

# Anish K. Simhal

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## Postdoctoral training

2021 – Present **Mathematical Oncology Initiative**  
**Department of Medical Physics, Memorial Sloan Kettering Cancer Center**  
*Advisors: Joseph O. Deasy & Allen Tannenbaum [1953-2023]*

2019 – 2021 **Autism Center, Child Mind Institute**  
*Advisors: Adriana Di Martino & Michael Milham*

## Education

2014 – 2019 **PhD — Electrical Engineering**  
*Advisor: Guillermo Sapiro*  
Duke University, Durham, NC  
*Pratt School of Engineering — Dept. of Electrical Engineering*

2014 – 2016 **Masters of Science — Electrical Engineering**  
Duke University, Durham, NC  
*Pratt School of Engineering — Dept. of Electrical Engineering*

2010 – 2014 **Bachelor of Science — Electrical Engineering**  
University of Virginia, Charlottesville, VA  
*School of Engineering and Applied Sciences*

## Publications

- 2024 [17] A.K. Simhal, C. Weistuch, K.A. Murgas, D. Grange, J. Zhu, J.H. Oh, R. Elkin, J.O. Deasy. “**ORCO: Ollivier-Ricci Curvature-Omics: an unsupervised method for analyzing robustness in biological systems.**” 2024. *biorxiv*.
- 2024 [16] A.K. Simhal, R.S. Firestone, J.H. Oh, V. Avutu, L. Norton, M. Hultcrantz, S.Z. Usmani, K.H. Maclachlan, J.O. Deasy. “**High WEE1 expression is independently linked to poor survival in multiple myeloma.**” 2024. *biorxiv*.
- 2024 [15] K.D. Micheva, A.K. Simhal, J. Schardt, S.J. Smith, R. Weinberg, S.F. Owen. “**Data-driven synapse classification reveals a logic of glutamate receptor composition.**” 2024. *biorxiv*.
- 2023 [14] A.K. Simhal, K.H. Maclachlan, R. Elkin, J. Zhu, L. Norton, J.O. Deasy, J.H. Oh, S.Z. Usmani, A. Tannenbaum. “**Gene interaction network analysis in multiple myeloma detects complex immune dysregulation associated with shorter survival.**” 2023. *Blood Cancer Journal*.
- 2023 [13] J.H. Oh, R. Elkin, A.K. Simhal, J. Zhu, J.O. Deasy, A. Tannenbaum. “**Optimal Transport for Kernel Gaussian Mixture Models.**” 2023. *Optimization for Machine Learning, NeurIPS 2023*.
- 2023 [12] J. Zhu, J.H. Oh, A.K. Simhal, R. Elkin, L. Norton, J.O. Deasy, A. Tannenbaum. “**Geometric graph neural networks on multi-omics data to predict cancer survival outcomes.**” 2023. *Computers in Biology and Medicine*.
- 2023 [11] B. Vibert, ..., A.K. Simhal, ..., A. D. Martino. “**CRISIS AFAR: An International Collaborative Study of the Impact of the COVID-19 Pandemic on Youth with Autism and Neurodevelopmental Conditions.**” 2023. *Molecular Autism*.

