Erik C. Johnson

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I am a research scientist at the Johns Hopkins University Applied Physics Laboratory. My research interests include neuroscience-inspired approaches to artificial intelligence, large scale processing tools for neuroimaging datasets, brain-machine interfaces and robotics.

Positions

Senior Research Scientist — Johns Hopkins University Applied Physics Laboratory (Laurel, MD) 2017-Present

Research Engineer — Sprite Robotics (Champaign, IL) 2016-2017

Research Assistant — University of Illinois at Urbana-Champaign (Champaign, IL) 2011-2016

Visiting Researcher — University of Texas San Antonio (San Antonio, TX) 2012

Graduate Fellow — University of Illinois at Urbana-Champaign (Champaign, IL) 2009-2011

Education

Doctor of Philosophy in Electrical and Computer Engineering — Advisor: Douglas L. Jones — University of Illinois at Urbana-Champaign 2016

Master of Science in Electrical and Computer Engineering — Advisor: Douglas L. Jones — University of Illinois at Urbana-Champaign 2016

Bachelor of Science in Electrical and Computer Engineering — University of Illinois at Urbana-Champaign 2008

Theses

Johnson, E. C. Minimum-Error, Energy-Constrained Source Coding by Sensory Neurons. Ph.D. thesis, University of Illinois at Urbana-Champaign, Urbana-Champaign, IL (2016).

Johnson, E. C. Recovery of Sparse Signals and Parameter Perturbations from Parameterized Signal Models. M. sc. thesis, University of Illinois at Urbana- Champaign, Urbana-Champaign, IL (2013).

Journal Publications

Smirnova, L., Caffo, B. S., Gracias, D. H., Huang, Q., Morales Pantoja, I. E., Tang, B., ... & Hartung, T. (2023). Organoid intelligence (OI): the new frontier in biocomputing and intelligence-in-a-dish. Frontiers in Science, 0.

Sidhu, R. S., Johnson, E. C., Jones, D. L., & Ratnam, R. (2022). A dynamic spike threshold with correlated noise predicts observed patterns of negative interval correlations in neuronal spike trains. Biological Cybernetics, 116(5-6), 611-633.

Sanchez, M., Moore, D., Johnson, E. C., Wester, B., Lichtman, J. W., & Gray-Roncal, W. (2022). Connectomics Annotation Metadata Standardization for Increased Accessibility and Queryability. Frontiers in Neuroinformatics, 16, 828458.

Cowley, H. P., Natter, M., Gray-Roncal, K., Rhodes, R. E., Johnson, E. C., Drenkow, N., ... & Gray-Roncal, W. (2022). A framework for rigorous evaluation of human performance in human and machine learning comparison studies. Scientific Reports, 12(1), 5444.

Robinson, B. S., Norman-Tenazas, R., Cervantes, M., Symonette, D., Johnson, E. C., Joyce, J., ... & Gray-Roncal, W. (2022). Online learning for orientation estimation during translation in an insect ring attractor

network. Scientific reports, 12(1), 1-15.

Hider Jr, R., Kleissas, D., Gion, T., Xenes, D., Matelsky, J., Pryor, D., ... & Wester, B. (2022). The brain observatory storage service and database (bossdb): A cloud-native approach for petascale neuroscience discovery. Frontiers in Neuroinformatics, 16.

Matelsky, J. K., Reilly, E. P., Johnson, E. C., Stiso, J., Bassett, D. S., Wester, B. A., & Gray-Roncal, W. (2021). DotMotif: an open-source tool for connectome subgraph isomorphism search and graph queries. Scientific Reports, 11(1), 13045.

Johnson, E. C., Wilt, M., Rodriguez, L. M., Norman-Tenazas, R., Rivera, C., Drenkow, N., ... & R. Gray-Roncal, W. (2020). Toward a scalable framework for reproducible processing of volumetric, nanoscale neuroimaging datasets. GigaScience, 9(12), giaa147.

Prasad, J. A., Balwani, A. H., Johnson, E. C., Miano, J. D., Sampathkumar, V., De Andrade, V., ... & Dyer, E. L. (2020). A three-dimensional thalamocortical dataset for characterizing brain heterogeneity. Scientific Data, 7(1), 358.

Matelsky, J., Kiar, G., Johnson, E., Rivera, C., Toma, M., & Gray-Roncal, W. Container- Based Clinical Solutions for Portable and Reproducible Image Analysis. Journal of digital imaging 31.3 (2018): 315-320.

