

# Adam S. Charles

Department of Biomedical Engineering  
Center for Imaging Science  
Mathematical Institute for Data Science  
Kavli Neuroscience Discovery Institute  
Department of Neuroscience  
The Johns Hopkins University  
Baltimore, MD, 21218, United States  
E-mail: [adamsc@jhu.edu](mailto:adamsc@jhu.edu), Website: <https://www.bme.jhu.edu/ascharles/>

## Research Interests

Signal processing, machine learning, neural imaging, data science, cybernetics, statistical inference, computational neuroscience, efficient sensing of structured signals.

## Education

2015	Ph.D. in Electrical and Computer Engineering Thesis: <i>Dynamics and correlations in sparse signal acquisition</i> Advisor: Dr. Christopher J. Rozell	Georgia Institute of Technology
2009	M.E in Electrical and Computer Engineering ( <i>Summa Cum Laude</i> ) Thesis: <i>Adjustable Subband Allocation Algorithm for Critically Sampled Subband Adaptive Filters</i>	Cooper Union
2009	B.E in Electrical and Computer Engineering ( <i>Summa Cum Laude</i> )	Cooper Union

## Positions

2020-Present	The Johns Hopkins University	Assistant Professor
2019-2020	The Johns Hopkins University	Assistant Research Professor
2015-2020	Princeton University	Post-Doctoral Fellow
2016-2018	Princeton University	Assistant Instructor
2009-2015	Georgia Institute of Technology	Research Assistant
2009	Georgia Institute of Technology	Teaching Assistant
2007-2009	Southwest Research Institute	Intern
2008-2009	Cooper Union	Teaching Assistant

## Honors and Awards

2016	Georgia Tech Sigma Xi 2015 Best Doctoral Thesis Award
2015	Selected as a recipient of funding from T32 training grant, "NRSA Training Grant in Quantitative Neuroscience"
2015	Georgia Tech Electrical and Computer Engineering Graduate Research Excellence Award
2014	Georgia Tech Center for Information and Signal Processing (CSIP) Outstanding Research Award
2010	1st Place, Science Applications International Corp. (SAIC) Georgia Tech student paper competition
2009	Harold S. Goldberg Leadership Prize (Cooper Union)
2009	Dale E. Zand Prize for Outstanding Achievement in Electrical Engineering (Cooper Union)
2009	Honorable Mention, IEEE Region 1 2009 paper contest
2005-2009	Cooper Union dean's list
2008	Inducted to Eta Kappa Nu
2007	Inducted to Tau Beta Pi
2006	Inducted to National Society of Collegiate Scholars
2005	3rd place Team Engineering Award, International Science and Engineering Fair
2005	Special award from the American Assn. for Artificial Intelligence (AAAI), Intl. Sci. and Eng. Fair
2005	Robert Luby Jr. Award "For excellence in scientific research", Intl. Sci. and Eng. Fair

## Professional Affiliations

2017-present	Society for Neuroscience (SfN)
2013-present	IEEE Signal Processing Society
2012-present	American Association for the Advancement of Science (AAAS)
2012-present	Society for Industrial and Applied Mathematics (SIAM)
2009-present	Institute of Electrical and Electronics Engineers (IEEE)

## Professional Service

Panelist:	NSF CRCNS, NSF SBIR, NIH
Grant	
Review:	DoD CDMRP, Agence Nationale de la Recherche (ANR)
Area Chair:	International Conference on Machine Learning (ICML) Conference (2023)
Area Chair:	Neural Information Processing Systems (NeurIPS) Conference (2021,2022)
Co-Organizer:	Conference on the Mathematical Theory of Deep Learning (2019-Present)
Co-Founder:	Conference on the Mathematical Theory of Deep Learning
Advising	
member:	AAIH Regulatory and Data working groups
Guest Editor	PLoS Computational Biology
Co-Organizer:	Workshop entitled <i>Interpretable statistical neuroscience: What are we modeling and what does it have to do with the brain?</i> at the 2020 Computational and Systems Neuroscience (CoSyNe) Conference
Program	
Committee	
Member:	2020 Association for the Advancement of Artificial Intelligence (AAAI) Conference on Artificial Intelligence
Co-Organizer:	2018 Joint Princeton University and Institute for Advanced Study Symposium on the Mathematical Theory of Deep Learning
Technical	
Program	
Chair:	2017 Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP) Conference
Co-Organizer:	Special Session on <i>Low-dimensional dynamical systems in signal processing and data analysis</i> at the 2017 Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP) Conference
Co-Organizer:	Workshop on <i>New methods for understanding neural dynamics and computation</i> at the 2017 Computational and Systems Neuroscience (CoSyNe) Conference
Co-Organizer:	Workshop on <i>Dimensionality reduction for the analysis and interpretation of high-dimensional neural datasets</i> at the 2016 Computational and Systems Neuroscience (CoSyNe) Conference
Session	
Co-Chair:	2015 Information Theory and Applications Workshop
Reviewer:	Nature Methods • Nature Neuroscience • Nature Communications • Cell Reports Methods • Journal of Machine Learning Research • Journal of Neuroscience • Journal of Computational Neuroscience • PLOS Computational Biology • eLife • SPIE Neurophotonics • IEEE Transactions on Signal Processing • IEEE Transactions on Image Processing • IEEE Transactions on Information Theory • IEEE International Symposium on Information Theory • IEEE Transactions on Molecular • Biological • and Multi-Scale Communications • IEEE Signal Processing Letters • IEEE Transactions of Geoscience and Remote Sensing • IEEE Journal of Special Topics in Applied Earth Observations and Remote Sensing • IEEE Geoscience and Remote Sensing Letters • IEEE Letters of the Computer Society • IEEE Transactions of Pattern Analysis and Machine Intelligence • Remote Sensing Letters • Applied Optics
Reviewer:	International Conference on Artificial Intelligence and Statistics (AISTATS) • Conference on Neural Information Processing Systems (NIPS) • Conference on Computational and Systems Neuroscience (CoSyNe) • Conference on Information Sciences and Systems (CISS) • Conference on Cognitive • Computational Neuroscience • Sampling Theory and Applications (SampTA) • Signal Processing with Adaptive Sparse Structured Representations (SPARS) • AWM/Springer Proceedings of the Women in Data Science and Mathematics (WiSDM) workshop
Code	
Reviewer:	Nature Neuroscience

