Sudhir K. Pathak

Machine Learning Scientist · Computational Mathematician · Bio-imaging Scientist

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Education and Experience

Learning Research and Development Center, University of Pittsburgh — *Pittsburgh, PA*

Research Associate — *May 2015 - Current*

- Research Topic: Supervised Deep-learning based diffusion MRI modeling, Physics informed neural networks for Diffusion MRI, Validation of diffusion models based on hollow textile phantoms, Ex-vivo biological diffusion model pig visual system.
- Research Areas: Validation of diffusion models in biological tissues, Biomarkers for Traumatic Brain Injury, Diffusion MRI, Microstructural Imaging, Fiber tractography
- Project Director: Dr. Walter Schneider

Bioengineering Department, University of Pittsburgh — *Pittsburgh, PA*

Ph.D., Bioengineering — *May 2010 - December 2015*

- Thesis Topic: Improved Quantification of Connectivity in Human Brain Mapping
- Area of Study: Diffusion magnetic resonance imaging, and Validation of diffusion MRI-based models
- Committee: Dr. Walter Schneider, Dr. Peter Basser, Dr. George Stetten, Dr. Juan Miranda Fernandez, Dr. Howard Aizenstein, Dr. John Galeotti

Learning Research and Development Center, University of Pittsburgh — *Pittsburgh, PA*

System Programmer — *May 2006 - December 2010*

- Research Topic: Predicting brain state using functional MRI and developing diffusion MRI-based connectivity analysis.
- Research Areas: Functional and diffusion magnetic resonance imaging, resting-state based brain connectivity and fiber tractography
- Project Director: Dr. Walter Schneider

Department of Biomedical Engineering, Carnegie Mellon University — *Pittsburgh, PA*

M.S., Biomedical Engineering — *August 2004 - December 2006*

- Thesis Topic: Optimal Elastic Registration of Cardiac Images
- Area of Study: Medical image registration

Mathematics Department, Indian Institute of Technology Kanpur — *Kanpur, Uttar Pradesh, INDIA*

M.Sc. (Integrated) and B.S., Mathematics and Scientific Computing — *August 1999 - May 2004*

- Thesis Topic: Parallel Numerical Simulation of Cardiac Electrical Activity
- Area of Study: Electro-physiology of the human heart

IDEA Sequence Programming VE11, Pulse programming course — *North Carolina*

Siemens Healthineers Headquarters — *October 2019*

- Topic: Sequence incorporation and Program implementation, Sequence Simulation, Real Time Events, Image Calculation Environment

Expertise

Applied Mathematics	Physics informed neural networks, Parallel Numerical algorithms, Mathematical optimization, Numerical solutions for PDE/ODE, and Finite element method.
Computer Science	Graphics/Shader (web)-programming, Deep learning, Machine learning, Unsupervised clustering techniques, Multi-Variate Pattern Analysis(MVPA) on fMRI datasets.
Medical Imaging	Multi-model registration, 3D-Image segmentation on Brain tissue, Resting state fMRI connectivity, Diffusion MR Imaging, and Fiber tractography.
Neuroscience	Functional neuroanatomy, White matter anatomy, Cognitive neuroscience.
Neuroimaging Packages	Freesurfer, FSL, AFNI, ANTS, MRTRIX, MNE-python, Osirix.

Software Skills

Computer Programming	C, C++, Python, LaTeX, Bash shell scripting, and CMAKE.
Numerical Analysis	R, Tidyverse (dplyr/ggplot), ShinyApp and MATLAB
Python Package	PyTorch, MONAI, SciPy, NumPy, OpenCV, Pandas, Scikit-learn, and DiPy
Visualization Libraries/Software	D3.js, ITK, VTK(.js), Paraview, CUDA, OpenGL/ES, and WebGL
Parallel/Deep-Learning Computing Libraries	CuPy, Keras, PETSc, FeniCS, and MPI

Current Research Projects

High Definition Fiber Tracking (HDFT) and Diffusion Modeling

Learning Research and Development Center, University Of Pittsburgh

- Designed a novel mathematical diffusion model that combines diffusion spectrum imaging and Multi-shell imaging, and constrained spherical deconvolution technique.
- Combined and utilized diffusion MRI based tractography and klingler's dissection technique to map brain networks involved in language (Arcuate and SLF) and consciousness (Claustrum).
- Designed and optimized a full pipeline of diffusion MRI analysis to create anatomically valid tracks.
- Used HDFT pipeline implementation to optimize diffusion analysis for multi-band technique (reducing scanning time) across major MRI scanners (Siemens, GE, and Phillips).