Kaloti A. S., Johnson E. C., Bresee C. S., Naufel S. N., Perich M. G., Jones D. L., and Hartmann M. J. Z. Representation of stimulus speed and direction in vibrissal- sensitive regions of the trigeminal nuclei: a comparison of single unit and population responses. PLoS ONE 11(7):e0158399 (2016)

Johnson E. C., Jones, D. L., Ratnam, R. A Minimum-Error, Energy-Constrained Neural Code is an Instantaneous Rate Code. Journal of Computational Neuroscience, 40.2 (2016): 193-206.

Johnson E. C., Robbins, B. A., Loui, M. C. What Do Students Experience as Peer Leaders of Learning Teams? Advances in Engineering Education 4.4 (2015).

Jones D. L., Johnson E. C., Ratnam R. A stimulus-dependent spike threshold is an optimal neural coder. Frontiers in Computational Neuroscience 9:61 (2015).

Loui, M. C., Robbins, B. A., Johnson, E. C., Venkatesan, N. Assessment of Peer-led Team Learning in an Engineering Course for Freshmen. International Journal of Engineering Education Volume 29:6 (2013).

Conference Papers

Johnson, E. C., Robinson, B. S., Vallabha, G. K., Joyce, J., Matelsky, J. K., Norman-Tenazas, R., ... & Hoffmann, J. A. (2023, June). Exploiting large neuroimaging datasets to create connectome-constrained approaches for more robust, efficient, and adaptable artificial intelligence. In Artificial Intelligence and Machine Learning for Multi-Domain Operations Applications V (Vol. 12538, pp. 394-405). SPIE.

Johnson, E. C., Matelsky, J. K., Cooke, C., Christie, B., Jones, K., Ledbetter, H., ... & Tenore, F. V. (2023, April). Automated Tools to Improve Spinal Cord Injury Outcomes with Epidural Stimulation. In 2023 11th International IEEE/EMBS Conference on Neural Engineering (NER) (pp. 1-4). IEEE.

Robinson, B. S., Joyce, J., Norman-Tenazas, R., Vallabha, G. K., & Johnson, E. C. (2023). Informing generative replay for continual learning with long-term memory formation in the fruit fly. bioRxiv, 2023-01.

Quesada, J., Sathidevi, L., Liu, R., Ahad, N., Jackson, J., Azabou, M., ... Johnson, E. C., & Dyer, E. (2022). MTNeuro: A Benchmark for Evaluating Representations of Brain Structure Across Multiple Levels of Abstraction. Advances in Neural Information Processing Systems, 35, 5299-5314.

McDaniel, S. L., Villafañe–Delgado, M., & Johnson, E. C. (2022, July). Investigating Echo State Network Performance with Biologically-Inspired Hierarchical Network Structure. In 2022 International Joint Conference

on Neural Networks (IJCNN) (pp. 01-08). IEEE.

Robinson, B. S., Lau, C. W., New, A., Nichols, S. M., Johnson, E. C., Wolmetz, M., & Coon, W. G. (2022, July). Continual learning benefits from multiple sleep stages: NREM, REM, and Synaptic Downscaling. In 2022 International Joint Conference on Neural Networks (IJCNN) (pp. 1-9). IEEE.

Norman-Tenazas, R., Robinson, B. S., Joyce, J., Western, I., Johnson, E. C., Gray-Roncal, W., & Hoffmann, J. A. (2022, July). Continuous State Estimation With Synapse-constrained Connectivity. In 2022 International Joint Conference on Neural Networks (IJCNN) (pp. 1-9). IEEE.

Johnson, E. C., Nguyen, E. Q., Schreurs, B., Ewulum, C. S., Ashcraft, C., Fendley, N. M., ... & Vallabha, G. K. (2022). L2explorer: A lifelong reinforcement learning assessment environment. AAAI Spring Symposium on Designing Artificial Intelligence for Open Worlds.

Balwani, A., Miano, J., Liu, R., Kitchell, L., Prasad, J. A., Johnson, E. C., ... & Dyer, E. L. (2021, September). Multi-scale modeling of neural structure in x-ray imagery. In 2021 IEEE International Conference on Image Processing (ICIP) (pp. 141-145). IEEE.

Robinson, B., Polevoy, A., McDaniel, S., Coon, W., Scholl, C., McLean, M., & Johnson, E. (2021, July). A spiking network model for semantic representation and replay-based association acquisition. In International Conference on Neuromorphic Systems 2021 (pp. 1-8).

