

Vivek Gopalakrishnan

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I am an first-year PhD student in Medical Engineering and Medical Physics at the Harvard-MIT Program in Health Sciences and Technology. My past research has focused on the development of computational methods to analyze multi-subject neuroimaging and cardiovascular data. Most recently, I developed statistical graph theory algorithms to perform biomarker discovery in network-valued maps of the brain. I also led a Design Team of undergraduate biomedical engineers to build a dynamic fusion image guidance system for minimally invasive heart surgery.

Education

- 8/21 – present **Massachusetts Institute of Technology and Harvard Medical School**, Cambridge, MA.
(*Incoming*) Doctor of Philosophy (Ph.D.) in Medical Engineering and Medical Physics.
○ **Advisors:** Professors Polina Golland, Rahul Deo (in rotations).
○ **Concentration Area:** Computer Science.
- 8/20 – 5/21 **Johns Hopkins University**, Baltimore, MD.
Master of Science and Engineering (M.S.E.) in Biomedical Engineering. GPA: 3.77/4.
○ **Advisors:** Professors Joshua T. Vogelstein (primary) and Carey E. Priebe (secondary).
○ **Concentration Area:** Biomedical Data Science.
○ **Thesis:** *Multiscale Statistical Hypothesis Testing for k-Sample Graph Inference*.
- 8/17 – 5/21 **Johns Hopkins University**, Baltimore, MD.
Bachelor of Science (B.S.) in Biomedical Engineering. GPA: 3.77/4.
○ **Advisor:** Professor René Vidal.
○ **Concentration Area:** Biomedical Data Science.

Research and Engineering Experience

- 1/20 – 5/21 **Design Team Leader**, *Dept. of Biomedical Engineering*, Johns Hopkins University.
○ Team leader and project manager for a team of eight undergraduate engineers.
○ Developed a multi-modal spatiotemporal registration algorithm to power a dynamic fusion image guidance system for minimally invasive heart surgery.
○ **Skills used:** *Computer vision, image registration, cardiology, Python, and Git*.
- 9/18 – 5/21 **Undergraduate Research Assistant**, *Neurodata Lab*, Johns Hopkins University.
○ Developed novel machine learning methods for analyzing populations of graph-valued objects [3, 1].
○ Discovered neuro-connectively similar subtypes of autism using joint embeddings of multi-network connectomes [4, 7].
○ **Skills used:** *Graph theory, statistics, machine learning, Python, and Git*.
- Summer 2018 **Summer Student Researcher**, *Ghebremichael Lab*, Ragon Institute of MGH, MIT and Harvard.
○ Developed predictive models of disease progression and immune recovery in HIV-positive children with TB co-infection [2].
○ Identified biomarkers for antiretroviral toxicity by applying machine learning methods to HIV-patient data [5].
○ **Skills used:** *Survival analysis, ROC models, R, and Git*.

- 12/17 – 5/18 **Design Team Member**, *Dept. of Biomedical Engineering*, Johns Hopkins University.
- Designed and implemented a clinical machine learning algorithm to predict the onset of lung failure in pediatric patients.
 - **Skills used:** *Representation learning, sparse dictionary learning, Python, and Git.*
- 6/17 – 7/17 **Summer Researcher**, *Fondazione Bruno Kessler*, Trento, Italy.
- Implemented a deep learning algorithm to quantitatively assess crop damage from images taken by farmers.
 - **Skills used:** *Computer vision, Keras, Python, and Git.*
- 6/16 – 6/17 **High School Researcher**, *Tufts University BioSeq Program*, Tufts University.
- Used next-generation sequencing (NGS) to generate a novel human oral microbiome data set.
 - Analyzed sequence data using dimensionality reduction and hidden Markov models to identify microbial biomarkers of oral health.
 - Presented at the 2017 Intel International Science and Engineering Fair, Los Angeles, CA.
 - **Skills used:** *DNA library construction, next-generation sequencing, dimensionality reduction, hidden Markov models, and R.*

