# Elijah Taeckens

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## Education

**University of Maryland, College Park** **GPA: 3.991/4.0**
*B.S. Electrical Engineering* Expected May 2024

- Honors College and ECE Departmental Honors

## Publications

E. Taeckens and S. Shah. "A Spiking Neural Network with Continuous Local Learning for Robust Online Brain Machine Interface." *J. Neural Eng.* 2023. doi: https://doi.org/10.1088/1741-2552/ad1787

E. Taeckens, R. Dong and S. Shah, "A Biologically Plausible Spiking Neural Network for Decoding Kinematics in the Hippocampus and Premotor Cortex," *2023 IEEE/EMBS Conference on Neural Engineering*, Baltimore, MD, USA, 2023, pp. 1-4, doi: https://doi.org/10.1109/NER52421.2023.10123745

## Skills

- **Programming Languages:** Python, MATLAB, C, C++, Verilog
- **Machine Learning:** PyTorch, SNNs, RNNs, LSTMs, SVMs, PCA, LDA
- **Electrical Engineering:** FPGAs, FIR & IIR Filter Design, Arduino, Altium PCB Design
- **Neuroscience:** Live EEG Recording, Kinematic Decoding, Computational Modelling

## Research Experience

**Shah Lab – Undergraduate Research Assistant** *Sept. 2021 – Present*

- Developed novel neural decoding algorithms using biologically inspired spiking neural networks under the supervision of Dr. Sahil Shah.
- Published as first author and presented research at multiple conferences and workshops.

***Spiking Neural Networks for Neural Decoding*** *June 2022 – November 2022*

- Designed spiking neural network for predicting arm velocity from neural recordings using Python.
- Matched state-of-the-art accuracy when compared to Kalman filter, LSTM decoder.
- Presented at **IEEE Conference on Neural Engineering** 2023.
- Received **ASPIRE Outstanding Research Award** for the best semester-long undergraduate engineering research project.

***Low Power FPGA Implementation of SNN*** *September 2022 – May 2023*

- Developed FPGA implementation of SNN decoder using Verilog.
- Designed asynchronous event-based logic for reduced power consumption.
- Defended ECE Departmental Honors Thesis, May 2023.
- Funded by SRC URP Intel Research Scholarship.

***Continuous Learning SNN for Online BMI*** *January 2023 – October 2023*

- Derived novel machine learning algorithm for SNNs to enable continuous learning during online BMI tasks without performing backpropagation.
- Enabled **92% reduction in memory** used during training.
- Increased resilience to neural disruptions; **27% faster** than state-of-the-art ReFIT Kalman filter and LSTM decoders when performing reaching tasks after a neural disruption.
- Demonstrated ability to train a decoder from scratch in a closed loop environment, allowing for a more intuitive calibration procedure for BMI users.
- Submitted for publication to **Journal of Neural Engineering.**

***Unsupervised Adaptive BMI with STDP*** *August 2023 - Present*

- Developing unsupervised learning mechanisms for long-term stable brain machine interfaces using biologically inspired spike timing dependent plasticity learning rule.
- Increased performance **by 60%** after a simulated neural disruption without any need for recalibration.
- Presented at **IEEE Brain Discovery and Neurotechnology Workshop** 2023.

***Music Decoding with EEG*** *March 2023 - Present*

- Proposed experimental procedure for decoding musical notes from EEG recordings with audio feedback.
- Used linear discriminant analysis to classify "expected" and "unexpected" notes from EEG data with 72% accuracy.
- Obtained IRB approval to perform a larger study in Spring 2024.

**UMD Gemstone Honors Research Program** *May 2021 - Present*

- Undergraduate research team using neuromorphic vision sensors to study bee colony health.
- Wrote original research topic proposal that was selected by peers as a final project.
- Developed novel algorithm to track the flight of bees in real time.
- Won **Best Poster** at UMD Undergraduate Research Day.

## Work Experience

**National Institutes of Health – Circuit Design Intern** *June 2023 – August 2023*

- Worked in instrumentation lab to develop tools needed for NIH experimental research.
- Implemented sensor processing circuit, 24V power regulating system, op-amp for scaling analog output, and programmed Arduino to issue commands to control a mouse tracking apparatus.
- Assisted neuroscience researchers on neural stimulation experiments on live monkeys.
- Attended journal club focusing on neuroscience.

## Relevant Coursework

- Current and Planned Courses: ENEE 620: Random Processes (graduate level), ENEE 436: Machine Learning, NEUR 200: Introduction to Neuroscience, MATH 403: Abstract Algebra
- Previous Courses: ENEE 425: Advanced Digital Signal Processing, ENEE 324: Engineering Probability, ENEE 322: Signals and Systems Theory, MATH 461: Linear Algebra, MATH 246: Differential Equations, MATH 241: Calculus III, BSCI 170 & 171: Molecular and Cellular Biology and Lab

## Outreach

**Maryland Science Olympiad Volunteer** *December 2021 – Present*

- Volunteered to support a science competition for high school students from across the state of Maryland.

**UMD ECE Student Tutor** *January 2023 – Present*

- Tutored fellow ECE students in courses on signal processing and analog circuit design.
- Explained lecture topics, developed study plans, and assisted on homework and exam preparation.

## Awards and Scholarships

ECE Undergraduate Research Assistantship Award *2023*

- $5,000 in funding, awarded to two ECE undergraduates for achievement in research.

UMD ASPIRE Outstanding Student Research Award *2023*

- Awarded for the top undergraduate engineering summer research project.

SRC URP Intel Research Scholarship *2022*

Banneker-Key Scholarship *2020*

- University of Maryland's most prestigious academic scholarship, $52,000/yr (full cost of attendance)

National Merit Scholarship Recipient *2020*

U.S. Presidential Scholar Semifinalist *2020*