Brown, C. J., Nguyen, H. H., Thompson, M. C., Joyce, J. M., Johnson, E. C., Fifer, M. S., & Osborn, L. E. (2021, May). Simulation and analysis of neuromorphic tactile data for object interaction speed detection. In 2021 10th International IEEE/EMBS Conference on Neural Engineering (NER) (pp. 136-139). IEEE.

Azabou, M., Azar, M. G., Liu, R., Lin, C. H., Johnson, E. C., Bhaskaran-Nair, K., ... & Dyer, E. L. (2021). Mine your own view: Self-supervised learning through across-sample prediction. arXiv preprint arXiv:2102.10106.

Villafañe-Delgado, M., Johnson, E. C., Hughes, M., Cervantes, M., & Gray-Roncal, W. (2020, August). STEM Leadership and Training for Trailblazing Students in an Immersive Research Environment. In 2020 IEEE Integrated STEM Education Conference (ISEC) (pp. 1-4). IEEE.

Reilly, E. P., Johnson, E. C., Hughes, M. J., Ramsden, D., Park, L., Wester, B., & Gray-Roncal, W. (2020, February). Connecting neural reconstruction integrity (NRI) to graph metrics and biological priors. In Complex Networks XI: Proceedings of the 11th Conference on Complex Networks CompleNet 2020 (pp. 182-193). Cham: Springer International Publishing.

Johnson, E. C., Rodriguez, L. M., Norman-Tenazas, R., Xenes, D., & Gray-Roncal, W. R. (2019, November). Transfer learning analysis of image processing workflows for electron microscopy datasets. In 2019 53rd Asilomar Conference on Signals, Systems, and Computers (pp. 1197-1201). IEEE.

Norman-Tenazas, R., Matelsky J., Katyal K., Johnson E., Gray-Roncal W. Worminator: A platform to enable bio-inspired (C. elegans) robotics. Cognitive and Computational Neuroscience 2018, Philadelphia, PA. (https://doi.org/10.32470/CCN.2018.1149-0)

Johnson E. C., Jones D. L., Ratnam R. Minimum squared-error, energy-constrained encoding by adaptive threshold models of neurons. In Proc. of IEEE ISIT, 2015, pp. 1337–1341

Johnson, E. C., Norton, J. S., Jun, D. M., Bretl, T., Jones, D. L. Sequential Selection of Window Length for Improved SSVEP-Based BCI Classification. Engineering in Medicine and Biology Society (EMBC), 2013 35th Annual International Conference of the IEEE., pp. 7060-7063.

Johnson, E. C., Jones, D. L. Joint Recovery of Sparse Signals and Parameter Perturbations with Parameterized Measurement Models. In Acoustics, Speech and Signal Processing (ICASSP), 2013 IEEE International Conference on (pp. 5900-5904). IEEE.

Johnson, E. C. and Loui, M. C. 2009. Work in progress - how do students benefit as peer leaders of learning teams? In Proceedings of the 39th IEEE international Conference on Frontiers in Education Conference (San Antonio, Texas, USA, October 18 - 21, 2009), 645-646.

Teaching Experience

Technical Training Co-Lead, JHU/APL CIRCUIT Intern Program https://www.jhuapl.edu/circuit/- 2019 to Present

Introduction to Biomemetic Systems, JHU Engineering for Professionals Program, Summer 2023, Summer 2022, Summer 2021, Summer 2019

Computational Neuroscience for AI, JHU/APL Strategic Education Program, Fall 2020

Graduate Teaching Assistant, Computer Systems and Programming- Spring 2015, Fall 2015, Spring 2016, University of Illinois

Graduate Teaching Assistant, Introduction to Electrical and Computer Engineering- Fall 2008, Spring 2009, University of Illinois

Graduate Teaching Assistant, Digital Signal Processing Summer School- June-July 2008, Ho Chi Minh City Technical University, Vietnam

Volunteer Teaching Assistant, Introduction to Electrical and Computer Engineering- Spring 2008, University of Illinois

Honors

University of Illinois Graduate College Focal Point Grant Recipient, 2011, 2013

University of Illinois Teaching Assistant Rating of Outstanding, Spring 2015, Fall 2015, Spring 2016

Burroughs Wellcome Fund Collaborative Travel Grant Recipient, 2012

NSF Neuroengineering IGERT Fellow, 2009-2011

University of Illinois Bronze Tablet Award- highest university graduation honor for undergraduates, 2008