

Joshua T. Vogelstein

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Personal Information

Primary Appointment

- 02/22 – **Associate Professor**, Department of Biomedical Engineering, JHU, Baltimore, MD, USA.
08/14 – 02/22 **Associate Professor**, Department of Biomedical Engineering, JHU, Baltimore, MD, USA.

Joint Appointments

- 09/19 – **Joint Appointment**, Department of Biostatistics, Johns Hopkins University, Baltimore, MD, USA.
08/15 – **Joint Appointment**, Department of Applied Mathematics and Statistics, JHU, Baltimore, MD, USA.
08/14 – **Joint Appointment**, Department of Neuroscience, JHU, Baltimore, MD, USA.
08/14 – **Joint Appointment**, Department of Computer Science, JHU, Baltimore, MD, USA.

Institutional and Center Appointments

- 08/15 – **Steering Committee**, Kavli Neuroscience Discovery Institute (KNDI), Baltimore, MD, USA.
08/14 – **Core Faculty**, Institute for Computational Medicine, JHU, Baltimore, MD, USA.
08/14 – **Core Faculty**, Center for Imaging Science, JHU, Baltimore, MD, USA.
08/14 – **Assistant Research Faculty**, Human Language Technology Center of Excellence, JHU, Baltimore, MD, USA.
10/12 – **Affiliated Faculty**, Institute for Data Intensive Engineering and Sciences, JHU, Baltimore, MD, USA.

Education & Training

- 2003 – 2009 **Ph.D in Neuroscience**, Johns Hopkins School of Medicine,
Advisor: Eric Young,
Thesis: OOPSI: a family of optical spike inference algorithms for inferring neural connectivity from population calcium imaging .
2009 – 2009 **M.S. in Applied Mathematics & Statistics**, Johns Hopkins University.
1998 – 2002 **B.A. in Biomedical Engineering**, Washington University, St. Louis.

Published Peer-Reviewed Research Articles

Note: CV author in bold; Trainees are underlined. Only showing the most recent 19 citations for brevity.
(100 papers; top 10 cited 3,997 times; H-index 38; 12 first, 17 last, 53 middle authorships) as of 2023/10/22

- [19] Ruoxuan Xiong, Allison Koenecke, Michael Powell, Zhu Shen, **Joshua T Vogelstein**, and Susan Athey. “Federated Causal Inference in Heterogeneous Observational Data”. In: *Statistics in Medicine* (Aug. 2023). DOI: [10.1002/sim.9868](https://doi.org/10.1002/sim.9868).
- [18] Benjamin D Pedigo, Mike Powell, Eric W Bridgeford, Michael Winding, Carey E Priebe, and **Joshua T Vogelstein**. “Generative network modeling reveals quantitative definitions of bilateral symmetry exhibited by a whole insect brain connectome”. In: *eLife Sciences Publications, Ltd* (Mar. 2023). URL: <https://elifesciences.org/articles/83739>.
- [17] Michael Winding, Benjamin D Pedigo, Christopher L Barnes, Heather G Patsolic, Youngser Park, Tom Kazimiers, Akira Fushiki, Ingrid V Andrade, Avinash Khandelwal, Javier Valdes-Aleman, Feng Li, Nadine Randel, Elizabeth Barsotti, Ana Correia, Richard D Fetter, Volker Hartenstein, Carey E Priebe, **Joshua T Vogelstein**, Albert Cardona, and Marta Zlatić. “The connectome of an insect brain”. In: *science* (Mar. 2023). URL: <https://www.science.org/doi/abs/10.1126/science.add9330>.
- [16] Benjamin D. Pedigo, Michael Winding, Carey E. Priebe, and **Joshua T. Vogelstein**. “Bisected graph matching improves automated pairing of bilaterally homologous neurons from connectomes”. In: *Network Neuroscience* (May 2022). bioRxiv: [2022.05.19.492713](https://doi.org/10.1101/2022.05.19.492713). URL: <https://www.biorxiv.org/content/10.1101/2022.05.19.492713>.