- 2022 [10] R.K. Simhal, T.N. Sholklapper, A.K. Simhal, A.L. Zwart, M.T. Danner, D. Kumar, N. Aghdam, S. Suy, R.A. Hankins, K.J. Kowalczyk, S.P. Collins. **“Association of Baseline Self-Reported Fatigue with Overall Survival After Stereotactic Body Radiation Therapy for Localized Prostate Cancer.”** 2022. *Frontiers in Oncology*.
- 2022 [9] A.K. Simhal, K. L. H. Carpenter, J. Kurtzberg, A. Song, A. Tannenbaum, L. Zhang, G. Sapiro, G. Dawson. **“Changes in the geometry and robustness of diffusion tensor imaging networks: secondary analysis from a randomized controlled trial of young autistic children receiving an umbilical cord blood infusion.”** 2022. *Frontiers in Psychiatry*.
- 2021 [8] A.K. Simhal, J. O. A. Filho, P. Segura, J. Cloud, E. Petkova, R. Gallagher, F. X. Castellanos, S. Colcombe, M. P. Milham, A. D. Martino. **“Predicting multiscan MRI outcomes in children with neurodevelopmental conditions following MRI simulator training.”** 2021. *Developmental Cognitive Neuroscience*.
- 2020 [7] A.K. Simhal, K. L. H. Carpenter, S. Nadeem, J. Kurtzberg, A. Song, A. Tannenbaum, G. Sapiro, G. Dawson. **“Measuring robustness of brain networks in autism spectrum disorder with Ricci curvature.”** 2020. *Scientific Reports*.
- 2019 [6] A.K. Simhal, Y. Zuo, M.M. Perez, D.V. Madison, G. Sapiro, and K.D. Micheva. **“Multifaceted changes in synaptic composition and astrocytic involvement in a mouse model of fragile x syndrome.”** 2019. *Scientific Reports*.
- 2018 [5] A.K. Simhal, B. Gong, J.S. Trimmer, R.J. Weinberg, S.J. Smith, G. Sapiro, and K.D. Micheva. **“A computational synaptic antibody characterization tool for array tomography.”** 12, 2018. *Frontiers in Neuroanatomy*.
- 2018 [4] M.N. Asiedu, A.K. Simhal, U. Chaudhary, J.L. Mueller, C.T. Lam, J.W. Schmitt, G. Venegas, G. Sapiro, and N. Ramanujam. **“Development of algorithms for automated detection of cervical pre-cancers with a low-cost, point-of-care, pocket colposcope.”** 2018. *IEEE Transactions on Biomedical Engineering*.
- 2018 [3] M.N. Asiedu, A.K. Simhal, C.T. Lam, J. Mueller, U. Chaudhary, J.W. Schmitt, G. Sapiro, and N. Ramanujam. **“Image processing and machine learning techniques to automate diagnosis of lugol’s iodine cervigrams for a low-cost point-of-care digital colposcope.”** 2018. *Optics and Biophotonics in Low-Resource Settings IV*. Volume 10485. International Society for Optics and Photonics.
- 2017 [2] A.K. Simhal, C. Aguerrebere, F. Collman, J.T. Vogelstein, K.D. Micheva, R.J. Weinberg, S.J. Smith, and G. Sapiro. **“Probabilistic fluorescence-based synapse detection.”** 2017. *PLoS Computational Biology*.
- 2014 [1] A.K. Simhal, V.G. Kanumuru, A. Holmes, and E. Berger. **“Exploring the use of student taught classes to introduce new technical topics to engineering undergraduates.”** 2014. *Frontiers in Education Conference, IEEE*, pages 1–8.

## Selected Poster Presentations

- 2024 [23] American Society of Hematology (2024). **“Immune-MRD Status Informs Tumor-MRD Outcome Prognostication in Multiple Myeloma Patients on Lenalidomide Maintenance.”** R.S. Firestone, A.K. Simhal, ..., A.M. Lesokhin.
- 2024 [22] American Society of Hematology (2024). **“Genomic Complexity Correlates with the Degree of Marrow Independence of Malignant Plasma Cells in the Context of Extramedullary Disease.”** K.H. Maclachlan, ..., A.K. Simhal, ..., U. Shah.
- 2024 [21] Stanford Graph Learning Workshop (2024). **“Going beyond the curse of infinite data: unsupervised network learning for oncology data using Ollivier-Ricci curvature.”** A.K. Simhal, R. Elkin, R. Firestone, J.H. Oh, L. Norton, S.Z. Usmani, K.H. Maclachlan, J.O. Deasy.
- 2024 [20] International Myeloma Society (2024). **“Increased WEE1 expression is predictive of short progression-free survival, independent of standard prognostic factors in multiple myeloma.”** A.K. Simhal, R. Firestone, J.H. Oh, L. Norton, S.Z. Usmani, J.O. Deasy, K.H. Maclachlan.