July 2014 - PRESENT

Neuroanatomical Validation of HDFT

Learning Research and Development Center, University Of Pittsburgh and UPMC

- Developed a novel and anatomically related diffusion anisotropic metric, directional axonal volume (dAV), to quantify white matter tracts.
- Led a novel project to validate mathematical models of diffusion and related anisotropic metric using a hollow fiber-based textile phantom. First time textile phantom has been used to create restricted compartment for the clinical scanner.
- Designed analysis processes for combining diffusion MRI-based metrics across multiple sites and multiple scanners in US and Europe.

July 2010 - PRESENT

Clinical and Neuroscientific Application of HDFT

Learning Research and Development Center, University Of Pittsburgh and UPMC

- Formulated an algorithm for pre-surgical planning to provide and predict surgical routes that can minimize brain tissue damage during neuro-surgical procedures.
- Enhanced visualization of HDFT-based fiber tracks in real-time during neurosurgery.
- Designed and implemented code using IGSTK to interface neuro-navigation systems (BrainLAB and Stryker) to visualize HDFT-based fiber tracts.
- Developed voxewise and tract-based techniques using diffusion MRI-based anisotropic metric to track the progression of neurodegenerative diseases such as Huntington's disease and ALS.
- Identified and implemented tracts and voxelwise techniques that can relate HDFT-based structural connectivity and neuropsychological scores in stroke patients (Aphasia).
- Developed mathematical techniques (non-negative matrix factorization) and biophysical diffusion models to localize brain damage in traumatic brain injury (TBI).

July 2011 - PRESENT

Eye and Hand transplant project

Learning Research and Development Center, University Of Pittsburgh and UPMC

- Designed a diffusion MRI-based tractography method to localize of the peripheral nervous system (hand, face, and leg) for limb transplant.
- Developed diffusion protocol on 3T and 7T to image Median Nerve in the human hand.
- Enhanced diffusion MRI-based techniques that can resolve fiber crossing, and quantify white matter that relates to the amount of axons in the Optic nerve, Optic tract, and Optic radiation in an ex-vivo pig visual-system Brain on 7T Bruker Machine.

July 2015 - PRESENT

Clinical Application of Magnetoencephalography (MEG)

University of Pittsburgh Medical Center

- Systematized localization of eloquent cortices (motor, somatosensory, language, and visual) in patient population using the novel clinical pipeline.
- Designed a classification method based on resting state MEG data for the TBI patient population using network analysis.
- Combined HDFT-based structural connectivity and MEG based evoked and resting-state functional connectivity in normal human population. This data set can further be used for comparison of the TBI population.

July 2012 - PRESENT

Past Research Projects

fMRI based Functional Connectivity

Learning Research and Development Center, University Of Pittsburgh

July 2006 - May 2010

- Developed a novel method (Global Connectivity) to identify the most connected brain regions in the human brain using resting-state fMRI.
- Used machine learning-based (support vector machine) method to predict brain state using task-based fMRI.
- Systematized localization of eloquent cortices (motor, somatosensory, language, and visual) using task-based fMRI using various neuro-imaging packages (AFNI, FSL).

Simulation of Cardiac Electrophysiology and Registration of Cardiac MRI

Carnegie Mellon University and Indian Institute of Technology Kanpur

May 2002 - May 2004

- Simulated cardiac electrical activity using bi-domain reaction-diffusion PDF on the left ventricle of the human heart.
- Designed and implemented a three-dimensional finite element model of a system of partial differential equations on parallel distributed computers using PetSc (MPI) library.
- Formulated mathematical model for elastic registration of time-varying cardiac MR images to estimate tissue displacement.

Grants

DEVELOPMENT and NEUROSURGICAL APPLICATION OF HIGH DEFINITION FIBER TRACKING (HDFT)

Scheme for Promotion of Academic and Research Collaboration (SPARC)

2020

Principle Investigator

THALAMIC SEGMENTATION USING ADVANCED IMAGING

International Radiosurgery Research Foundation (IRRF)

2020

Co-Principle Investigator (PI: Dr. Ajay Niranjan)

QUALITATIVE AND QUANTITATIVE ANALYSIS OF THE STRUCTURE OF THE WHITE MATTER OF THE HUMAN BRAIN

The Walter L. Copeland Fund of the Pittsburgh Foundation Funding for Cranial Research

2011

Co-Principle Investigator (PI: Dr. Juan Miranda Fernandez)

HIGH DEFINITION FIBER TRACKING IN NEUROSURGERY

The Walter L. Copeland Fund of the Pittsburgh Foundation Funding for Cranial Research

2010

Co-Principle Investigator (PI: Dr. Juan Miranda Fernandez)