- [15] Thomas L. Athey, Daniel J. Tward, Ulrich Mueller, **Vogelstein Joshua T.**, and Michael I. Miller. “Hidden Markov modeling for maximum probability neuron reconstruction”. In: *Communications Biology* (Apr. 2022). ISSN: 5:388. DOI: [10.1038/s42003-022-03320-0](https://doi.org/10.1038/s42003-022-03320-0). eprint: <https://www.nature.com/articles/s42003-022-03320-0.pdf>. URL: <https://doi.org/10.1038/s42003-022-03320-0>.
- [14] Dhireesha Kudithipudi, Mario Aguilar-Simon, Jonathan Babb, Maxim Bazhenov, Douglas Blackiston, Josh Bongard, Andrew P. Brna, Suraj Chakravarthi Raja, Nick Cheney, Jeff Clune, Anurag Daram, Stefano Fusi, Peter Helfer, Leslie Kay, Nicholas Ketz, Zsolt Kira, Soheil Kolouri, Jeffrey L. Krichmar, Sam Kriegman, Michael Levin, Sandeep Madireddy, Santosh Manicka, Ali Marjaninejad, Bruce McNaughton, Risto Miikkulainen, Zaneta Navratilova, Tej Pandit, Alice Parker, Praveen K. Pilly, Sebastian Risi, Terrence J. Sejnowski, Andrea Soltoggio, Nicholas Soures, Andreas S. Tolias, Darío Urbina-Meléndez, Francisco J. Valero-Cuevas, Gido M. van de Ven, **Joshua T. Vogelstein**, Felix Wang, Ron Weiss, Angel Yanguas-Gil, Xinyun Zou, and Hava Siegelmann. “Biological underpinnings for lifelong learning machines”. In: *Nature Machine Intelligence* 4.3 (Mar. 2022), pp. 196–210. ISSN: 2522-5839. DOI: [10.1038/s42256-022-00452-0](https://doi.org/10.1038/s42256-022-00452-0). URL: <https://doi.org/10.1038/s42256-022-00452-0>.
- [13] Shilong Li, Tomi Jun, Jonathan Tyler, Emilio Schadt, Yu-Han Kao, Zichen Wang, Maximilian F. König, Chetan Bettegowda, **Joshua T. Vogelstein**, Nickolas Papadopoulos, Ramon E. Parsons, Rong Chen, Eric E. Schadt, Li Li, and William K. Oh. “Inpatient Administration of Alpha-1-Adrenergic Receptor Blocking Agents Reduces Mortality in Male COVID-19 Patients”. In: *Front. Med.* 9 (Feb. 2022), p. 849222. URL: <https://www.frontiersin.org/articles/10.3389/fmed.2021.637647/full>.
- [12] **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 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 Puppo, Florian Engert, Elizabeth Hillman, Julia Brown, Chris White, and Weiwei Yang. “Prospective Learning: Back to the Future”. In: *The 2nd Conference on Lifelong Learning Agents (CoLLAs)*, 2023 (Jan. 2022). URL: <https://arxiv.org/abs/2201.07372>.
- [11] Jean-Baptiste Poline, David N. Kennedy, Friedrich T. Sommer, Giorgio A. Ascoli, David C. Van Essen, Adam R. Ferguson, Jeffrey S. Grethe, Michael J. Hawrylycz, Paul M. Thompson, Russell A. Poldrack, Satrajit S. Ghosh, David B. Keator, Thomas L. Athey, Joshua T. Vogelstein, Helen S. Mayberg, and Maryann E. Martone. “Is Neuroscience FAIR? A Call for Collaborative Standardisation of Neuroscience Data”. In: *Neuroinformatics* (Jan. 2022). URL: <https://link.springer.com/article/10.1007/s12021-021-09557-0>.
- [10] Thomas Hartung, Lena Smirnova, Itzy E. M. Pantoja, Akwasi Akwaboah, Dowlette-Mary A. E. Din, Cindy Berlinicke, J. L. Boyd, Brian S. Caffo, Ben Cappiello, Tzahi Cohen-Karni, Lowry Curley, Ralph Etienne-Cummings, Raha Dastgheyb, David H. Gracias, Frederic Gilbert, Christa W. Habela, Fang Han, Tim Harris, Kathrin Herrmann, Eric J. Hill, Qi Huang, Rabih E. Jabbour, Erik C. Johnson, Brett J. Kagan, Caroline Krall, Andre Levchenko, Paul Locke, Alexandra Maertens, Monica Metea, Alysson R. Muotri, Rheinallt Parri, Barton L. Paulhamus, Jesse D. Plotkin, Paul Roach, July C. Romero, Jens C. Schwamborn, Fenna Sille, Alexander Szalay, Katya Tsaioun, Daniel Tornero, **Joshua T. Vogelstein**, Karl Wahlin, and Donald J. Zack. “The Baltimore Declaration toward the exploration of organoid intelligence”. In: *Frontiers in Science* (2022).
- [9] Jaewon Chung, Bijan Varjavand, Jesús Arroyo-Relión, Anton Alyakin, Joshua Agterberg, Minh Tang, Carey E. Priebe, and **Joshua T. Vogelstein**. “Valid two-sample graph testing via optimal transport Procrustes and multiscale graph correlation with applications in connectomics”. In: *Stat* 11.1 (2022), e429.
- [8] Michael Powell, Allison Koenecke, James Byrd, Akihiko Nishimura, Maximilian König, Ruoxuan Xiong, Sadiqa Mahmood, Chetan Mucaj Veraand Bettegowda, Liam Rose, Suzanne Tamang, Adam Sacarny, Brian Caffo, Susan Athey, Elizabeth Stuart, and **Joshua Vogelstein**. “Ten Rules for Conducting Retrospective Pharmacoepidemiological Analyses: Example COVID-19 Study”. In: *Frontiers in Pharmacology* (July 2021), p. 1799. DOI: [10.3389/fphar.2021.700776](https://doi.org/10.3389/fphar.2021.700776). URL: <https://www.frontiersin.org/articles/10.3389/fphar.2021.700776/full>.