- 2024 [19] International Myeloma Society (2024). **“Para-medullary (PMD) and extra-medullary (EMD) myeloma demonstrate increased copy number aberration, mutational burden, structural variants and genomic complexity compared to marrow-based myeloma.”** K.H. Maclachlan, ..., A.K. Simhal, ..., U. Shah.
- 2024 [18] European Hematology Association (2024). **“Increased WEE1 expression correlates with poor survival in multiple myeloma independent of standard prognostic factors.”** A.K. Simhal, R. Firestone, J.H. Oh, K.H. Maclachlan, L. Norton, S.Z. Usmani, J.O. Deasy.
- 2023 [17] American Association for Cancer Research (2023). **“Protein network analysis uncovers a poor-survival subtype in multiple myeloma.”** A.K. Simhal, K.H. Maclachlan, R. Elkin, J. Zhu, S.Z. Usmani, J.J. Keats, L. Norton, J.O. Deasy, J.H. Oh, A. Tannenbaum.
- 2023 [16] American Association for Cancer Research (2023). **“Deep neural networks using protein-protein network information predict multiple myeloma survival.”** J. Zhu, J.H. Oh, A.K. Simhal, R. Elkin, L. Norton, J.O. Deasy, A. Tannenbaum.
- 2022 [15] American Society of Hematology (2022). **“Geometric network analysis defines poor prognosis subtypes in multiple myeloma.”** A.K. Simhal, K.H. Maclachlan, R. Elkin, J. Zhu, S.Z. Usmani, J.J. Keats, L. Norton, J.O. Deasy, J.H. Oh, A. Tannenbaum.
- 2022 [14] Society of Neuroscience Annual Meeting (2022). **“Conjugate IF-SEM: A tool to provide ground truth for synapse detection and analysis.”** A.K. Simhal, J.L. Schardt, S.J. Smith, R.J. Weinberg, K.D. Micheva.
- 2022 [13] Society of Neuroscience Annual Meeting (2022). **“Collaborative conjugate array tomography to characterize synapses in mouse neocortex.”** J.L. Schardt, A.K. Simhal, K.D. Micheva, S.J. Smith, R.J. Weinberg.
- 2022 [12] International Myeloma Society (2022). **“Network topology analysis reveals unique multiple myeloma genomic subtypes and potential new therapeutic targets.”** A.K. Simhal, K.H. Maclachlan, R. Elkin, J. Zhu, S.Z. Usmani, J.O. Deasy, J. H. Oh, A. Tannenbaum.
- 2022 [11] Annual Meeting of the American Urology Association (2022). **“Baseline self-reported fatigue predicts overall survival after stereotactic body radiation therapy for localized prostate cancer.”** R. Simhal, T. Sholklapper, A.K. Simhal, A. Zwart, M. Danner, D. Kumar, N. Aghdam, S. Suy, R. Hankins, K. Kowalczyk, S. Collins. *Podium presentation*
- 2022 [10] Flux Society (2022). **“Transdiagnostic connectome-based mapping of autistic traits in children with autism and/or attention deficit/hyperactivity disorder.”** P. Segura, J.O.A. Filho, A.K. Simhal, J. Stroud, J. Cloud, S. Bishop, S.H. Kim, C. Lord, F.X. Castellanos, S. Colcombe, M. Milham, A.D. Martino.
- 2021 [9] Microscopy and Microanalysis (2021). **“Electron microscopy explorations of the human brain: using immunofluorescence to address challenges.”** K. Micheva, M. Perez, A.K. Simhal, R. Weinberg, D. Madison.
- 2020 [8] Organization for Human Brain Mapping Annual Meeting (June 2020). **“Mock MRI training impact on MRI scanning in children with neurodevelopmental disorders.”** A. K. Simhal, J. O. A. Filho, P. Segura, J. Cloud, F. X. Castellanos, S. Colcombe, M. P. Milham, A. D. Martino.
- 2019 [7] American Academy of Child & Adolescent Psychiatry Annual Meeting (Oct 2019). **“Graph curvature as a method for discerning robustness in brain networks in autism spectrum disorder.”** K. L. H. Carpenter, A. K. Simhal, S. Nadeem, J. Sun, J. Kurtzberg, A. Song, A. Tannenbaum, G. Sapiro, G. Dawson
- 2018 [6] Society of Neuroscience Annual Meeting (2018). **“An array tomography exploration tool: Exploring synapses from FMR1 knockout mice.”** A.K. Simhal, K. D. Micheva, Y. Zuo, R.J. Weinberg, S.J. Smith, G. Sapiro
- 2017 [5] Society of Neuroscience Annual Meeting (2017). **“Automated Antibody Characterization for Array Tomography.”** A.K. Simhal, B. Gong, J. Trimmer, R.J. Weinberg, S.J. Smith, G. Sapiro, K.D. Micheva

