Alec Hoyland

I'm a computational scientist at Clarifai and a PhD student in Biomedical Engineering at Worcester Polytechnic Institute. At Clarifai, I am a technical lead on a multi-million dollar ARR government R&D project, where my team designs and tests better object detection and tracking deep learning algorithms. My work contributed to a 35% improvement for some classes. For my PhD, I use advanced signal processing and machine learning to improve biosignal data collection and analysis, using 90% fewer samples for the same accuracy.

Personal Data

Location:	Worcester, MA	Phone:	774-372-1164
Email:	entropyvsenergy@posteo.de	Website:	https://alec-hoyland.github.io

Technical Details

Programming Languages	Bash/Zsh, Python, MATLAB®, Julia, C++, R, LaTeX
Deployment	Docker, Kubernetes, AWS/GCP/Azure, HPCC (slurm, SGE), GitHub Actions
Project Management	Jira, Confluence, Markdown, git
Machine Learning	PyTorch/Lightning, Flux.jl, TensorBoard, Guild AI, MMDetection
Models/Algorithms	CNNs, echo state networks, Transformers, YOLO, DETR/DINO, Faster-R-CNN, random forests, xgboost, VAEs, compressed sensing, FFT, numerical integration
Tools	Jupyter/Pluto, SciPy/NumPy, dask, ray, matplotlib/seaborn, streamlit, SQL
Security	US citizen, SECRET clearance, interim TOP SECRET clearance

Work Experience

Oct 2021-Present
Institution

Senior Research Scientist
Clarifai Inc., Wilmington, DE
R&D for public sector AI/ML. Developed and optimized object detection, object tracking, and dataset enrichment algorithms using PyTorch, Docker, Kubernetes. Developed and deployed solutions on bare-metal and cloud compute. Technical lead on a multimillion dollar ARR line-of-effort as part of Project Maven for USDI/NGA. Competed against and outperformed trillion-dollar companies in head-to-head competition. Implemented unsupervised data preprocessing that improved state-of-the-art by up to 35% average precision on some classes. Presented at collaboration events and industry conferences. Onboarded, assigned and monitored work of senior and junior research staff. Maintained documentation on best practices/workflow for development.

Sep 2020-Sep 2021
Institution

Staff Research Scientist
Boston Fusion Corp., Lexington, MA
R&D for public sector AI/ML. Developed rule-based AI and machine learning models for denoising radar, maritime surveillance, sensor fusion, and semantic classification. Successfully navigated SBIR projects to Phase III as technical lead. Primary author on SBIR/STTR proposals and scrum master.

Jul 2018-Aug 2020
Principal Investigator
Institution

Scientific Programmer & Data Analyst
Michael Hasselmo, DPhil
Center for Systems Neuroscience, Boston University, Boston, MA
Designed and maintained software tools to study neuromodulation in the entorhinal cortex of rodents, including automating data analysis on high-performance computing hardware, designing statistical and numerical models, integrating state-of-the-art machine learning for motion tracking, and automating data collection in experiments using Arduino microcontrollers. Published three papers, two conference papers, and developed a tech stack still used by the lab today. Built and administrated the website. Enrolled in graduate courses concurrently through tuition remission.

Feb 2015-Jul 2018
Principal Investigator
Institution

Research Assistant in Computational Neuroscience
Eve Marder, PhD
Brandeis University, Waltham, MA
Built simulation software for neuronal simulation, including `xolotl`, which simulates at state-of-the-art speeds with built-in parameter optimization and real-time visualization. Software and documentation design patterns developed for `xolotl` have been adopted company-wide at Inscopix (VC-backed neurotech firm, $20-25M ARR, acquired by Bruker Corp. in 2022). Studied neuromodulation using biophysically-realistic models of a motor circuit.

Education

Jan 2021-Present	PhD Student in Biomedical Engineering
Institution	**Worcester Polytechnic Institute**, Worcester, MA
	GPA: 4.0/4.0
Advisor	Prof. Adam Lammert, PhD
Research	Using compressive sensing and machine learning to dramatically reduce the number of trials required to characterize high-dimensional representations of tinnitus in a reverse correlation experiment.

Aug 2018-Aug 2020	Non-Degree Graduate Student in Engineering
Institution	**Boston University**, Boston, MA
	GPA: 3.8/4.0
Courses Taken	Linear Algebra, Statistical & Numerical Methods, Ordinary Differential Equations, Partial Differential Equations, Machine Learning, Universal Natural Language Processing, Artificial Intelligence.