- [7] Thomas L. Athey, Jacopo Teneggi, **Joshua T. Vogelstein**, Daniel Tward, Ulrich Mueller, and Michael I. Miller. "Fitting Splines to Axonal Arbors Quantifies Relationship between Branch Order and Geometry". In: *Frontiers in Neuroinformatics* (June 2021). URL: https://www.frontiersin.org/articles/10.3389/fninf.2021.704627/full?utm_source=Email_to_authors_20utm_medium=Email_20utm_content=T1_11.5e1_author_20utm_campaign=Email_publication_20field=20journalName=Frontiers_in_Neuroinformatics_20id=704627.
- [6] Allison Koenecke, Michael Powell, Ruoxuan Xiong, Zhu Shen, Nicole Fischer, Sakibul Huq, Adham M. Khalafallah, Marco Trevisan, Pr Sparen, Juan J. Carrero, Akihiko Nishimura, Brian Caffo, Elizabeth A. Stuart, Renyuan Bai, Verena Staedtke, David L. Thomas, Nickolas Papadopoulos, Kenneth W. Kinzler, Bert Vogelstein, Shibin Zhou, Chetan Bettegowda, Maximilian F. Konig, Brett Mensh, **Joshua T. Vogelstein**, and Susan Athey. "Alpha-1 adrenergic receptor antagonists to prevent hyperinflammation and death from lower respiratory tract infection", journal=Elife". In: 10 (June 2021), e61700. DOI: [10.7554/eLife.61700](https://doi.org/10.7554/eLife.61700). URL: <https://elifesciences.org/articles/61700>.
- [5] **Joshua T. Vogelstein**, Eric W. Bridgeford, Minh Tang, Da Zheng, Christopher Douville, Randal Burns, and Mauro Maggioni. "Supervised dimensionality reduction for big data". In: *Nature Communications* 12:2872 (May 2021), pp. 1–9. ISSN: 2041-1723. DOI: [10.1038/s41467-021-23102-2](https://doi.org/10.1038/s41467-021-23102-2).
- [4] Ronan Perry, Gavin Mischler, Richard Guo, Theodore Lee, Alexander Chang, Arman Koul, Cameron Franz, Hugo Richard, Iain Carmichael, Pierre Ablin, Alexandre Gramfort, and **Joshua T. Vogelstein**. "mvlarn: Multiview Machine Learning in Python". In: *Journal of Machine Learning Research* 22:109 (May 2021), pp. 1–7. URL: <http://jmlr.org/papers/v22/20-1370.html>.
- [3] Shilong Li, Tomi Jun, Zichen Wang, Yu-Han Kao, Emilio Schadt, Maximilian F. Konig, Chetan Bettegowda, **Joshua T. Vogelstein**, Nickolas Papadopoulos, Ramon E. Parsons, et al. "COVID-19 outcomes among hospitalized men with or without exposure to alpha-1-adrenergic receptor blocking agents". In: *Frontiers in Medicine* (Apr. 2021). URL: <https://www.medrxiv.org/content/10.1101/2021.04.08.21255148v1.full>.
- [2] Shangsi Wang, Jesús Arroyo, **Joshua T. Vogelstein**, and Carey E. Priebe. "Joint Embedding of Graphs". In: *Transactions on Pattern Analysis and Machine Intelligence* 43 (Apr. 2021). URL: <https://ieeexplore.ieee.org/document/8889404>.
- [1] Jaewon Chung, Bijan Varjavand, Jesus Arroyo, Anton Alyakin, Joshua Agterberg, Minh Tang, **Joshua T. Vogelstein**, and Carey E. Priebe. "Valid Two-Sample Graph Testing via Optimal Transport Procrustes and Multiscale Graph Correlation with Applications in Connectomics". In: *arXiv* (2021). Statistical Network Analysis: [1911.02741](https://arxiv.org/abs/1911.02741) (stat.ME). URL: <https://arxiv.org/abs/1911.02741>.