## Departmental Service

2022-2023	Biomedical Data Science focus area PhD admissions coordinator
2021-Present	Biomedical Data Science masters focus area coordinator
2021-Present	BME MSE Financial aid review committee
2021-Present	CIS/MINDS Seminar co-organizer
2020	MINDS faculty search committee
2020	BME MSE student admissions committee

## Other Activities

2021	Organizer: Kavli Neural Imaging Analysis Working Group
2016-2018	Organizer: Princeton computational neuroscience journal club
2011-2012	Manager: Lab server
2011-2012	Coordinator: Lab group

## Teaching

Spring 2023	Instructor (Johns Hopkins): EN.580.438/EN.580.638 “Biomedical Data Design”, EN.580.426 “The Neural Control of Movement”, EN.580.747 “Center for Imaging Science Seminar”
Fall 2022	Instructor (Johns Hopkins): EN.580.437/EN.580.697 “Biomedical Data Design”, EN.580.746 “Center for Imaging Science Seminar”
Spring 2022	Instructor (Johns Hopkins): EN.580.426 “The Neural Control of Movement”, EN.580.746 “Center for Imaging Science Seminar”
Fall 2021	Instructor (Johns Hopkins): EN.580.746 “Center for Imaging Science Seminar”
Fall 2016	Assistant Instructor (Princeton University): NEU314 “Mathematical Tools for Neuroscience”
Spring 2014	Guest Lecture (Georgia Tech): “Inferring Materials in Hyperspectral Imaging using Maximum A-Posteriori Estimation”
Fall 2012	Guest Lecture (Georgia Tech): “Causal Inference of Sparse Time-dependent Signals”
2011-2018	Undergraduate student mentor
2009	Teaching Assistant (Georgia Tech): ECE3075 “Probability and Stochastic Processes”, ECE4270 “Digital Signal Processing”
2008	Teaching Assistant (Cooper Union): ECE101 “Communication Theory”, ECE114 “Digital Signal Processing”
2008-2009	Instructor (Cooper Union): ECE211 “MATLAB Seminar: Signals & Systems”

## Peer-reviewed Publications

- [P1] N. Mudrik, Y. Chen, E. Yezerets, C. J. Rozell, and **A. S. Charles**. Decomposed linear dynamical systems (dLDS) for learning the latent components of neural dynamics. 2022. Submitted
- [P2] Noga Mudrik and Adam S. Charles. Multi-lingual dall-e storytime, 2022
- [P3] A. El Hady\*, D. Takahashi\*, R. Sun, T. Boyd-Meredith, Y. Zhang, **A. S. Charles**<sup>+</sup>, and C. D. Brody<sup>+</sup>. Chronic functional ultrasound imaging for cognitive behaviors in freely moving rodents. 2022. Under review, \*Equal contribution, +joint last author
- [P4] T. Xu\*, A. R. Graves\*, G. Coste, R. Huganir, D. Bergles, **A. S. Charles**<sup>+</sup>, and J. Sulam<sup>+</sup>. Cross-modality supervised image restoration enables nanoscale tracking of synaptic plasticity in living mice. *Nature Methods*, 2023. Accepted. \*Equal Contribution. +joint last author
- [P5] H. Benisti, A. Song, G. Mishne, and **A. S. Charles**. Data processing of functional optical microscopy for neuroscience. *Neurophotonics*, 9(4):041402, 2022
- [P6] J. L. Gauthier, S. A. Koay, E. H. Nieh, D. W. Tank, J. W. Pillow, and **A. S. Charles**. Detecting and correcting false transients in calcium time-trace inference. *Nature Methods*, 19:470–478, March 2022
- [P7] **A. S. Charles**, N. Cermak, R. Affan, B. Scott, J. Schiller, and G. Mishne. Graft: Graph filtered temporal dictionary learning for functional neural imaging. *IEEE Transactions of Image Processing*, 31:3509–3524, 2022
- [P8] S. A. Koay, **A. S. Charles**, S. Y. Thiberge, C. D. Brody, and D. W. Tank. Sequential and efficient neural-population coding of complex task information. *Neuron*, 110(2):328–349.e11, 2022