Patent

1. Anthony P Zuccolotto, John Dzikiy, Leroy K Basler, Benjamin A Rodack, Walter Schneider, and Sudhir K Pathak. Mri phantom having filaments of integral textile axon simulations and anisotropic homogeneity mri phantom using the filaments, June 21 2022. US Patent 11,366,192
2. Walter SCHNEIDER and Sudhir PATHAK. Directional diffusion fiber tracking, September 21 2012. WO Patent 2,012,125,829 A2
3. Anthony P Zuccolotto, John Dzikiy, Leroy K Basler, Benjamin A Rodack, Walter Schneider, Sudhir K Pathak, and Michael A Boss. Mri phantom including mri compatible temperature measurement device and pressure expansion bladder device, December 19 2019. US Patent App. 16/443,323

Teaching Experience

PSY 2575: Mapping Human Brain Connectivity — *University of Pittsburgh*

Co-Instructor — *Fall 2020/2019/2018, Spring 2017/2014, Spring 2012*

- Responsible for a lecture on the mathematics behind MRI, diffusion MRI.
- Lectures on image registration and advanced techniques to quantify white matter tissue in the human brain.

PSY 2476: Brain Connectivity Mapping — *University of Pittsburgh*

Teaching Assistant — *January 2009 to May 2009*

- Responsible for 2-hour lecture and supervision of 2-hour laboratory.
- Authored course material and lab sessions.

BME 42735: Medical Image Analysis — *Carnegie Mellon University*

Guest Lecturer — *April 2010, April 2012*

- Graduate-level course in medical imaging (Registration and Segmentation)
- Lecture: "Basic MRI, Diffusion MRI, Neuroanatomy, and Fiber Tracking."

Professional Activities and Awards

Editorial Board Member — *Claustrum*

Claustrum Journal. — *July 2015*

Editor's Choice award in Methods and Modeling — *Neuroimage*

Identifying brain most globally connected regions — *June 2010*

Best Project Award for M.Sc. thesis — *Mathematics Department, IIT Kanpur*

Simulation of electrophysiology of Heart — *May 2004*

University Scholarship — *IIT Kanpur*

Indian Institute of Technology, Kanpur. — *May 2002*

Regional Mathematical Olympiad Competition — *Delhi Association*

Qualified for a regional Mathematical Olympiad Competition conducted by the regional Delhi association — *March 1998*

Media and Special Reports

***Discover Magazine:* High Definition Fiber Tracking** — *Discover*

Broken Cables: High-definition imaging helps researchers map the damage from traumatic brain injury with unprecedented accuracy. — *September 2015*

***Discovery Channel:* High Definition Fiber Tracking** — *Discovery Channel*

Exploring High Definition Fiber Tracking: Physician Education, Neurology-Neurosurgery — *April 2013*

***Gehirn und Geist Magazine:* Corpus Callosum Rendering** — *Gehirn und Geist, Page 49*

Verbindungskabel in Kopf — *February 2013*

***Scientific American:* Corpus Callosum Rendering** — *Scientific American, Page 54-55*

The Mystery of the Missed Connection: A common but little understood malformation reveals the brain's incredible plasticity. — *February 2013*

***Neurosurgery Newsletter:* Special Report on High Definition Fiber Tractography** — *Neurosurgery Newsletter*

University of Pittsburgh Medical Center, Neurosurgery Newsletter, Volume 13, Number 1 — *December 2012*

- Juan C. Fernandez-Miranda, Sudhir Pathak, Walter Schneider, High Definition Fiber Tractography: Unraveling the connections of the human brain.
- Johnathan Engh, Sudhir Pathak, Juan C. Fernandez-Miranda, HDFT endoscopic port surgery synergistic in management of deep brain tumors.
- Arlan Mintz, Johnathan Engh Sudhir Pathak, Intra-operative use of HDFT with image guidance valuable in awake craniotomy for tumor resection.

***Scientific American:* High Definition Fiber Tracking rendering** — *Scientific American, Page 43*

HEAD SHOTS: Artistry abounds in these 10 maps of the human mind — *December 2011*

Refereed Journal Publications

1. Ranjeet Ranjan Jha, BV Rathish Kumar, Sudhir K Pathak, Arnav Bhavsar, and Aditya Nigam. Trganet: Transforming 3t to 7t dmri using trapezoidal rule and graph based attention modules. *Medical image analysis*, 87:102806
2. Ranjeet Ranjan Jha, BV Rathish Kumar, Sudhir KPathak, Walter Schneider, Arnav Bhavsar, and Aditya Nigam. Undersampled single-shell to msmt fodf reconstruction using cnn-based ode solver. *Computer Methods and Programs in Biomedicine*, 230:107339, 2023
3. Ranjeet Ranjan Jha, Sudhir K Pathak, