David Mayerich

CONTACT INFORMATION	Assistant Professor NSF BRAIN Center Co-Director CPRIT Scholar in Cancer Research Department of Electrical and Computer Engineering University of Houston W330 Engineering Building 2 Houston, TX 77204-4005 USA	Phone: +1-713-743-6105 E-mail: mayerich@uh.edu www: stim.ee.uh.edu

RESEARCH INTERESTS

My work focuses on high-performance computing and biomedical imaging. Maps describing tissue structure and composition are critical for understanding biological functions. This data is particularly important for research in complex phenotypes, such as the brain tissue and tumor biopsies. However, whole organ imaging is impractical with existing instrumentation and data processing algorithms. My research enables three-dimensional whole organ phenotyping by developing methods for exploring large biological samples at sub-micrometer resolution. I focus on developing new instrumentation and utilizing high-performance computing to create large-scale multi-dimensional and hyperspectral data sets that will enable advances in disease research, diagnosis, and precision medicine.

EDUCATION

Texas A&M University, College Station, TX, USA

Ph.D., Computer Science and Engineering, August 2009
- Dissertation: Imaging and Computational Methods for Exploring Sub-Cellular Anatomy
- Advisors: Dr. John Keyser, Dr. Bruce McCormick

M.S., Computer Science and Engineering, August 2003
- Thesis: *Acquisition and Reconstruction of Brain Tissue Using Knife-Edge Scanning Microscopy*
- Advisors: Dr. John Keyser

Southwestern Oklahoma State University, Weatherford, OK, USA

B.S., Computer Science, June 2000 (Cum Laude)

ACADEMIC APPOINTMENTS

Assistant Professor   **September 2014 to present**

Department of Electrical and Computer Engineering, University of Houston
- CPRIT Scholar in Cancer Research
- NIH/NLM K99/R00 Fellow
- Director of the Scalable Tissue Imaging and Modeling (STIM) Laboratory
- Focus on cancer and whole organ microscopic imaging and modeling

Beckman Postdoctoral Fellowship   **July 2009 to September 2014**

Beckman Institute, University of Illinois at Rubana-Champaign
- Privately funded fellowship supporting interdisciplinary research
- Focus on broadband spectroscopic imaging and image processing for cancer diagnosis
- Affiliations:
  - Chemical Imaging and Structures Laboratory, PI: Dr. Rohit Bhargava
  - Optical Science Group, PI: Dr. P. Scott Carney
  - Computer Graphics Group, PI: Dr. John C. Hart

Research Assistant   **September 2004 to June 2009**

Brain Networks Laboratory, Texas A&M University
- Developed knife-edge scanning microscopy (KESM)
- Developed processing and visualization techniques for terabyte-scale images

PROFESSIONAL MEMBERSHIPS

Institute of Electrical and Electronics Engineers **(IEEE)**, Association for Computing Machinery **(ACM)**, Society for Applied Spectroscopy **(SAS)**, Society for Neuroscience **(SfN)**

HONORS AND AWARDS	**Research**	
	• 3rd Place Student Presentation Competition, 13th Annual Graduate Research Conference (with Jiabing Li)	**2017**
	• Urvish Medh Best Poster Presentation, 12th Annual Graduate Research Conference (with Rupali Mankar)	**2016**
	• 3rd Place – David Kuck Poster Competition, CSE Annual Meeting, Urbana, IL	**2013**
	• IEEE Symposium on Biomedical Imaging Student Grant, Paris, France (*supported by NSF*)	**2008**
	• Symposium on Solid and Physical Modeling Student Grant, Stony Brook, NY	**2008**
	• Faculty of Neuroscience Student Grant, Society for Neuroscience, San Diego, CA	**2007**
	• Graduate Assistance in Areas of National Need (GAANN) Fellowship	**2006**
	Teaching	
	• Teaching Excellence Award – Computer Graphics *(awarded to one TA/year)*	**2004**
SERVICE	**University**	
	• ECE Seminar Committee	**2015-2017**
	• ECE Admissions Committee	**2015-2017**
	• ECE Faculty Search Committee	**2015-2016**
	• Chinese Scholarship Council Graduate Student Recruitment Fair, Beijing	**October 2015**
	• Summer Research, Harmony Public Schools *(Zeynep Civelek, Cecilia Ballesteros)*	**2015-2016**
	Professional	
	• Review Editor, Frontiers in Physics and Optics	**2014-present**
	• Organizer, ECE Distinguished Lecture Series	**2016-2017**
	• Symposium Organizer, Microscopy and Microanalysis	**2015-2016**
	• Organizer, Beckman Graduate Seminar	**2011-2012**
	• Scientific Reviewer, Wellcome Trust	**2011**
	• Review Panelist, NIH/National Library of Medicine ITK A2-D2	**2010**
	• Co-Organizer, Computer Game Design Competition, Texas A&M University	**2007**
	• Co-Organizer, Seminar Series on Molecular and Biological Networks	**2005**
	Memberships	
	• Society for Applied Spectroscopy (SAS)	**2012-present**
	• Society for Neuroscience (SfN)	**2006-present**
	• Association for Computing Machinery (ACM)	**2006-present**
	• Institute for Electrical and Electronics Engineers (IEEE)	**2006-present**