May 2018	Master of Science in Neuroscience
Institution	**Brandeis University**, Waltham MA
	Highest Honors, GPA: 3.4/4.0
Thesis	*Differential Responses to Neuromodulation in Model Neurons of the Crustacean Stomatogastric Ganglion*
Advisor	Prof. Eve Marder, PhD

May 2018	Bachelor of Science in Neuroscience
	Bachelor of Science in Biological Physics
Institution	**Brandeis University**, Waltham MA
	Highest Honors, GPA: 3.4/4.0
	Minor in the History of Ideas
Advisors	Prof. Eve Marder, PhD & Prof. Aparna Baskaran, PhD

Maintained Open-Source Projects

Dec 2022-Present	Tinnitus Reconstruction
Website	https://alec-hoyland.github.io/tinnitus-reconstruction/
Publications	Hoyland, N. Barnett, et al. 2023; Hoyland, N. V. Barnett, et al. 2023b
	Reconstructs a frequency spectrum representation of the subjective internal experience of tinnitus, using human subject data from a brief alternate-forced choice task. The reconstruction algorithms are ML- and compressed sensing-based.

Dec 2019-Present	Neural Decoder
Website	https://github.com/hasselmonians/neural-decoder
	Produces a stochastic convolutional model of the relationship between an extrinsic observative signal and an intrinsic covarying spike train.

Aug 2018-Present	BandwidthEstimator
Publications	Dannenberg, Lazaro, et al. 2020; Dannenberg, Kelley, et al. 2019
Website	https://github.com/hasselmonians/BandwidthEstimator
	Implements a maximum-likelihood leave-one-out cross-validated bandwidth parameter estimation algorithms for general point processes (including spike trains).

Aug 2018-Present	RatCatcher
Publications	Dannenberg, Lazaro, et al. 2020; Dannenberg, Kelley, et al. 2019
Website	https://github.com/hasselmonians/RatCatcher
	A data- & analysis-agnostic pipeline for automating analysis on a high-performance computing cluster, with a local interface. Written in MATLAB®.

Aug 2017-Present	Xolotl
Publications	Gorur-Shandilya, Hoyland, and Marder 2018; Hoyland 2018
Website	https://go.brandeis.edu/xolotl
	A fast and flexible neuronal simulator in `C++` with an extensive MATLAB® front-end. Achieves state-of-the-art efficiency on non-branching models.

Funding

Jan 2022	Tinnitus Characterization using Reverse Correlation with Applications to Retraining Therapies, Pilot Project Program, UMASS Center for Clinical and Translational Science ($50,000)
Mar 2017	Computational Neuroscience Traineeship, NIH/NIMH ($11,000)
Apr 2016	Quantitative Biology Research Community Fellowship, HHMI ($5,000)

Publications

Hoyland, Alec, Nelson V. Barnett, Benjamin W. Roop, Danae Alexandrou, Myah Caplan, Jacob Mills, Benjamin Parrell, Divya A. Chari, and Adam C. Lammert (Jan. 6, 2023a). *Reverse Correlation Uncovers More Complete Tinnitus Spectra*. DOI: 10.1101/2022.12.23.521795. URL: https://www.biorxiv.org/content/10.1101/2022.12.23.521795v2 (visited on 01/10/2023). preprint.

– (2023b). "Reverse Correlation Uncovers More Complete Tinnitus Spectra". In: *IEEE Open Journal of Engineering in Medicine and Biology*, pp. 1–3. ISSN: 2644-1276. DOI: 10.1109/OJEMB.2023.3275051.

Dannenberg, Holger, Hallie Lazaro, Pranav Nambiar, Alec Hoyland, and Michael E Hasselmo (Dec. 10, 2020). "Effects of Visual Inputs on Neural Dynamics for Coding of Location and Running Speed in Medial Entorhinal Cortex". In: *eLife* 9. Ed. by Adrien Peyrache, Laura L Colgin, and Kevin Allen, e62500. ISSN: 2050-084X. DOI: 10.7554/eLife.62500. URL: https://doi.org/10.7554/eLife.62500 (visited on 06/06/2022).

