Anish K. Simhal

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Postdoctoral training

2021 – Present **Department of Medical Physics, Memorial Sloan Kettering Cancer Center**
Advisors: Allen Tannenbaum & Joseph Deasy

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 [16] 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 [15] 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*.

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 [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

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.

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.

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.