Postdoctoral Advising

Camille Artur (Raman Spectroscopy, Expansion Microscopy)

Sebastian Berisha (Hyperspectral Analysis, Convolutional Neural Networks)

Ph.D. Committee Chair (7)

Pavel Govyadinov, Rupali Mankar, Leila Saadatifard, Shihao Ran, Jiabing Li, Mahsa Lotfollahi, Jiaming Guo

M.S. Committee Chair (2 graduated)

Daver Daeinejad (2017), Srijaani Mukherjee (2017)

PEER-REVIEWED JOURNAL PUBLICATIONS	[1]	Feng Lin, Guang Yang, Chao Niu, Yanan Wang, Zhuan Zhu, Haokun Luo, Chong Dai, Yandi Hu, Xufeng Zhou, Zhaoping Liu, Jonathan Hu, Zhiming Wang, **David Mayerich**, Jiming Bao, "Planar Alignment of Graphene Sheets by a Rotating Magnetic Field for Full Exploitation of Graphene as a 2D Material," *Advanced Functional Materials*, in press.
	[2]	**Jiaming Guo**, Keely A. Keller, **Pavel Govyadinov**, Paul Ruchhoeft, John. H. Slater, and **David Mayerich**, "Accurate flow in augmented networks (AFAN): An approach to generating three-dimensional biomimetic microfluidic networks with controlled flow," *Analytical Methods*, in press.

[3]   Hengyang Lu, **Jiabing Li**, Melisa Martinez Paniagua, Irfan Bandey, Amit Amritkar, Harjeet Singh, **David Mayerich**, Navin Varadarajan, Badrinath Roysam, "TIMING 2.0: High-throughput single-cell profiling of dynamic cell-cell interactions by time-lapse imaging microscopy in nanowell gids," *Bioinformatics*, in press.

[4]   **Pavel Govyadinov**, Tasha Womack, Jason Eriksen, Guoning Chen, **David Mayerich**, "Robust Tracing and Visualization of Heterogeneous Microvascular Networks," *IEEE Transactions on Visualization and Computer Graphics* (accepted, 2018)

[5]   **Leila Saadatifard**, Louise C. Abbott, Laura Montier, Jokubas Ziburkus, **David Mayerich**, "Robust Cell Detection for Large-Scale 3D Microscopy Using GPU-Accelerated Iterative Voting," *Frontiers in Neuroanatomy*, 12:28 (2018)

[6]   **Shihao Ran**, **Sebastian Berisha**, **Rupali Mankar**, Wei-Chuan Shih, **David Mayerich**, "Mitigating Fringing in Discrete Frequency Infrared Imaging Using Time-Delayed Integration," *Biomedical Optics Express*, 9(2): 832-843, February 2018

[7]   **Rupali Mankar**, Michael Walsh, Rohit Bhargava, Saurabh Prasad, and **David Mayerich**, "Selecting optimal features from Fourier transform infrared spectroscopy for discrete-frequency imaging," *Analyst*, 143:1147-1156, 2018

[8]   **Camille Artur**, Tasha Womack, Fusheng Zhao, Jason Eriksen, **David Mayerich**, and Wei-Chuan Shih, "Plasmonic nanoparticle-based expansion microscopy with surface-enhanced Raman and dark-field spectroscopic imaging," *Biomedical Optics Express*, 9(2): 603-615, 2018

[9]   Chen Wu, Henry Le, **Shihao Ran**, Manmohan Singh, Irina V. Larina, **David Mayerich**, Mary E. Dickinson, Kirill V. Larin, "Comparison and combination of rotational imaging optical coherence tomography and selective plane illumination microscopy for embryonic study," *Biomedical Optics Express*, 8(10): 4629-4639, 2017

[10] **Sebastian Berisha**, Thomas van Dijk, Rohit Bhargava, P. Scott Carney, **David Mayerich** "BIM-Sim: Interactive Simulation of Broadband Imaging Using Mie Theory," *Frontiers in Physics: Optics and Biophotonics*, 5 (January 2017)

[11] **Sebastian Berisha, Shengyuan C., Sam Saki, Davar Daeinejad, Ziqi He, Rupali Mankar, David Mayerich** "SIproc: an open-source biomedical data processing platform for large hyperspectral images," *Analyst*, 142(8):1350-1357 (April 2017)

[12] Keely Heintz, **David Mayerich**, John Slater, "Image-Guided, Laser-Based Fabrication of Vascular-Derived Microfluidic Networks," *Journal of Visualized Experiments* (119), e55101 (January 2017)

[13] Bradley Deutsch, Rohith Reddy, **David Mayerich**, R. Bhargava, Carney, P.S., "Compositional prior information in computed infrared spectroscopic imaging," *Journal of the Optical Society of America A*, 32(6): 1126-1131 (June 2015)

[14] L. Suzanne Leslie, Tomas Wrobel, **David Mayerich**, Bindra, S., Emmadi, R., Rohit Bhargava, "High Definition Infrared Spectroscopic Imaging for Lymph Node Histopathology," *PloS ONE* (June 2015)

[15] **David Mayerich,** Michael Walsh, Andre Kadjacsy-Balla, Partha Ray, Stephen Hewitt, Rohit Bhargava, "Stain-less Staining for Computed Histopathology," *Technology*, 3(1): 27-31 (March 2015)

[16] **David Mayerich**, Thomas van Dijk, Michael Walsh, Matthew Schulmerich, P. Scott Carney, Rohit Bhargava, "On the importance of image formation optics in the design of infrared spectroscopic imaging systems," *The Analyst*, 139, 16, 4031–4036 (Aug. 2014)

[17] Thomas van Dijk, **David Mayerich**, Rohit Bhargava, and P. Scott Carney, "Rapid spectral-domain localization," *Optics Express*, 21, 10, 12822–12830 (May 2013)

[18] Thomas van Dijk, **David Mayerich**, P. Scott Carney, Rohit Bhargava, "Recovery of absorption spectra from Fourier transform infrared (FT-IR) microspectroscopic measurements of intact spheres," *Applied Spectroscopy*, 67, 5, 546–552 (May 2013)

[19] **David Mayerich**, Michael Walsh, Matthew Schulmerich, Rohit Bhargava, "Real-time interactive data mining for chemical imaging information: application to automated histopathology," *BMC bioinformatics*, 14, 156 (2013)

[20] **David Mayerich**, Christopher Bjornsson, Jonathan Taylor, and Badrinath Roysam, "NetMets: software for quantifying and visualizing errors in biological network segmentation," *BMC bioinformatics*, 13 Suppl 8, S7 (2012)
- Appeared in IEEE Symposium on Biomedical Data Visualization (BioVis 2012)

[21] Ji Ryang Chung, Chul Sung, **David Mayerich**, Jaerock Kwon, Daniel E. Miller, Todd Huffman, John Keyser, Louise C. Abbott, Yoonsuck Choe, "Multiscale Exploration of Mouse Brain Microstructures Using the Knife-Edge Scanning Microscope Brain Atlas," *Frontiers in Neuroinformatics*, 5 (Nov. 2011)

[22] **David Mayerich**, Jaerock Kwon, Chul Sung, Louise C. Abbott, John Keyser, Yoonsuck Choe, "Fast macro-scale transmission imaging of microvascular networks using KESM," *Biomedical Optics Express*, 2, 1, 2888–2896 (Oct. 2011)

[23] Ji Ryang Chung, Chul Sung, **David Mayerich**, Jaerock Kwon, Daniel Miller, Todd Huffman, John Keyser, Louise C. Abbott, Yoonsuck Choe, "Multiscale exploration of mouse brain microstructures using the knife-edge scanning microscope brain atlas," *Frontiers in Neuroinformatics*, 5, 29 (2011)

[24] Yoonsuck Choe, **David Mayerich**, Jaerock Kwon, D.E. Miller, Chul Sung, Ji Ryang Chung, T. Huffman, John Keyser, and Louise C. Abbott, "Specimen preparation, imaging, and analysis protocols for knife-edge scanning microscopy," *Journal of Visualized Experiments: JoVE*. 58 (2011)

[25] **David Mayerich**, and John Keyser, "Hardware Accelerated Segmentation of Complex Volumetric Filament Networks," IEEE Transactions on Visualization and Computer Graphics, 15(4):670–681 (July 2009)

[26] **David Mayerich**, Louise C. Abbott, Bruce H. McCormick, "Knife-Edge Scanning Microscopy for Imaging and Reconstruction of Three-Dimensional Anatomical Structures of the Mouse Brain," *Journal of Microscopy*, 231(1): 134-143 (July 2008) (cover image)

[27] **David Mayerich**, Louise C. Abbott, John Keyser, "Visualization of Cellular and Microvascular Relationships," *IEEE Transactions on Visualization and Computer Graphics*, 14(6): 1611-1618, (Dec. 2008)
- Appeared in Proceedings of IEEE Visualization

[28] Zeki Melek, **David Mayerich**, Cem Yuksel, John Keyser, "Visualization of Fibrous and Thread-Like Data," *IEEE Transactions on Visualization and Computer Graphics*, 12(5): 1165-1172 (Oct. 2006)
- Appeared in Proceedings of IEEE Visualization

[29] Bruce H. McCormick, W. Koh, Yoonsuck Choe, Louise C. Abbott, **David Mayerich**, Zeki Melek, P. Doddapaneni, "Construction of Anatomically Correct Models of Mouse Brain Networks," *Neurocomputing*, 58-60: 670-681 (June 2004)

PEER-REVIEWED CONFERENCE PUBLICATIONS

[1] **David Mayerich,** John C. Hart, "Volume Visualization of Serial Electron Microscopy Images Using Local Variance," *IEEE Symposium on Biological Data Visualization (BioVis 2013)*, pp. 9-16 (Oct. 2012)

[2] Rohith Reddy, **David Mayerich,** Michael Walsh, M. Schulmerich, P. Scott Carney, R. Bhargava, "Optimizing the Design of FT-IR Spectroscopic Imaging Instruments to Obtain Increased Spatial Resolution of Chemical Species," *IEEE International Symposium on Biomedical Imaging (ISBI 2012)* (May 2012)

[3] Rohith Reddy, **David Mayerich,** Michael Walsh, P. Scott Carney, R. Bhargava, "Rigorous Electromagnetic Model of FT-IR Spectroscopic Imaging Applied to Automated Histology of Prostate Tissue Specimens," *International Conference on Optics, Lasers and Spectroscopy (ICOLS 2012)* (March 2012)

[4] **David Mayerich,** Christopher Bjornsson, J. Taylor, Badrinath Roysam "Metrics for Comparing Explicit Representations of Interconnected Biological Networks," *IEEE Symposium on Biological Data Visualization (BioVis)*, pp. 79-86 (Oct. 2011)

[5] Yoonsuck Choe, **David Mayerich,** Jaerock Kwon, Daniel Miller, Ji Ryang Chung, Chul Sung, John Keyser, Louise C. Abbott "Knife-Edge Scanning Microscopy for Connectomics Research," *IEEE*

World Congress on Computational Intelligence: International Joint Conference on Neural Networks (IJCNN 2011) (July 2012)