Hasselmo, Michael E., Andrew S. Alexander, Alec Hoyland, Jennifer C. Robinson, Marianne J. Bezaire, G. William Chapman, Ausra Saudargiene, Lucas C. Carstensen, and Holger Dannenberg (Apr. 8, 2020). "The Unexplored Territory of Neural Models: Potential Guides for Exploring the Function of Metabotropic Neuromodulation". In: *Neuroscience*. ISSN: 0306-4522. DOI: 10.1016/j.neuroscience.2020.03.048. URL: http://www.sciencedirect.com/science/article/pii/S0306452220302141 (visited on 06/25/2020).

Dannenberg, Holger, Craig Kelley, Alec Hoyland, Caitlin K. Monaghan, and Michael E. Hasselmo (May 1, 2019). "The Firing Rate Speed Code of Entorhinal Speed Cells Differs across Behaviorally Relevant Time Scales and Does Not Depend on Medial Septum Inputs". In: *Journal of Neuroscience* 39.18, pp. 3434–3453. ISSN: 0270-6474, 1529-2401. DOI: 10.1523/JNEUROSCI.1450-18.2019. pmid: 30804092. URL: http://www.jneurosci.org/content/39/18/3434 (visited on 06/12/2019).

Gorur-Shandilya, Srinivas, Alec Hoyland, and Eve Marder (2018). "Xolotl: An Intuitive and Approachable Neuron and Network Simulator for Research and Teaching". In: *Frontiers in Neuroinformatics* 12. ISSN: 1662-5196. DOI: 10.3389/fninf.2018.00087. URL: https://www.frontiersin.org/articles/10.3389/fninf.2018.00087/full (visited on 06/01/2021).

Hoyland, Alec (2018). "Differential Responses to Neuromodulation in Model Neurons of the Crustacean Stomatogastric Ganglion". Thesis. Brandeis University. URL: http://bir.brandeis.edu/handle/10192/35686 (visited on 08/14/2019).

Conference Papers & Posters

Hoyland, Alec, Nelson Barnett, Benjamin Roop, Danae Alexandrou, Benjamin Parrel, Divya Chari, and Adam Lammert (Feb. 11, 2023). "Characterizing Complex Tinnitus Sounds Using Reverse Correlation: A Feasibility Study". In: *Association for Research in Otolaryngology*. 46th Annual Midwinter Meeting. Orlando FL.

Ning, Wing, John H. Bladon, Jerry Chen, S Steinwenter, Alec Hoyland, and Michael E. Hasselmo (2019). "A Cortical-Hippocampal Network Supporting the Temporal Organization of Memory". In: *2019 Neuroscience Meeting Planner*. Society for Neuroscience. 164.05. Chicago, IL.

Dannenberg, Holger, Craig Kelley, Alec Hoyland, Caitlin K. Monaghan, and Michael E. Hasselmo (2018). "Speed Coding by Entorhinal Cortex Speed Cells Differs across Behaviorally Relevant Timescales and Is Independent of Cholinergic Modulation". In: Society for Neuroscience. 508.27. San Diego, CA.

Teaching & Mentorship

Sep 2022-Dec 2022	AI/ML Subject Matter Expert
Institution	**Norfolk Collegiate School**, Norfolk, VA
	Presented on machine learning concepts to middle school students working on a LEGO robotics competition project. Built an interactive Streamlit demo of a fully-connected neural network for demonstration purposes.
Jul 2018-Aug 2020	Scientific Computing Tutor
Institution	**Boston University**, Boston, MA
	Organized and ran a `Julia` learning group for undergraduate and graduate students.
Aug 2016-Aug 2018	Quantitative Biology Research Community (QBReC)
Institution	**Brandeis University**, Waltham, MA
	QBReC is an interdisciplinary undergraduate research community for handpicked Brandeis science majors, who perform hands-on research internships. Engaged in this research and mentored other students as a co-leader.
Oct 2016-Oct 2018	SPLASH Teaching Fellow
Institution	**Brandeis University**, Waltham, MA
	Taught theoretical neuroscience courses to high-school students. Organized "lunch & learn" seminars between high school students and Brandeis faculty.
Oct 2014-Feb 2017	Brandeis Maker Lab Volunteer
Institution	**Brandeis University**, Waltham, MA
	Worked with the Brandeis Maker Lab's 3-D printers, volunteered at the student-run hackathon geared towards learning and hardware.

References

	Shelley Cazares, PhD
Position	Research Manager
Institution	Clarifai Inc.
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	Adam Lammert, PhD
Position	Assistant Professor of Biomedical Engineering (Computer Science affiliate)
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	Carl Weir, PhD
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