Publications and Preprints

- [1] Jaewon Chung, Eric Bridgeford, Jesus Arroyo, Benjamin D. Pedigo, Ali Saad-Eldin, **Vivek Gopalakrishnan**, Liang Xiang, Carey E Priebe, and Joshua T Vogelstein. “Statistical Connectomics”. *Annual Review of Statistics and Its Application* (Mar. 2021). DOI: <https://doi.org/10.1146/annurev-statistics-042720-023234>.
- [2] **Vivek Gopalakrishnan**, Eliezer Bose, Usha Nair, Yuwei Cheng, and Musie Ghebremichael. “Pre-HAART CD4+ T-Lymphocytes as Biomarkers of Post-HAART Immune Recovery in HIV-Infected Children with or without TB Co-Infection”. *BMC Infectious Diseases* (Oct. 2020). DOI: [10.1186/s12879-020-05458-w](https://doi.org/10.1186/s12879-020-05458-w).
- [3] **Vivek Gopalakrishnan**, Jaewon Chung, Eric Bridgeford, Benjamin D. Pedigo, Jesús Arroyo, Lucy Upchurch, G. Allan Johnson, Nian Wang, Youngser Park, Carey E. Priebe, and Joshua T. Vogelstein. “Multiscale Comparative Connectomics”. *arXiv:2011.14990* (Nov. 2020). arXiv: [2011.14990](https://arxiv.org/abs/2011.14990).
- [4] Nian Wang, Robert J Anderson, David G Ashbrook, **Vivek Gopalakrishnan**, Youngser Park, Carey E Priebe, Yi Qi, Rick Laoprasert, Joshua T Vogelstein, Robert W Williams, and G Allan Johnson. “Variability and Heritability of Mouse Brain Structure: Microscopic MRI Atlases and Connectomes for Diverse Strains”. *NeuroImage* (Aug. 2020). DOI: [10.1016/j.neuroimage.2020.117274](https://doi.org/10.1016/j.neuroimage.2020.117274).
- [5] Jong Soo Lee, Elijah Paintsil, **Vivek Gopalakrishnan**, and Musie Ghebremichael. “A Comparison of Machine Learning Techniques for Classification of HIV Patients with Antiretroviral Therapy-Induced Mitochondrial Toxicity from Those Without Mitochondrial Toxicity”. *BMC Medical Research Methodology* (Nov. 2019). DOI: [10.1186/s12874-019-0848-z](https://doi.org/10.1186/s12874-019-0848-z).

Conference Presentations

- [6] **Vivek Gopalakrishnan** and Joshua T Vogelstein. “Statistical Methods for Multiscale Comparative Connectomics”. *NeuroMatch*. Oct. 2020. URL: https://www.neuromatch.io/abstract?submission_id=recARY71P6SjXY3xK.
- [7] **Vivek Gopalakrishnan** and Joshua T Vogelstein. “Towards Discovering Heterogeneity in Autism via Multi-Network Connectomics”. *Biomedical Engineering Society (BMES)*. Philadelphia, PA, Oct. 2019.

Skills

Programming Python, R, C++, git, \LaTeX

DevOps GitHub, AWS, Docker, CircleCI
APIs NumPy, Pandas, scikit-learn, PyTorch, Matplotlib, Seaborn
Bioinformatics Microbiome and B cell repertoire analysis
Wet Lab Microfabrication, 3-D tissue culture, NGS library construction

Teaching

Spring '21 **Head TA – NeuroData Design II**, *EN.BME.438/638*, Johns Hopkins University.
Fall '20 **Head TA – NeuroData Design I**, *EN.BME.437/637*, Johns Hopkins University.
Fall '20 **TA – Linear Algebra**, *AS.MATH.201*, Johns Hopkins University.
Fall '20 **TA – Computational Cardiology Lab**, *EN.BME.487*, Johns Hopkins University.
Fall '18 **Head PILOT Leader**, *Dept. of Academic Support*, Johns Hopkins University.
to Spring '20

- Led group tutoring sessions (≈ 10 students/group), and wrote weekly problem sets and lectures.
- Led weekly meetings to train junior PILOT leaders in mathematics and pedagogy.

Fellowships and Awards

2020 **Provost's Undergraduate Research Award**, *Office of Undergraduate Research*, Johns Hopkins University.
2019 **INBT Research Award**, *Institute for NanoBioTechnology*, Johns Hopkins University.
2019 **Joseph C. Pistritto Research Fellowship**, *Dept. of Computer Science*, Johns Hopkins University.
2018 **AWS Cloud Credits for Research Grant**, *Dept. of Computer Science*, Johns Hopkins University.
2017 **Second Place Winner**, *Intel International Science and Engineering Fair (ISEF)*, Category: Microbiology.
2017 **Internship Award**, *Intel ISEF Special Award*, Fondazione Bruno Kessler.
2017 **Semi-Finalist**, *Regeneron Science Talent Search*, Microbiology.
2017 **Second Place Winner**, *Massachusetts State Science & Engineering Fair*.
2016 **Second Place Winner**, *Massachusetts State Science & Engineering Fair*.