Alicia Mathew

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Education

Bachelor of Math in Computational Mathematics (Honours Co-op) | University of Waterloo Sept 2019 - Aug 2024
Waterloo, ON, Canada

- **Minors**: Computing & Psychology
- **Relevant Courses (Math/CS)**: Linear Algebra, Algorithmic Problem Solving, Optimization, Data Structures & Algorithms, Neural Networks, Computational Modeling of Cellular Systems
- **Relevant Courses (Psychology)**: Cognitive Processes, Psychopathology, Human Neuropsychology, Physiological, Clinical, and Developmental Psychology
- **Final two years GPA**: 3.7/4.0 (A-)
- **Associations**: Member of Varsity Track & Field team

Work Experience

Research Assistant / Data Engineer | Rotman Research Institute, Baycrest (Cranium Lab) Sep 2023 - Present
North York, ON, Canada - University of Toronto

- Leading the EEG component of a transcranial and intranasal photobiomodulation (PBM) project, studying the influence of this non-invasive low-level light therapy on the power and complexity of EEG frequency bands in principle brain regions as a potential therapy for neurodegenerative disease symptoms.
- Building and managing in-house spectral power and entropy analysis workflows using **EEGLAB**, **MATLAB**, and **Bash** to transform raw neural signals into isolated frequency bands and study the temporal dynamics of EEG responses.
- Developing statistical analysis infrastructure integrating spatial clustering algorithms and correlation-based electrode grouping to identify significant neural responses across dense electrode arrays through permutation testing.
- Implementing linear mixed effects models to quantify the effect of key stimulation parameters (wavelength, frequency, irradiance) and individual biological factors (sex, skin tone) on region- and band-specific neural responses, enabling data-driven optimization of brain PBM parameters in collaboration with Vielight Inc., with findings submitted in two first-author publications.

Research Assistant | Face Processing & Social Cognition Lab May - Aug 2023
Waterloo, ON, Canada - University of Waterloo

- Managed multi-modal data collection (EEG, eye-tracking, emotion-based responses) across participants to analyze Event-Related Potentials (ERPs) used in processing facial features.
- Developed and optimized EEG data processing pipelines using **EEGLAB** and **MATLAB** for channel filtering, artifact rejection, epoch extraction, and ICA decomposition, integrating the **LIMO** toolbox for statistically identifying key ERP components (N170, P300) associated with perceiving and distinguishing emotions.

Full-Stack Developer | Woodbridge Jan - Apr 2022
Mississauga, ON, Canada

- Developed a full-stack web application using **Flask**, **React**, and **Python** that streamlined chemical formulation management for chemists, reducing formula modification time and improving data accuracy.

Data Science / AI Projects Assistant | M42 (G42 Healthcare) Jan - Aug 2021
Abu Dhabi, UAE

- Led a machine learning project, engineering end-to-end data processing pipelines for CDC's NHANES healthcare datasets (1999-2018), creating custom workflows using Numpy and Pandas to extract, transform, impute, and clean complex medical data in varying formats.
- Implemented transformation pipelines using Scikit-learn, improving pre-processing for categorical and continuous data and optimizing models (Random Forest, XGBoost) across multiple approaches (data-driven vs. domain-driven, with/without lab data) for multi-class diabetes prediction, achieving ROC AUC scores up to 0.83.
- Collaborated with domain experts to integrate clinical knowledge into feature engineering, identifying clinically significant predictors for classification (non-diabetic, pre-diabetic, diabetic) as Phase 1 of a larger initiative to apply these methods to electronic health records in the UAE.

Research Papers

Mathew, A., Van Lankveld, H., Zhong, X. Z., Chen, J. X., Chen, J. J., 2025. Real-time EEG response to pulsed transcranial photobiomodulation in healthy young adults: Effects of stimulation parameters and skin tone. bioRxiv. 10.1101/2025.05.26.656199

Zhong, X., Van Lankveld, H., **Mathew, A.**, Chen, J.J., 2025. The link between steady-state EEG and rs-fMRI metrics in healthy young adults: the effect of macrovascular correction. bioRxiv. 10.1101/2025.06.06.658306

Motsenyat, A., Zhong, X., Van Lankveld, H., Chen, J.X., **Mathew, A.**, Chen, J.J., 2025. Modulating cerebrospinal fluid dynamics using pulsed photobiomodulation: feasibility, parameter and skin-colour dependence. bioRxiv. 10.1101/2025.05.06.652458

Research Abstracts

Mathew A, Van Lankveld H, Chen J. X., and Chen J. J. The EEG Response to Pulsed Forehead Photobiomodulation: Dependence on Wavelength and Frequency. OHBM 2025.

Van Lankveld H, **Mathew A**, Niculescu S., Lim L., Hosseinkhah N. and Chen J. J. The Effect of Transcranial Photobiomodulation on EEG Power: Variation with Light Pulsation Frequency. OHBM 2024.

Van Lankveld H, **Mathew A**, Niculescu S., Zomorrodi R., Lim L., Hosseinkhah N. and Chen J. J. The real-time EEG response to transcranial photobiomodulation and the effect of light pulsation frequency. WALT 2024.

Research Projects

Smart Budget Tracker Application July 2024

- Developed a Flask + React web app for personal/group budgeting with features for expense logging, categorization, visualizations, and smart suggestions.
- Integrated **SQLite3** for efficient data storage and tracking.
- *Final grade: 85% (CS 338: Computer Applications of Databases)*.

Mathematical Model of Cellular Responses to Alcohol During Photobiomodulation Apr 2024

- Built a mathematical model using ordinary differential equations (ODEs) to study alcohol's effect on mitochondrial dynamics during PBM.
- Simulated oxidative stress–PBM interactions and conducted sensitivity analyses on superoxide production to assess how varying alcohol levels influence mitochondrial superoxide production, demonstrating the potential risks associated with alcohol during PBM.
- *Final grade: 88% (AMATH 382: Computational Modeling of Cellular Systems)*.

Critical Review of Cochlear Implant Efficacy in Pediatric Populations Apr 2024

- Authored a critical review on somatosensory reorganization in pediatric cochlear implant (CI) users and its impact on speech perception.
- Analyzed the relationship between sensory adaptation and auditory outcomes, highlighting the role of brain plasticity in CI effectiveness.
- Critiqued methodology, recommended the integration of EEG/fMRI, and proposed a follow-up study using advanced imaging for improved auditory rehab strategies.
- *Final grade: 90% (PSYCH 211: Developmental Psychology)*.

Technical Skills

Languages/Libraries: MATLAB, Python, R, SQL, NumPy, Pandas, Scikit-learn, Matplotlib, TensorFlow, PyTorch
Tools/Frameworks: EEGLAB, ERPLAB, LIMO, FreeSurfer, FSL, Flask, React, Jupyter, Gurobi Optimizer

Certifications, Scholarships & Awards

- Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans **Certification**
- University of Waterloo President's **Scholarship** [2019-2020] ($2,000)
- University of Waterloo Athletic **Financial Award** - Varsity Track & Field [2021, 2022] ($1,000)