- 2017 [4] Society of Neuroscience Annual Meeting (2017). **“Comparing Mouse and Human Synapses with Automated Probabilistic Synapse Analysis.”** K.D. Micheva, A.K. Simhal, J.T. Ting, A.L. Ko, W.W. Seeley, E.F. Chang, A.N. Li, E. Lein, F. Collman, D.V. Madison, R.J. Weinberg, S.J. Smith, G. Sapiro
- 2016 [3] Society of Neuroscience Annual Meeting (2016). **“Probabilistic Synapse Detection in Array Tomography.”** A.K. Simhal, C. Aguerrebere, F. Collman, J.T. Vogelstein, K.D. Micheva, R.J. Weinberg, S.J. Smith, G. Sapiro
- 2015 [2] NeurIPS 2015 (Dec 2015). **“Computational statistics for whole brain CLARITY analysis using the Open Connectome Project.”** A.K. Simhal, W.G. Roncal, K.A. Lillaney, K. Kutten, M.I. Miller, J.T. Vogelstein, R. Burns, L. Ye, R. Tomer, K. Deisseroth, G. Sapiro
- 2015 [1] Society of Neuroscience Annual Meeting (2015). **“Computational statistics for whole brain CLARITY analysis using the Open Connectome Project.”** A.K. Simhal, W.G. Roncal, K.A. Lillaney, K. Kutten, M.I. Miller, J.T. Vogelstein, R. Burns, L. Ye, R. Tomer, K. Deisseroth, G. Sapiro

## Selected Talks

- 2018 Simhal, Anish K et al. “A Computational Synaptic Antibody Characterization Tool for Array Tomography.” School of Electrical Engineering, **Tel Aviv University**. 15 October 2018. Tel Aviv, Israel.
- 2018 Simhal, Anish K et al. “A Computational Synaptic Antibody Characterization and Screening Framework for Array Tomography.” Data Dialogue, IID, **Duke University**. 22 March 2018. Durham, North Carolina.
- 2017 Simhal, Anish K et al. “Automated Antibody Characterization and Screening for Array Tomography via Probabilistic Synapse Detection.” Seminario Interdisciplinario Procesamiento y Análisis de Imágenes Biomédicas, **Universidad de la República**. 9 November 2017. Montevideo, Uruguay.
- 2017 Simhal, Anish K et al. “Probabilistic fluorescence-based synapse detection.” Facultad de Ingeniería, **Universidad de la República**. 6 November 2017. Montevideo, Uruguay.

## Leadership Experience

- 2018 – 2024 **Bull City Classrooms — Founder, Board of Directors**
- Founded a nonprofit 501(c)(3) to address the needs of Durham Public Elementary School teachers.
  - Engaged 400+ volunteers at 15+ events at local elementary schools.
  - Raised \$2,000+ from community partners to support these efforts.
  - [www.bullcityclassrooms.org](http://www.bullcityclassrooms.org)
- 2016 – 2018 **Little League Coach, Durham Boys and Girls Club – Head Coach**
- Coached twelve children, ages 9-12, for the Durham Bulls Youth Athletic League organization.
  - During the season, spent 10 hours a week with the children.
  - Organized practices, recruited assistant coaches, communicated with parents in English and Spanish.

## Awards

- 2019 **Durham Public School Spark Advocate of the Year Award**
- Awarded by the Durham Public Schools Board of Education to an individual not affiliated with DPS for exceptional service.
  - Won in recognition of creating a nonprofit to engage the Durham community with Durham Public School teachers and staff.

- 2013 **Microsoft Imagine Cup Entrepreneurship Competition — 1st Place – Innovation**  
 – Created a physical therapy application to provide patients performing exercises and stretches real-time feedback via the Kinect Sensor in C#.  
 – Researched product development strategies, business models, and performed market analysis.
- 2013 **Harrison Undergraduate Research Award**  
 – Won competitive Harrison Award for 'outstanding undergraduate research,' which provided substantial research funding. Presented by the Center for Undergraduate Excellence at U.Va.