- [P9] Joshua T. Vogelstein, Timothy Verstynen, Konrad P. Kording, Leyla Isik, John W. Krakauer, Ralph Etienne-Cummings, Elizabeth L. Ogburn, Carey E. Priebe, Randal Burns, Kwame Kutten, James J. Knierim, James B. Potash, Thomas Hartung, Lena Smirnova, Paul Worley, Alena Savonenko, Ian Phillips, Michael I. Miller, Rene Vidal, Jeremias Sulam, **Adam S. Charles**, Noah J. Cowan, Maxim Bichuch, Archana Venkataraman, Chen Li, Nitish Thakor, Justus M Kebschull, Marilyn Albert, Jinchong Xu, Marshall Hussain Shuler, Brian Caffo, Tilak Ratnanather, Ali Geisa, Seung-Eon Roh, Eva Yezerets, Meghana Madhyastha, Javier J. How, Tyler M. Tomita, Jayanta Dey, Ningyuan, Huang, Jong M. Shin, Kaleab Alemayehu Kinfu, Pratik Chaudhari, Ben Baker, Anna Schapiro, Dinesh Jayaraman, Eric Eaton, Michael Platt, Lyle Ungar, Leila Wehbe, Adam Kepecs, Amy Christensen, Onyema Osuagwu, Bing Brunton, Brett Mensh, Alysson R. Muotri, Gabriel Silva, Francesca Puppò, Florian Engert, Elizabeth Hillman, Julia Brown, Chris White, and Weiwei Yang. Prospective learning: Back to the future, 2022
- [P10] A. Song, J. L. Gauthier, D. W. Tank, J. W. Pillow, and **A. S. Charles**. Neural anatomy and optical microscopy (NAOMi) simulation for evaluating calcium imaging methods. *Journal of Neuroscience Methods*, 358:109173, July 2021
- [P11] R. She, X. Wu, B. Jelfs, **A. S. Charles**, , and R. H. M. Chan. Network modeling of short over-dispersed spike-counts: A hierarchical parametric empirical bayes framework. *IEEE Transactions of Signal Processing*, 69:3236–3251, 2021
- [P12] J. Choi, K. Kumar, M. Khazali, K. Wingel, M. Choudhury, **A. S. Charles**, and B. Peseran. Optimal adaptive electrode selection to maximize simultaneously recorded neuron yield. *Neural Information Processing Systems (NeurIPS), Vancouver, Canada*, December 2020
- [P13] **A. S. Charles**, B. Falk, N. Turner, T. D. Pereira, D. Tward, B. D. Pedigo, J. Chung, R. Burns, S. S. Ghosh, J. M. Kebschull, W. Silversmith, and J. T. Vogelstein. Toward community-driven big open brain science: Open big data and tools for structure, function, and genetics. *Annual Reviews of Neuroscience*, 43, July 2020
- [P14] S. Gigante, **A. S. Charles**, S. Krishnaswamy, and G. Mishne. Visualizing the phase of neural networks. *Neural Information Processing Systems (NeurIPS), Vancouver, Canada*, December 2019
- [P15] N. P. Bertrand\*, **A. S. Charles**\*, J. Lee\*, P. B. Dunn, and C. J. Rozell. Efficient tracking of sparse signals via an earth mover’s distance dynamics regularizer. *IEEE Signal Processing Letters*, 27:1120–1124, 2020. \*Joint first author
- [P16] G. Barello, **A. S. Charles**, and J. W. Pillow. Sparse-coding variational auto-encoders. 2018. biorxiv.399246
- [P17] G. Mishne and **A. S. Charles**. Learning spatially-corellated temporal dictionaries for calcium imaging. *Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), Brighton, UK*, May 2019. (Selected for oral presentation)
- [P18] **A. S. Charles**\*, M. Park\*, J. Patrick Weller, Gregory D. Horwitz, and J. W. Pillow. Dethroning the fano factor: a flexible, model-based approach to partitioning neural variability. *Neural Computation*, 30(4):1012–1045, 2018. \*Joint first author
- [P19] **A. S. Charles** and J. W. Pillow. Additive continuous-time joint partitioning of neural variability. *Proceedings of the Conference on Cognitive Computational Neuroscience (CCN), Philadelphia, PA, USA*, September 2018
- [P20] **A. S. Charles**, H. L. Yap, D. Lin, and C. J. Rozell. Short-term sequence memory: Compressive effects of recurrent network dynamics. *Proceedings of the Conference on Cognitive Computational Neuroscience (CCN), Philadelphia, PA, USA*, September 2018
- [P21] N. P. Bertrand, J. Lee, **A. S. Charles**, P. Dunn, and C. J. Rozell. Sparse dynamic filtering via earth mover’s distance regularization. *Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), Calgary, Alberta, Canada*, April 2018
- [P22] M. Shvartsman, N. Sudaram, M. C. Aoi, **A. S. Charles**, T. L. Wilke, and J. D. Cohen. Matrix-variate models for fMRI analysis. *The International Conference on Artificial Intelligence and Statistics (AISTATS), Playa Blanca, Lanzarote, Canary Islands*, April 2018
- [P23] A. Song\*, **A. S. Charles**\*, S. A. Koay, J. L. Gauthier, S. Y. Thiberge, J. W. Pillow, and D. W. Tank. Volumetric two-photon imaging of neurons using stereoscopy (vTwINS). *Nature Methods*, 14(4):420–426, Apr. 2017. \*Joint first author
- [P24] **A. S. Charles**, N. P. Bertrand, J. Lee, and C. J. Rozell. Earth-mover’s distance as a tracking regularizer. *Proceedings of the IEEE International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP), Curacao, Dutch Antilles*, December 2017