Funding

External Research Support: Current

- 2022-2027 **NIH**, *The Heart and the Mind: An Integrative Approach to Brain-Body Interactions in the Zebrafish*, 2U19NS104653,
 PI: F. Engert
 Role on Project: Co-Investigator
 Term: 01-Sep-2022 to 31-Aug-2024
 Funding to lab, entire period: \$412,500 (total)
 Funding to lab, current year:
 Johns Hopkins University will be responsible for developing all algorithms and software in support of the Atlas project, as well as running the Data Core. This will include writing software to store, manage, and visualize the data, as well as algorithms for scalable analysis and support of modeling. .
- 2020-2024 **NSF**, *Neural Net Learning for Graph*, NSF 2113099,
 PI: C. Shen
 Role on Project: Co-Investigator
 Term: 01-Sep-2021 to 31-Aug-2024
 Funding to lab, entire period: \$73,597 (total)
 Funding to lab, current year:
 Goal of this project is methodological development, theoretical investigation, and simulation and real data experimentation toward the end goal of principled understanding and advancement of the mathematics and science of graph neural network. .

- 2021-2024 **NIH**, *An Alignment Framework for Mapping Brain Dynamics and Substrates of Human Cognition Across Species*, 1RF1MH128696,
 PI: T. Xu
 Role on Project: Co-Investigator
 Term: 01-Sep-2021 to 31-Aug-2024
 Funding to lab, entire period: \$270,189 (total)
 Funding to lab, current year:
 We will continue collecting, organizing, and analyzing another cohort of the NKI-Rockland Sample. .
- 2021-2027 **NIH**, *The NKI Rockland Sample II: An Open Resource of Multimodal Brain, Physiology & Behavior Data from a Community Lifespan Sample*, 2U19NS104653,
 PI: M. Milham
 Role on Project: Co-Investigator
 Term: 01-Jul-2022 to 30-Apr-2026
 Funding to lab, entire period: \$3,831,854 (total)
 Funding to lab, current year:
 The major goal is to establish multimodal MRI and electrophysiology lifespan sample to open and prospectively share with the larger scientific community. .
- 2020-2025 **NSF**, *Collaborative Research: Transferable, Hierarchical, Expensive, Optimal, Robust, Interpretable Networks*, NSF 20-540,
 PI: R. Vidal
 Role on Project: Co-Investigator
 Term: 01-Sep-2020 to 31-Aug-2025
 Funding to lab, entire period: \$1,650,000 (direct)
 Funding to lab, current year: \$660,000 (direct)
 The goal of this project is to develop a mathematical, statistical and computational frame- work that helps explain the success of current network arcitectures, understand its pitfalls, and guide the design of novel architectures with guaranteed confidence, robustness, inter- pretability, optimality, and transferability .
- 2020 – **Microsoft**, *Federated Causal Inference for Multi-site Real-World Evidence & Clinical Trial Analysis*, Studies in Pandemic Preparedness,
 PI: M. Powell
 Role on Project: Co-Investigator
 Term: 01-Aug-2020 to current
 Funding to lab, entire period: N/A
 Funding to lab, current year: N/A
 This project will conduct federated retrospective analyses designed to assess the benefit of off-label drug use by pooling multiple disparate databases, to help prioritize and guide subsequent initiation and recruitment of randomized clinical trials. This will include evaluating the impact of the target drugs on patient outcomes from diseases similar to COVID-19, such as pneumonia or acute respiratory distress, generating artificial datasets using generative adversarial networks to asses performance of methods when 'ground truth' is known, applying the best methods to analyze the effect of the target drugs on the outcomes of COVID-19 patients across hospital systems, and using the results to evaluate the potential of these drugs and suggest guidelines for clinical trials. .
- 2020-2023 **NIH**, *Graspy: A python package for rigorous statistical analysis of populations of attributed connectomes*, NIH MH-19-147,
 PI: J. Vogelstein
 Role on Project: Principal Investigator
 Term: 01-Jul-2020 to 30-Jun-2023
 Funding to lab, entire period: \$861,240 (direct) \$1,416,279 (total)
 Funding to lab, current year: \$283,301 (direct) \$471,082 (total)
 The goal of this project is to establish a state-of-the-art toolbox for analysis of connectomes, spanning taxa, scale, and complexity. we will develop and extend implementations to enable neurobiologists to (1) estimate latent structure from attributed connectomes, (2) identify meaningful clusters among populations of connectomes, and (3) detect relationships be- tween connectomes and multivariate phenotypes .

