuroimaging Specialization (Audited Course**) **|** *2024*
  Johns Hopkins University (Online Course)

- **Python for Data Science, AI & Development |** *2024*
  IBM (Online Course)

- **Data Management for Clinical Research |** *2024*
  Vanderbilt University (Online Course)

Academic Service

- **Peer Reviewer**
  Biomedical Signal Processing and Control (Elsevier): Reviewed manuscripts related to biomedical engineering and neuroimaging (2024–2025).

Selected Honors and Activities

- **Nationwide Entrance Exam (Konkur):** Ranked within the top 1% of the Iranian Entrance for bachelor's degree among out of 204,278 students.
- **Leadership Role:** Led the Biomedical Engineering Student Association, organizing workshops and seminars on medical technology and neuroimaging, fostering collaboration on research projects.
- **Sports Achievements:** Excelled in competitive sports, including three consecutive championships in Tehran city, third place in the Youth Premier League, and participation in the adult league finals as a youth player.