- [P25] **A. S. Charles**, D. Yin, and C. J. Rozell. Distributed sequence memory of multidimensional inputs in recurrent networks. *Journal of Machine Learning Research*, 18(7):1–37, 2017
- [P26] **A. S. Charles**, A. Song, S. A. Koay, D. W. Tank, and J. W. Pillow. Stochastic filtering of two-photon imaging using reweighted  $\ell_1$ . *Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, New Orleans, Louisiana, Mar 2017
- [P27] **A. S. Charles**, A. Balavoine, and C. J. Rozell. Dynamic filtering of time-varying sparse signals via  $\ell_1$  minimization. *IEEE Transactions on Signal Processing*, 64(21):5644–5656, 2016
- [P28] **A. S. Charles**, H. L. Yap, and C. J. Rozell. Short term network memory capacity via the restricted isometry property. *Neural Computation*, 26(6), June 2014
- [P29] **A. S. Charles** and C. J. Rozell. Spectral superresolution of hyperspectral imagery using reweighted- $\ell_1$  spatial filtering. *IEEE Geoscience and Remote Sensing Letters*, 11(3):602–606, March 2014
- [P30] **A. S. Charles** and C. J. Rozell. Convergence of basis pursuit de-noising with dynamic filtering. *Proceedings the IEEE Global Conference on Signal and Information Processing (GlobalSIP)*, Atlanta, Georgia, December 2014
- [P31] **A. S. Charles**, D. Yin, and C. J. Rozell. Can random linear networks store multiple long input streams? *Proceedings the IEEE Global Conference on Signal and Information Processing (GlobalSIP)*, Atlanta, Georgia, December 2014
- [P32] **A. S. Charles** and C. J. Rozell. Dynamic filtering of sparse signals using reweighted  $\ell_1$ . *Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, Vancouver, Canada, May 2013
- [P33] **A. S. Charles**, A. Ahmed, A. Joshi, S. Conover, C. Turnes, and M. A. Davenport. Cleaning up toxic waste: Removing nefarious contributions to recommendation systems. *Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, Vancouver, Canada, May 2013
- [P34] **A. S. Charles**, P. Garrigues, and C. J. Rozell. A common network architecture efficiently implements a variety of sparsity-based inference problems. *Neural Computation*, 24(12):3317–3339, 2012
- [P35] H. L. Yap, **A. S. Charles**, and C. J. Rozell. The restricted isometry property for echo state networks with application to sequential memory capacity. *Proceedings of the Statistical Signal Processing Workshop (SSP)*, Ann Arbor, Michigan, August 2012
- [P36] S. Shapero, **A. S. Charles**, C. J. Rozell, and P. Hasler. Low power sparse approximation on reconfigurable analog hardware. *IEEE Journal on Emerging and Selected Topics in Circuits and Systems*, 2(3):530–541, 2011
- [P37] M. S. Asif, **A. S. Charles**, J. Romberg, and C. J. Rozell. Estimation and dynamic updating of time-varying signals with sparse variations. *Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, Prague, Czech Republic, May 2011
- [P38] **A. S. Charles**, B. A. Olshausen, and C. J. Rozell. Learning sparse codes for hyperspectral imagery. *IEEE Journal of Selected Topics in Signal Processing*, 5(5):963–978, 2011
- [P39] **A. S. Charles**, M. S. Asif, J. Romberg, and C. J. Rozell. Sparsity penalties in dynamical system estimation. *Proceedings of Conference for Information Sciences and Systems (CISS)*, Baltimore, Maryland, March 2011. (Selected for oral presentation)
- [P40] **A. S. Charles**, A. A. Kressner, and C. J. Rozell. Causal sparse decompositions of audio signals. *Proceedings of the IEEE Digital Signal Processing Workshop*, Sedona, Arizona, January 2011. (Nominated for best student paper)
- [P41] **A. S. Charles**, B. A. Olshausen, and C. J. Rozell. Sparse coding for spectral signatures in hyperspectral images. *Proceedings of the Asilomar Conference on Signals, Systems and Computers*, Pacific Grove, California, November 2010

## Conference Abstracts

- [A1] E. Yezerets, N. Mudrik, Y. Chen, C. Rozell, and **A. S. Charles**. Decomposed linear dynamical systems for c. elegans functional connectivity. *Computational and Systems Neuroscience (CoSyNe)*, Montreal, Canada, March 2023
- [A2] I. Dmitrieva, S. Babkin, and **A. S. Charles**. On-line pseudo for real-time cell recognition in calcium imaging. *Computational and Systems Neuroscience (CoSyNe)*, Montreal, Canada, March 2023