- 2020-2025 **NSF**, *NeuroNex2: Enabling Identification and Impact of Synaptic Weight in Functional Networks*, NSF 2014862,
 PI: K. Harris
 Role on Project: Co-Investigator
 Term: 01-Apr-2020 to 31-Mar-2025
 Funding to lab, entire period: \$609,294 (direct) \$997,719 (total)
 Funding to lab, current year: \$121,587 (direct) \$199,543 (total)
 The goal is to develop the requisite technology to understand the impact of synaptic weight on functional networks .
- 2020-2025 **NSF**, *CAREER: Foundational Statistical Theory and Methods for Analysis of Populations of Attributed Connectomes*, NSF 17-537,
 PI: J. Vogelstein
 Role on Project: Principal Investigator
 Term: 01-Jan-2020 to 31-Dec-2025
 Funding to lab, entire period: \$630,230 (total) \$384,873 (direct)
 Funding to lab, current year: \$126,046 (total) \$76,975 (direct)
 The goal is to establish foundational theory and methods for analyzing populations of attributed connectomes .
- 2019-2023 **NIH**, *Brain Networks in Mouse Models of Aging*, NIH RO1AG066184-01,
 PI: A. Badea
 Role on Project: Co-Investigator
 Term: 01-Dec-2019 to 30-Nov-2023
 Funding to lab, entire period: N/A
 Funding to lab, current year: \$205,998
 The goal of this grant is to generate connectomes and RNA-seq transcriptomes to characterize and differentiate APOE mice as a model of aging .
- 2019 – **Microsoft**, *Microsoft Research Award*, ,
 PI: J. Vogelstein
 Role on Project: Principal Investigator
 Term: Unrestricted Gift
 Funding to lab, entire period: \$50,000 (total)
 Funding to lab, current year: N/A
 Research and development of neuroscience and connectomes around neuronal circuit and system modeling, application of time-series-of-graphs and dynamics to neuronal signaling analysis and connectomes, and in the abstractions of matter, math, machines that point toward complex systems composed of low-level components .

Startups

- 2017 – **Chief Intelligent Officer**, [sensie](#), Sensie is a startup devoted to unblocking intelligence to optimize our collective wellness.
- 2017 – **Co-Founder**, *gigantum*, The future of data science is open, decentralized and user friendly. That is why we created a platform that enables anybody to create and share totally reproducible computational work with the world., Completed initial round of seed funding for undisclosed amount from [Digital Science](#), which also funds figshare, readcube, altmetric, overleaf, and more. Gigantum was acquired by nVidia in early 2022.
- 2016 – **Co-Founder**, *global domain partners*, Global Domain Partners is a quantitative hedge fund that was acquired by Mosaic Investment Partners in 2012.