## Industry Experience

- June/July 2016 **Allen Institute for Brain Sciences, Synapse Biology — Summer Visitor**  
 – Worked with the synapse biology team, led by Dr. Stephen J. Smith, to develop new tools for detection synapses in array tomography data.
- Summer 2013 **Azure Summit Technology — Electrical Engineering Intern**  
 – Developed a signal processing GUI in MATLAB to augment spectrogram analysis, digital down conversion, and other signal processing tools.  
 – Designed various filters to equalize hardware system channel responses.  
 – Learned agile software development.
- Summer 2012 **Decisive Analytics Corporation — Image Processing Intern**  
 – Transformed video footage from unmanned aerial vehicles to create panoramic imagery to augment existing map data.  
 – Designed and executed object detection algorithms to track vehicles throughout a video using OpenCV libraries; wrote documentation.  
 – Implemented and evaluated an image processing research paper in C++.
- Summer 2011 **EOIR Technologies, Inc. — Software Engineering Intern**  
 – Developed video analysis software based on the Python and OpenCV libraries to analyze and augment the results of an object tracking algorithm.  
 – Collaborated with engineers to develop and manage evolving requirements and specifications; learned the Software Development Life Cycle.

## Teaching Experience

- Spring 2016, 2017 **Image Processing (Duke ECE 590) — Teaching Assistant**  
 – Supported students taking the course in-person at Duke and online via Coursera.
- Spring 2014 **Digital Signal Processing (UVa ECE 4750/6750) — Teaching Assistant**  
 – Explained a variety of topics in DSP to both undergraduate and graduate students.  
 – Created and graded weekly homework assignments and exams.  
 – Held regular office hours attended by an average of 20+ students.
- Fall 2012, 2013 **Circuit Analysis (UVa ECE 2630) — Teaching Assistant**  
 – Taught various circuit analysis techniques to second year EE/CPE students.  
 – Demonstrated an array of lab skills, including using oscilloscopes.
- Fall 2011 **Engineering Explorations — 1st Year Seminar (UVa ENGR 1595) — Instructor**  
 – Introduced and facilitated an "Explorations in Engineering" Seminar to provide 1st year students with an overview of all engineering disciplines – Coordinated with the Dean's Office to create and manage the curriculum.
- 2008 – 2015 **Smithsonian National Air & Space Museum — Education Volunteer**  
 – Dynamically adapted to a wide spectrum of age groups to educate and engage visitors from topics ranging from how an airplane flies to how astronauts live and work in space.

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## Undergraduate Research Experience

- 2014 **Heliotropism in Sunflowers @ VIVA Research Group — Dr. Scott Acton, ECE**  
– Researched and designed an algorithm to track the motion of sunflowers over extended periods of time. It is a fascinating problem due to the constantly evolving shape of the plant and the variety present within the species.  
– Collaborated and implemented the algorithm via MATLAB and delivered GUI to Dr. Blackman, U.Va Biology Dept.
- 2012 – 2014 **Semi-Enclosed Area Occupancy Detection — Dr. Archie Holmes, ECE**  
– Designed an integrated wireless sensor platform to detect occupancy in semi-enclosed area, to help students find an empty study areas via a mobile application.  
– Constructed a full scale prototype by integrating a microprocessor, passive & thermal infrared sensors, and digital radios in a 3D printed custom enclosure.
- 2012 – 2013 **INTERIA Wireless Health Research — Dr. John Lach, ECE**  
– Designed calibration procedure for an Ankle Foot Orthopedic device with multiple sensors and created software tool chain to support it.  
– Researched various activity classifications algorithms and created step counter.  
– Created program (BodySim) to scan in 3D models of the human body via the Microsoft Kinect in C++ to model human kinematics.

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## Selected News Articles

- 2019 9th Street Journal. “Bull City Classrooms ushers volunteers to Durham elementary schools.” January 25th, 2019.
- 2014 UVA Today. “U.Va. Undergrads Track Foot Traffic to Make Study Areas More Accessible.” March 18th, 2014.
- 2013 UVA Today. “From Programming Languages to Auto Mechanics, Engineering Students Give Teaching a Try.” December 15th, 2013.
- 2013 UVA Today. “U.Va. Engineering Students Earn Microsoft’s Imagine Cup for Innovation.” June 28th, 2013.