- [A3] S. Susheel, T. Harris, and **A. S. Charles**. Automatic spike sorting correction and burst detection for high-density electrophysiological recordings. *Computational and Systems Neuroscience (CoSyNe)*, Montreal, Canada, March 2023
- [A4] D. Zoltowski, **A. S. Charles**, J. Pillow, and S. Keeley. Improved estimation of latent variable models from calcium imaging data. *Computational and Systems Neuroscience (CoSyNe)*, Montreal, Canada, March 2023
- [A5] S. Moore, Z. Wang, R. Sun, A. Lee, **A. S. Charles**, and K. Kuchibhotla. Revealing sudden transitions from goal-directed to habitual behavior during learning in mice. *Computational and Systems Neuroscience (CoSyNe)*, Montreal, Canada, March 2023
- [A6] J. Haggerty, J. Choi, M. W. Choudhury, K. Wingel, B. Pesaran, and **A. S. Charles**. Mapping and localizing neurons using a robotic multiphoton microscope in nhp. *Society for Neuroscience (SfN)*, San Diego, California, November 2022. Selected for nanosymposium
- [A7] B. Pesaran, **A. S. Charles**, J. Choi, K. Wingel, J. Haggerty, H. Hafizi, A. Dubey, M. W. Choudhury, and R. Bakhshi. A robotic platform for multiregional calcium imaging in the non-human primate brain. *Society for Neuroscience (SfN)*, San Diego, California, November 2022. Selected for nanosymposium
- [A8] K. Wingel, J. Choi, M. Choudhury, **A. S. Charles**, H. Hafizi, A. Dubey, R. Bakhshi, and B. Pesaran. Multi-regional functional two photon calcium imaging in an awake behaving rhesus macaque. *Society for Neuroscience (SfN)*, San Diego, California, November 2022
- [A9] X. Yuan, J. Colonell, **A. S. Charles**, and T. Harris. Neuron tracking with chronic neuropixels 2.0 recordings from mouse visual cortex. *Society for Neuroscience (SfN)*, San Diego, California, November 2022
- [A10] S. Moore, Z. Wang, R. Sun, Z. Zhu, A. Lee, **A. S. Charles**, and K. Kuchibhotla. Sudden transition from goal-directed to habitual behavior during sensorimotor learning in mice. *Society for Neuroscience (SfN)*, San Diego, California, November 2022
- [A11] T. Xu, A. Graves, G. Coste, R. Hugarir, D. Bergles, **A. S. Charles**, and J. Sulam. Cross-modality supervised image restoration enables nanoscale tracking of synaptic plasticity in living mice. *Society for Neuroscience (SfN)*, San Diego, California, November 2022
- [A12] D. Day, J. Gauthier, D. Tank, and **A. S. Charles**. Classifying transients in calcium imaging via convolutional neural nets. *Neuromatch Academy 4.0*, November 2021
- [A13] T. Xu, A. Graves, G. Coste, R. Hugarir, D. Bergles, **A. S. Charles**, and J. Sulam. Cross-modality supervised image restoration enables nanoscale tracking of synaptic plasticity in living mice. *Neuromatch Academy 4.0*, November 2021
- [A14] J. Choi, M. Khazali, **A. S. Charles**, and B. Pesaran. Multi-scale measurements of primate motor cortex during free reaching. *Brain Initiative Investigator's Meeting*, June 2021
- [A15] S. Keeley, D. Zoltowski, **A. S. Charles**, and J. W. Pillow. Improved estimation of neural encoding models from calcium imaging data. *Brain Initiative Investigator's Meeting*, June 2020
- [A16] **A. S. Charles**, N. Cermak, J. Shiller, and G. Mishne. Calcium imaging analysis with graph filtered temporal dictionary learning. *Society for Neuroscience (SfN)*, Chicago, Illinois, October 2019
- [A17] **A. S. Charles** and J. W. Pillow. Continuous-time partitioning of neural variability. *Society for Neuroscience (SfN)*, Chicago, Illinois, October 2019
- [A18] G. Mishne, N. Cermak, J. Shiller, and **A. S. Charles**. Spatially-filtered temporal dictionary learning for calcium imaging analysis. *Signal Processing with Adaptive Sparse Structured Representations (SPARS)*, Toulouse, France, June 2019
- [A19] G. Mishne, B. Scott, S. Thiberge, N. Cermak, J. Schiller, C. Brody, D. W. Tank, and **A. S. Charles**. Graph-filtered temporal dictionary learning for calcium imaging analysis. *Computational Neuroscience Meeting (CNS)*, Barcelona, Spain, July 2019. (Selected for oral presentation)
- [A20] J. L. Gauthier, S. A. Koay, E. Nieh, D. W. Tank, J. W. Pillow, and **A. S. Charles**. Detecting and correcting false transients in calcium imaging. *Computational and Systems Neuroscience (CoSyNe)*, Lisbon, Portugal, February 2019
- [A21] G. Mishne, B. Scott, S. Thiberge, N. Cermak, J. Schiller, C. Brody, D. W. Tank, and **A. S. Charles**. Temporal dictionary learning for calcium imaging analysis. *Computational and Systems Neuroscience (CoSyNe)*, Lisbon, Portugal, February 2019
- [A22] G. Barello, **A. S. Charles**, and J. W. Pillow. Sparse-coding variational auto-encoders. *Computational and Systems Neuroscience (CoSyNe)*, Lisbon, Portugal, February 2019