[6] **David Mayerich,** Jaerock Kwon, A. Panchal, John Keyser, Yoonsuck Choe, "Fast Cell Detection in High-Throughput Imagery Using GPU-Accelerated Machine Learning," *IEEE International Symposium on Biomedical Imaging (ISBI 2011)*, pp. 719-723 (March 2011)

[7] Jaerock Kwon, **David Mayerich,** Choe, Y, "Automated Cropping and Artifact Removal for Knife-Edge Scanning Microscopy," *IEEE International Symposium on Biomedical Imaging (ISBI 2011)*, pp. 1366-1369 (March 2011)

[8] **David Mayerich,** Jaerock Kwon, Yoonsuck Choe, Louise C. Abbott, John Keyser, "Constructing High-Resolution Microvascular Models," *Microscopic Image Analysis with Applications in Biology (MIAAB 2008)* (Sep. 2008)
- Images appeared in "Portraits of the Mind: Visualizing the Brain from Antiquity to the 21st Century," C. Schoonover (ed.), 2010

[9] Jaerock Kwon, **David Mayerich,** Yoonsuck Choe, Bruce H. McCormick "Automated Lateral Sectioning for Knife-Edge Scanning Microscopy," *IEEE International Symposium on Biomedical Imaging (ISBI 2008)*, pp. 1371-1374 (May 2008)

[10] **David Mayerich,** Bruce H. McCormick, John Keyser, "Noise and Artifact Removal in Knife-Edge Scanning Microscopy," *IEEE International Symposium on Biomedical Imaging (ISBI 2007)*, pp. 556-559 (April 2007)

REFEREED SHORT PAPERS AND LETTERS

[1] **David Mayerich,** Michael Walsh, R. Bhargava, "Designing Transfer Functions for Exploring Hyperspectral Images," *Proceedings of IEEE Visualization (Vis 2011)*

[2] **David Mayerich,** Yoonsuck Choe, John Keyser, Jaerock Kwon, Louise C. Abbott "Comparing the MOST Technique to KESM," *Science E-Letters* (2011)

[3] **David Mayerich,** John Keyser, "GPU-based Dynamic Tubular Grids for Sparse Volume Rendering," *Proceedings of IEEE Visualization (Vis 2010)* (2010)

[4] Yoonsuck Choe, Louise C. Abbott, G. Ponte, John Keyser, Jaerock Kwon, **David Mayerich,** Daniel Miller, D. Han, A. Grimaldi, G. Fiorito, D. Edelman, J. McKinstry, "Charting Out the Octopus Connectome at Submicron Resolution Using the Knife-Edge Scanning Microscope," *BMC Neuroscience*, 11(Suppl 1):P136 (2010)

[5] **David Mayerich,** John Keyser, "Filament Tracking and Encoding for Complex Biological Networks," *Proceedings of the ACM Symposium on Solid and Physical Modeling* (2008)

[6] Bruce H. McCormick, P. Doddapaneni, **David Mayerich,** Zeki Melek, John Keyser, "Compression, Segmentation, and Modeling of Large-Scale Filamentary Volumetric Data," *Proceedings of IEEE Visualization* (2004)

BOOK CHAPTERS

[1] J. Dieter, and J. Ranu, editors. Encyclopedia of Computational Neuroscience (2014)
- **David Mayerich,** Yoonsuck Choe, John Keyser, "Reconstruction, Techniques, and Validation"
- Yoonsuck Choe, Jaerock Kwon,, **David Mayerich,** Louise C. Abbott "Connectome, mouse"

[2] Yoonsuck Choe, Louise C. Abbott, D. Han, P. Huang, John Keyser, Jaerock Kwon,, **David Mayerich,** Zeki Melek, Bruce H. McCormick, "Knife-Edge Scanning Microscopy: High-Throughput Imaging and Analysis of Massive Volumes of Biological Microstructures," *High-Throughput Image Reconstruction and Analysis: Intelligent Microscopy Applications*, Series on Bioinformatics and Biomedical Imaging, Artech House Publishers, pp. 11-34 (Jan. 2009)

