

DAVID MAYERICH

Beckman Institute for Advanced Science and Technology
University of Illinois, Urbana-Champaign
405 North Matthews Avenue, Urbana, IL 61801 | 979-255-1571 | mayerich@illinois.edu | www.davidmayerich.net

RESEARCH INTERESTS

My research focuses on the development of high-throughput optical microscopy and spectroscopy techniques, high-performance and GPU-based computing, and the segmentation and visualization of large biomedical data sets.

EDUCATION

Ph.D. in Computer Science 2009

Texas A&M University, College Station, TX
Dissertation: "Imaging and Computational Methods for Exploring Sub-Cellular Anatomy"
Advisors: John Keyser, Bruce McCormick
Committee: Yoonsuck Choe, Louise Abbott, and Donald House

M.S. in Computer Science 2003

Texas A&M University, College Station, TX
Thesis: "Acquisition and Reconstruction of Brain Tissue Using Knife-Edge Scanning Microscopy"
Advisor: John Keyser
Committee: Andreas Klappenecker and Ergun Akleman

B.S. in Computer Science 2000

Southwestern Oklahoma State University, Weatherford, OK (*Cum Laude*)

PROFESSIONAL EXPERIENCE

Beckman Institute, University of Illinois at Urbana-Champaign
Postdoctoral Fellow 2009 – Present

Brain Networks Laboratory, Texas A&M University
Research Assistant 2004 – 2009

Swiki Anderson and Associates / Accu*Air
Research and Software Development 2002 – 2004

TEACHING EXPERIENCE

Graduate Teaching Academy Fellow (2008)

Student Research Mentor

- Max Sigalov and Edo Roth, University of Illinois I-STEM Education Initiative (2011)
- Aleksander Bapst, University of Illinois, Undergraduate Researcher – Digital Staining Software (2011)
- Kasra Manavi, University of New Mexico, Research Experience for Undergraduates (2008)
- Gabriel Dzodom, University of Virginia, Research Experience for Undergraduates (2007)
- Colby Stevens, Texas A&M University, Research Experience for Undergraduates (2003)

Teaching Assistant

- Computer Graphics (2004-2005)
- C++ Programming (2004)
- Java Programming (2000)

REFEREED PUBLICATIONS

“NetMets: Quantifying and Visualizing Errors in Biological Network Segmentation”

D. Mayerich, C. Bjornsson, J. Taylor, B. Roysam, *BMC Bioinformatics* (accepted)

- Special issue on *Highlights from BioVis 2011* (extended paper)

“Optimizing the Design of FT-IR Spectroscopic Imaging Instruments to Obtain Increased Spatial Resolution of Chemical Species”

R. Reddy, D. Mayerich, M. Walsh, R. Bhargava, *IEEE International Symposium on Biomedical Imaging*, 2012 (accepted)

“Rigorous Electromagnetic Model of FT-IR Spectroscopic Imaging Applied to Automated Histology of Prostate Tissue Specimens”

R. Reddy, D. Mayerich, M. Walsh, P.S. Carney, R. Bhargava, *International Conference on Optics, Lasers and Spectroscopy*, 2012 (accepted)

“Specimen Preparation, Imaging, and Analysis Protocols for Knife-Edge Scanning Microscopy”

Y. Choe, D. Mayerich, J. Kwon, D. Miller, C. Sung, J.R. Chung, T. Huffman, J. Keyser, L.C. Abbott, *Journal of Visualized Experiments* (58), Dec. 2011

“Metrics for Comparing Explicit Representations of Interconnected Biological Networks”

D. Mayerich, C. Bjornsson, J. Taylor, B. Roysam, *IEEE Symposium on Biological Data Visualization (BioVis)*, pp. 79-86, Oct. 2011

“Fast Macro-Scale Transmission Imaging of Microvascular Networks Using KESM”

D. Mayerich, J. Kwon, C. Sung, L. Abbott, J. Keyser, Y. Choe, *Biomedical Optics Express*, 2(10): 2888-2896, Oct. 2011

- Featured in *Research Highlights from Biomedical Optics Express, Oct. 2011 (1 of 3 papers)*

“Multiscale Exploration of Mouse Brain Microstructures Using the Knife-Edge Scanning Microscope Brain Atlas”