- [A23] **A. S. Charles**, H. L. Yap, D. Yin, and C. J. Rozell. Rigorous guarantees on sequence memory capacity in recurrent neural networks using randomized dimensionality reduction. *Theoretical Foundation of Deep Learning*, October 2018
- [A24] J. L. Gauthier, **A. S. Charles**, D. W. Tank, and J. W. Pillow. Robust identification and removal of false transients in calcium fluorescence imaging data. *Society for Neuroscience (SfN)*, San Diego, California, September 2018
- [A25] M. Shvartsman, N. Sudaram, M. C. Aoi, **A. S. Charles**, T. L. Wilke, and J. D. Cohen. Matrix-normal models for fMRI analysis. *Organization for Human Brain Mapping (OHBM)*, Singapore, June 2018. (Selected for oral presentation)
- [A26] M. Shvartsman, N. Sudaram, M. C. Aoi, **A. S. Charles**, T. L. Wilke, and J. D. Cohen. Matrix-normal models for fMRI analysis. *Computational and Systems Neuroscience (CoSyNe)*, Denver, Colorado, March 2018
- [A27] M. Shvartsman, N. Sudaram, M. C. Aoi, **A. S. Charles**, T. L. Wilke, and J. D. Cohen. Matrix-variate models for fMRI analysis. *Neural Information Processing Systems (NIPS) Workshops, Long Beach, California*, December 2017
- [A28] J. Lee, **A. S. Charles**, N. P. Bertrand, and C. J. Rozell. An optimal transport tracking regularizer. *Neural Information Processing Systems (NIPS) Workshops, Long Beach, California*, December 2017
- [A29] A. Song, **A. S. Charles**, S. Y. Thiberge, J. L. Gauthier, S. A. Koay, J. W. Pillow, and D. W. Tank. Volumetric two-photon imaging via stereoscopy and two-photon calcium imaging simulator. *Emerging Tools for Acquisition and Interpretation of Whole-Brain Functional Data*, Ashburn, Virginia, November 2017
- [A30] J. L. Gauthier, **A. S. Charles**, D. W. Tank, and J. W. Pillow. Robust estimation of calcium transients by modeling contamination. *Society for Neuroscience (SfN)*, Washington D.C., November 2017
- [A31] J. L. Gauthier, **A. S. Charles**, J. W. Pillow, and D. W. Tank. Evidence for distinct hippocampal representations of current location and distance to goal. *Society for Neuroscience (SfN)*, Washington D.C., November 2017
- [A32] M. Shvartsman, N. Sudaram, M. C. Aoi, **A. S. Charles**, T. L. Wilke, and J. D. Cohen. Matrix-variate models for fMRI analysis. *Society for neuroscience (SfN)*, Washington D.C., November 2017
- [A33] A. Song, **A. S. Charles**, D. W. Tank, and J. W. Pillow. A two-photon microscopy simulation framework for optimizing optics and benchmarking cell-finding algorithms. *Society for Neuroscience (SfN)*, Washington D.C., November 2017
- [A34] **A. S. Charles**, A. Song, S. A. Koay, J. L. Gauthier, S. Y. Thiberge, D. W. Tank, and J. W. Pillow. Adaptive orthogonal basis pursuit for volumetric two-photon microscopy. *Signal Processing with Adaptive Sparse Structured Representations (SPARS)*, Lisbon, Portugal, June 2017
- [A35] **A. S. Charles**, D. Yin, and C. J. Rozell. Compression of multiple input streams into recursive neural networks. *Signal Processing with Adaptive Sparse Structured Representations (SPARS)*, Lisbon, Portugal, June 2017
- [A36] **A. S. Charles**, J. Lee, N. P. Bertrand, and C. J. Rozell. Dynamic filtering with earth mover’s distance regularization. *Signal Processing with Adaptive Sparse Structured Representations (SPARS)*, Lisbon, Portugal, June 2017
- [A37] **A. S. Charles** and J. W. Pillow. Continuous-time partitioning of binned spike counts. *Computational and Systems Neuroscience (CoSyNe)*, Salt Lake City, Utah, February 2017
- [A38] J. L. Gauthier, **A. S. Charles**, J. W. Pillow, and D. W. Tank. Robust estimation of calcium transients by modeling contamination. *Computational and Systems Neuroscience (CoSyNe)*, Salt Lake City, Utah, February 2017
- [A39] A. Song, **A. S. Charles**, J. L. Gauthier, S. A. Koay, D. W. Tank, and J. W. Pillow. Two-photon microscopy simulation for optics optimization and benchmarking. *Computational and Systems Neuroscience (CoSyNe)*, Salt Lake City, Utah, February 2017
- [A40] **A. S. Charles**, H. L. Yap, D. Yin, and C. J. Rozell. Short-term sequence memory in recurrent networks. *Neural Information Processing Systems (NIPS) Workshops, Barcelona, Spain*, December 2016
- [A41] N. P. Bertrand, H. L. Yap, **A. S. Charles**, and C. J. Rozell. Efficient randomized filtering for dimensionality reduction in electrophysiology data. *Neural Information Processing Systems (NIPS) Workshops, Barcelona, Spain*, December 2016

- [A42] A. Song, **A. S. Charles**, S. Y. Thiberge, J. L. Gauthier, S. A. Koay, J. W. Pillow, and D. W. Tank. Two-photon imaging of neurons using stereoscopy (twins). *Society for Neuroscience (SfN), San Diego, California*, November 2016
- [A43] **A. S. Charles** and C. J. Rozell. Learning a dynamics dictionary for time-varying sparse signals. *Signal Processing with Adaptive Sparse Structured Representations (SPARS), Cambridge, United Kingdom*, July 2015
- [A44] **A. S. Charles** and C. J. Rozell. Robust estimation of sparse time-varying signals. *Information Theory and Applications Workshop (ITA), La Jolla, California*, February 2015. Invited contribution
- [A45] C. J. Rozell, M. Zhu, **A. S. Charles**, H. L. Yap, and M. Norko. The role of sparsity in visual perception. *Conference on Biologically Inspired Cognitive Architectures (BICA), Cambridge, Massachusetts*, November 2014
- [A46] **A. S. Charles**, C. J. Rozell, and N. Tufillaro. Sparsity based spectral super-resolution and applications to ocean water color. *International Geoscience and Remote Sensing Symposium, (IGARSS), Québec, Canada*, May 2014. Invited contribution
- [A47] **A. S. Charles** and C. J. Rozell. Stochastic filtering via reweighted  $\ell_1$ . *Signal Processing with Adaptive Sparse Structured Representations (SPARS), Laussane, Switzerland*, July 2013
- [A48] **A. S. Charles**, H. L. Yap, and C. J. Rozell. Using compressed sensing to study sequence memory capacity in networked systems. *Signal Processing with Adaptive Sparse Structured Representations (SPARS), Laussane, Switzerland*, July 2013
- [A49] A. A. Kressner, **A. S. Charles**, and C. J. Rozell. Causal locally competitive algorithm for the sparse decomposition of audio signals. *IEEE Women's Workshop on Communications and Signal Processing, Banff, Canada*, July 2012
- [A50] **A. S. Charles**, H. L. Yap, , and C. J. Rozell. Short-term memory in neural networks via the restricted isometry property. *Computational Neuroscience Meeting (CNS) Workshop on Methods of Information Theory in Computational Neuroscience, Atlanta, Georgia*, July 2012
- [A51] C. J. Rozell and **A. S. Charles**. Spectral super-resolution of hyperspectral images. *SIAM Conference on Imaging Science, Philadelphia, Pennsylvania*, May 2012
- [A52] C. J. Rozell and **A. S. Charles**. Recursive estimation of dynamic signals with sparsity models via re-weighted  $\ell_1$  minimization. *Janelia Farm Conference on Machine Learning, Statistical Inference, and Neuroscience, Ashburn, Virginia*, May 2012
- [A53] **A. S. Charles**, H. L. Yap, and C. J. Rozell. Short-term memory capacity in recurrent networks via compressed sensing. *Janelia Farm Conference on Machine Learning, Statistical Inference, and Neuroscience, Ashburn, Virginia*, May 2012
- [A54] H. L. Yap, **A. S. Charles**, and C. J. Rozell. Short-term memory capacity in recurrent networks via compressed sensing. *Challenges in Geometry, Analysis and Computation: High-dimensional Synthesis, Yale University, New Haven, Connecticut*, June 2012
- [A55] **A.S. Charles**, H.L. Yap, and C.J. Rozell. Short-term memory capacity in recurrent neural networks via compressive sensing. *Computational and Systems Neuroscience (CoSyNe), Salt Lake City, Utah*, February 2012
- [A56] **A.S. Charles**, B. Olshausen, and C.J. Rozell. Learning sparse codes for hyperspectral images. *Duke Workshop on Sensing and Analysis of High-dimensional Data (SAHD), Durham, North Carolina*, July 2011
- [A57] **A. S. Charles** and C. J. Rozell. A hierarchical re-weighted- $\ell_1$  approach for dynamic sparse signal estimation. *Signal Processing with Adaptive Sparse Structured Representations (SPARS), Edinburgh, Scotland, United Kingdom*, June 2011

## Other Publications

- [O1] **A. S. Charles.** Interpreting deep learning: The machine learning rorschach test? *Society for Applied and Industrial Mathematics (SIAM) News*, July/August 2018
- [O2] **A. S. Charles.** Interpreting deep learning: The machine learning rorschach test? *arXiv:1806.00148*, June 2018. Extended version of *SIAM News* article
- [O3] M. Shvartsman, N. Sudaram, M. C. Aoi, **A. S. Charles**, T. L. Wilke, and J. D. Cohen. Matrix-variate models for fMRI analysis. *arXiv:1711.03058*, November 2017
- [O4] **A. S. Charles.** *Dynamics and Correlations in Sparse Signal Acquisition*. PhD thesis, Georgia Institute of Technology, 2015
- [O5] **A. S. Charles.** Adjustable subband allocation algorithm for critically sampled subband adaptive filters. *The Cooper Union for the Advancement of Science and Art, Albert Nerkin School of Engineering*, pages 1–127, 2009
- [O6] **A. S. Charles.** Bayesian derivation of the Kalman Filter. January 2011. Connexions: <http://cnx.org/content/m36679/1.1/>

## Presentations

- 2022 Consider the data: The computational side of functional imaging, Stanford University.
- 2022 Analyzing and modeling neural data: The sparse way, Rensselaer Polytechnic Institute (RPI) Department of Biomedical Engineering Seminar Series
- 2022 Analyzing and modeling neural data: The sparse way, Johns Hopkins Applied Physics Lab (APL)
- 2022 Consider the data: The computational side of big imaging, NSF Neuronex Big Brain Imaging Workshop, Boston University
- 2020 Data science in neuroscience: From sensors to theory, Johns Hopkins University MINDS&CIS Seminar
- 2020 Computational Advances in Calcium Imaging of Neural Populations, Janelia research campus Optics Interest Group Seminar
- 2020 Detecting and correcting false transients in calcium imaging, Johns Hopkins Kavli Neuroscience Discovery Institute
- 2019 Signals and Noise in Two-Photon Calcium Imaging, Princeton University PNI Seminar
- 2019 Neural data science: from recordings to theoretical models, University of California at San Diego ECE Seminar
- 2019 Neural information representation: From single neuron responses to neural populations, NYU CNS/CDS Seminar
- 2019 Neural data science at the cellular level: From recordings to theoretical models, Columbia University & Biomedical Engineering Seminar
- 2019 Neural data science: from recordings to theoretical models, John Hopkins University & Biomedical Engineering Seminar
- 2019 Neural data science: from recordings to theoretical models, Yale Statistics & Data Science Seminar
- 2019 Modern methods for calcium imaging, NYU Langone Tech4Health Seminar
- 2018 New methods for two-photon calcium imaging, Emory University
- 2018 New signal processing methods for robust and volumetric calcium imaging, Simons Foundation, New York City
- 2018 Signal processing for functional neural calcium imaging, DSO National Laboratories, Singapore
- 2018 Matrix-normal models for fMRI analysis, Organization for Human Brain Mapping, Singapore
- 2018 Modern methods for neural signal processing, Massachusetts Institute of Technology
- 2018 Modern methods for neural signal processing, University of Michigan
- 2017 Volumetric two-photon imaging of neurons using spectroscopy (vTwINS), Rutgers University
- 2017 Distributed short-term memory in recurrent neural networks, Computational and Systems Neuroscience (CoSyNe) Workshops
- 2017 Volumetric two-photon imaging via spectroscopy, Georgia Tech CSIP Seminar Series
- 2016 Denoising calcium imaging, Georgia Tech CSIP Seminar Series
- 2014 Bounds on distributed memory of networked systems, Princeton University
- 2014 Robust tracking of high-dimensional signals, Rehabilitation Clinic of Chicago
- 2014 Can an echo-state network remember what you did last summer?, Georgia Tech CSIP Seminar Series
- 2014 Sparsity based techniques for hyperspectral image analysis, Georgia Tech CSIP Seminar Series
- 2011 Sparsity penalties in dynamical system estimation, CISS, Baltimore, MD, USA
- 2011 Causal sparse decompositions of audio signals, DSP Workshop, Sedona, AZ, USA
- 2011 A hierarchical re-weighted- $\ell_1$  approach for dynamic sparse signal estimation, SPARS, Edinburgh, UK
- 2011 Modern signal processing and sparse coding, The Cooper Union IEEE series

## Mentorship

Eva Yezerets	(2021-pres.)	PhD Student, Johns Hopkins University Department of Biomedical Engineering
Liang Xiang	(2021-pres.)	PhD Student, Johns Hopkins University Department of Biomedical Engineering (Co-advised with F Kanold)
Noga Mudrik	(2021-pres.)	PhD Student, Johns Hopkins University Department of Biomedical Engineering
Michael Xie	(2022-pres.)	MD/PhD Student, Johns Hopkins University Department of Biomedical Engineering
Sai Koukuntla	(2022-pres.)	PhD Student, Johns Hopkins University Department of Biomedical Engineering (Co-advised with Harris)
Gabby Kang	(2020-pres.)	Undergraduate Student, Johns Hopkins University Department of Biomedical Engineering
Iuliia Dmitrieva	(2022-pres.)	Undergraduate Student, Johns Hopkins University Department of Biomedical Engineering

## Past mentees

Xiaoran (Augustine)	(2020-2021)	MSE Student, Johns Hopkins University Department of Biomedical Engineering (Graduated: current RA at Janelia Research Campus)
Yuan David Day	(2020-2021)	Undergraduate Student, Johns Hopkins University Department of Biomedical Engineering

## Thesis committees

Nick Bertrand	Georgia Institute of Technology Department of Electrical and Computer Engineering
Miguel Lazo	Johns Hopkins University Department of Neuroscience
Tomer Hamam	Georgia Institute of Technology Department of Electrical and Computer Engineering

## Funding and Support (current)

NSF	AN:2041303 (PI) Broadening Participation at The Conference on the Mathematical Theory of Deep Learning (2020): \$20,000
-----	---