PATENTS

[1] Jason Eriksen, **David Mayerich.** US Patent Application 62/464,524, "Surface Ablation Lathe Tomography (SALT) Systems and Methods for Whole Organ Phenotyping," (February 2017)

[2] R. Bhargava, P. Scott Carney, **David Mayerich,** Thomas van Dijk. US Patent Application 61/829,252, "Infrared Microspectroscopy for Intact Spheres," (November 2012)

[3] Thomas van Dijk, **David Mayerich,** R. Bhargava, P. Scott Carney. US Patent Application 2895/168, "Coherent Optical Mapping of Particles," (November 2012)

Whole Organ Labeling and Embedding in Machinable Hydrogels   **2018-2019**
PI: *David Mayerich*, Jason Eriksen
Source: BRAIN Center
Total: $45,000

NLM Bioinformatics Training Program – Optical Coherence Micro-Elastography for   **2018-2020**
Colorectal Cancer Assessment
PI: Manmohan Singh
Advisors: Kirill Larin (primary), *David Mayerich*, Manoop Bhutani
Source: National Institutes of Health (NIH), National Library of Medicine (NLM)
Total: $50,000

NLM Bioinformatics Training Program – Identifying predictive molecular markers in   **2018-2020**
ovarian tumors using infrared histology
PI: Sebastian Berisha
Advisors: *David Mayerich* (primary), Anil Sood
Source: National Institutes of Health (NIH), National Library of Medicine (NLM)
Total: $50,000

REU SITE: Neurotechnologies to Help the Body Move, Heal, and Feel Again   **2018-2021**
PI: Jose Contreras-Vidal, Co-I: Stuart Long, John Wolfe, Charles Layne, George
Zouridakis, Luca Pollonini, Saurabh Prasad, Yingchun Zhang, Cunjiang Yu, Aaron Becker,
David Mayerich, Rose Faghih
Source: National Science Foundation (NSF)

Serial Ablation Lathe Tomography (SALT)   **2018-2019**
PI: *David Mayerich*
Source: University of Houston Division of Research
Total: $60,000

High-Throughput Multiplex Using Block-Face UV and Raman Imaging   **2017-2018**
PI: *David Mayerich*
Source: BRAIN Center
Total: $45,000

Reconstructing high-resolution infrared spectroscopic images from high-speed multi-   **2017-2018**
modal microscopes
PI: David Mayerich, Zhu Han
Source: SeFAC (Seed Funding for Advanced Computing) UH Division of Research
Total: $32,552

A Vascularized, In Vitro, Organotropic Metastasis Model to Generate Dormant   **2017-2018**
Micrometastases
PI: John Slater, Co-I: *David Mayerich*
Source: National Institutes of Health / National Library of Medicine (Federal)
Total: $27,000

BRAIN: Building Reliable Advances and Innovation in Neurotechnology Center   **2016-2021**
PI: Jose Contreras-Vidal, Co-PI: *David Mayerich* and Ahmet Omurtag
Source: National Science Foundation (Federal)
Total: $750,000 ($150k/year)

Agilent University Relations Grant   **2016-2017**

PI: *David Mayerich*
Total: $46,500
Source: Agilent Technologies (Industrial)

Planning Grant: Collaborative Research: I/UCRC for Building Reliable Advances and Innovation in Neurotechnology (BRAIN)   **2015-2016**
National Science Foundation (NSF)
PI: Jose Contreras-Vidal, Ahmet Omurtag, *David Mayerich*, Ji Chen
Total: $11,500

                                                                              2014-2017
Large-Scale reconstruction of microvascular networks and the surrounding cellular geometry
PI: *David Mayerich*
Source: NIH/National Library of Medicine (Federal)
Total: $750,000

                                                                              2014-2018
High-throughput instrumentation and analysis for whole-tumor phenotyping
PI: *David Mayerich*
Source: Cancer Prevention and Research Institute of Texas (State)
Total: $2M ($500k/year for 4 years)

PROFESSIONAL DEVELOPMENT

Legal Issues in Higher Education Workshop (1/15/2015); Faculty Senate Assistant Professor Forum (1/22/2015); Cullen College of Engineering CAREER Workshop (1/30/2015)