J.R. Chung, C. Sung, D. Mayerich, J. Kwon, D. Miller, T. Huffman, J. Keyser, L. Abbott, Y. Choe, *Frontiers in Neuroinformatics*, 5:29, Nov. 2011

- Special Issue on *Mapping the Connectome: Multi-Level Analysis of Brain Connectivity*

“Knife-Edge Scanning Microscopy for Connectomics Research”

Y. Choe, D. Mayerich, J. Kwon, D. Miller, J.R. Chung, C. Sung, J. Keyser, L.C. Abbott, *IEEE World Congress on Computational Intelligence: International Joint Conference on Neural Networks (IJCNN)*, July 2011

“Fast Cell Detection in High-Throughput Imagery Using GPU-Accelerated Machine Learning”

D. Mayerich, J. Kwon, A. Panchal, J. Keyser, Y. Choe, *IEEE International Symposium on Biomedical Imaging (ISBI)*, pp. 719-723, Mar. 2011

“Automated Cropping and Artifact Removal for Knife-Edge Scanning Microscopy”

J. Kwon, D. Mayerich, Y. Choe, *IEEE International Symposium on Biomedical Imaging (ISBI)*, pp. 1366-1369, Mar. 2011

“Hardware Accelerated Segmentation of Complex Volumetric Filament Networks”

D. Mayerich, J. Keyser, *IEEE Transactions on Visualization and Computer Graphics*, 15(4): 670-681, Jul.-Aug. 2009

“Knife-Edge Scanning Microscopy for Imaging and Reconstruction of Three-Dimensional Anatomical Structures of the Mouse Brain”

D. Mayerich, L.C. Abbott, B.H. McCormick, *Journal of Microscopy*, 231(1): 134-143, Jul. 2008 (Cover Image)

“Visualization of Cellular and Microvascular Relationships”

D. Mayerich, L.C. Abbott, J. Keyser, *IEEE Transactions on Visualization and Computer Graphics*, 14(6): 1611-1618, Nov.-Dec. 2008

- Appeared in *Proceedings of IEEE Visualization (VIS)*, 2008

“Constructing High-Resolution Microvascular Models”

D. Mayerich, J. Kwon, Y. Choe, L.C. Abbott, J. Keyser, *Microscopic Image Analysis with Applications in Biology (MIAAB)*, Sept. 2008

- Images appeared in *Portraits of the Mind: Visualizing the Brain from Antiquity to the 21st Century*, C. Schoonover (ed.), 2010

“Automated Lateral Sectioning for Knife-Edge Scanning Microscopy”

J. Kwon, D. Mayerich, Y. Choe, B.H. McCormick, *IEEE International Symposium on Biomedical Imaging (ISBI)*, pp. 1371-1374, May 2008

“Noise and Artifact Removal in Knife-Edge Scanning Microscopy”

D. Mayerich, B.H. McCormick, J. Keyser, *IEEE International Symposium on Biomedical Imaging (ISBI)*, pp. 556-559, Apr. 2007

“Visualization of Fibrous and Thread-Like Data”

Z. Melek, D. Mayerich, C. Yuksel, J. Keyser, *IEEE Transactions on Visualization and Computer Graphics*, 12(5): 1165-1172, Sept.-Oct. 2006

- Appeared in *Proceedings of IEEE Visualization (IEEE VIS)*, 2006

“Construction of Anatomically Correct Models of Mouse Brain Networks”

B.H. McCormick, W. Koh, Y. Choe, L.C. Abbott, J. Keyser, D. Mayerich, Z. Melek, P. Doddapaneni, *Neurocomputing*, 58-60: 670-681, Jun. 2004

REFEREED SHORT PAPERS AND LETTERS

“Designing Transfer Functions for Exploring Hyperspectral Images”

D. Mayerich, M. Walsh, R. Bhargava, *Proceedings of IEEE Visualization*, 2011

“Comparing the MOST Technique to KESM”

D. Mayerich, Y. Choe, J. Keyser, J. Kwon, L. Abbott, *Science E-Letters*, 2011

“GPU-based Dynamic Tubular Grids for Sparse Volume Rendering”

D. Mayerich, J. Keyser, *Proceedings of IEEE Visualization*, 2010

“Charting Out the Octopus Connectome at Submicron Resolution Using the Knife-Edge Scanning Microscope”

Y. Choe, L. Abbott, G. Ponte, J. Keyser, J. Kwon, D. Mayerich, D. Miller, D. Han, A. Grimaldi, G. Fiorito, D. Edelman, J. McKinstry, *BMC Neuroscience* 2010, 11(Suppl 1):P136

- Appeared in *Proceedings of the 19th Annual Computational Neuroscience Meeting (CNS*2010)*

“Filament Tracking and Encoding for Complex Biological Networks”

D. Mayerich, John Keyser, *Proceedings of the ACM Symposium on Solid and Physical Modeling*, 2008

“Compression, Segmentation, and Modeling of Large-Scale Filamentary Volumetric Data”

B.H. McCormick, P. Doddapaneni, D. Mayerich, Z. Melek, J. Keyser, *Proceedings of IEEE Visualization*, 2004

BOOK CHAPTERS

“Knife-Edge Scanning Microscopy: High-Throughput Imaging and Analysis of Massive Volumes of Biological Microstructures”

Y. Choe, L.C. Abbott, D. Han, P. Huang, J. Keyser, J. Kwon, D. Mayerich, Z. Melek, B.H. McCormick, *High-Throughput Image Reconstruction and Analysis: Intelligent Microscopy Applications*, Series on Bioinformatics and Biomedical Imaging, Artech House Publishers, pp. 11-34, Jan. 2009

TECHNICAL REPORTS

“Knife-Edge Scanning Microscope Using an Ultra-Precision 3-Axis CNC Diamond Turning Lathe”, Texas A&M University, 2005

B.H. McCormick, M. Wiercigroch, D. Mayerich

“Brain Tissue Scanner: User Interface”, Texas A&M University, 2003

C.B. Stephens, D. Mayerich

INVITED TALKS

“Processing and Visualization Methods for High-Throughput Biomedical Imaging”

Beckman Institute Director’s Seminar, May 2012 (invited)

“Infrared Spectroscopic Imaging of Human Cells and Tissue”

M. Walsh, D. Mayerich, A. Kajdacsy-Balla, R. Bhargava, *Microscopic Image Analysis with Applications in Biology Workshop, ACM Conference on Bioinformatics, Computational Biology and Biomedicine*, August 2011

“GPU-based Segmentation and Visualization of High-Throughput Microscopy Datasets”

D. Mayerich, Y. Choe, J. Keyser, *Workshop on High-Throughput 3D Microscopy and High-Performance Computing for Multi-Scale Modeling and Simulation of Large-Scale Neuronal Circuits, Computational Neuroscience (CNS*2010)*, July 2010

“High-Throughput Imaging of the Whole Mouse Brain Using Knife-Edge Scanning Microscopy”

L.C. Abbott, D. Mayerich, J. Kwon, Y. Choe, *Workshop on High-Throughput 3D Microscopy and High-Performance Computing for Multi-Scale Modeling and Simulation of Large-Scale Neuronal Circuits, Computational Neuroscience (CNS*2010)*, July 2010

“A Short Course on Interactive Graphics”
Computer Science Department Seminar, Southwestern Oklahoma State University, Jan. 2008

“Imaging, Modeling, and Visualization of Tissue Microstructure”
Ph.D. Colloquium, IEEE Visualization (VIS 2008), Oct. 2008

“Acquisition and Reconstruction in Large Scale Volume Microscopy”
Ph.D. Colloquium, National Science Foundation Symposium on Cyber-Enabled Development and Innovation, 2007
(Nominated by Texas A&M and Invited by NSF)

“Nanomachining for High-Resolution Scanning of Mammalian Brain Microstructure”
B.H. McCormick, D. Mayerich, M. Wiercigroch
11th International Conference on Fracture, 2005

RECENT CONFERENCE ABSTRACTS (2010 – PRESENT)

“Knife-Edge Scanning Microscope Brain Atlas: A Submicrometer-Resolution Web-Based Mouse Brain Atlas”
C. Sung, D. Mayerich, J. Kwon, D. Miller, T. Huffman, J. Keyser, L. Abbott, Y. Choe, *Society for Neuroscience*, Nov. 2011

“Mid-Infrared Spectroscopic Imaging for Breast Tissue Diagnosis”
M. Walsh, D. Mayerich, R. Bhargava, *Federation of Analytical Chemistry and Spectroscopy Societies (FACSS)*, Oct. 2011

“Developing Chemical Imaging for Single Molecule to Massively Multiplexed Molecular Sensing in Pathology”
R. Bhargava, M. Walsh, A. Kodali, D. Mayerich, A. Kajdacsy-Balla, *Federation of Analytical Chemistry and Spectroscopy Societies (FACSS)*, Oct. 2011

“Mid-Infrared Spectroscopic Imaging for Tissue Histopathology”
M. Walsh, D. Mayerich, A. Kajdacsy-Balla, R. Bhargava, *Sixth International Conference on Advanced Vibrational Spectroscopy (ICAVS-6)*, 2011

“Automated Cropping and Artifact Removal for Knife-Edge Scanning Microscopy”
J. Kwon, D. Mayerich, Y. Choe, *Society for Neuroscience*, 2010

“Multiscale Imaging, Analysis, and Integration of Mouse Brain Networks”
Y. Choe, L. Abbott, J. Keyser, D. Miller, D. Han, H. Yang, J. Chung, C. Sung, D. Mayerich, J. Kwon, K. Micheva, S. Smith, *Society for Neuroscience*, 2010

“Mid-IR Imaging for the Identification of Cells and Mucin in the Gastrointestinal Tract”
M. Walsh, J. Ip, D. Mayerich, J. Croix, A. Benefiel-Kunkel, R. Gaskins, R. Bhargava, *Federation of Analytical Chemistry and Spectroscopy Societies*, 2010

Mid-Infrared Imaging as a Label-Free Alternative to Immunohistochemistry for Breast Pathology”
M. Walsh, D. Mayerich, N. Pounder, E. Wiley, A. Kajdacsy-Balla, R. Bhargava, *Federation of Analytical Chemistry and Spectroscopy Societies*, 2010

AWARDS

Teaching Excellence Award (*awarded to one TA per year*) **2004**

Funding

Beckman Institute Fellowship, 52k yearly stipend and 25k for independent research **2009-2012**

Graduate Assistance in Areas of National Need (GAANN) Fellowship, 20k yearly stipend **2006-2007**

Funding (pending)

“Large-Scale Reconstruction of Microvascular Networks”, NIH K99/R00 (submitted 10-2011) **2012-2016**

Travel Grants

Stony Brook Modeling Week Student Travel Grant, Stony Brook, NY **2008**

ISBI Student Travel Grant, Paris, France (*supported by NSF*) **2008**

Faculty of Neuroscience Travel Grant, Society for Neuroscience, San Diego, CA **2007**

MEMBERSHIPS

Institute for Electrical and Electronics Engineers (IEEE)
Society for Neuroscience (SfN)
Association for Computing Machinery (ACM)

SERVICE AND ACTIVITIES

Organizer, Beckman Graduate Seminar (2011-2012)
Wellcome Trust Scientific Reviewer (2011)
Grant 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, Texas A&M University (2005)
Paper Reviews

- Applied Spectroscopy
- Computers & Graphics
- IEEE Transactions on Biomedical Engineering
- IEEE Transactions on Visualization and Computer Graphics
- IEEE Visualization
- International Joint Conference on Neural Networks
- Journal of the American Society for Mass Spectrometry
- Medical Image Analysis
- Theoretical Chemistry Accounts

SCIENTIFIC SOFTWARE

(available at www.davidmayerich.net/software)

Hyperspectral Transfer Functions (2011): This software allows interactive processing of data to (a) decouple structural and chemical characteristics of hyperspectral images and (b) design transfer functions for visualizing hyperspectral data.

KESM Brain Atlas (2011): This online atlas (kesm.cs.tamu.edu) combines the Google Maps API with novel visualization methods for the dissemination of terabyte-scale 3D data sets imaged using KESM.

Explicit Network Connectivity Metrics (NetMets) (2011): This software package allows users to compare the geometry and connectivity of interconnected networks represented as SWC and OBJ files.

KESM Optics Simulator (2011): This GPU-based software package performs interactive geometric simulation of the unique optics used in KESM. The application is designed to aid in diamond knife fabrication and optimization of KESM imaging systems.

KESM Stack Processor (2010): Software for performing fast out-of-core processing and re-lighting for KESM image stacks.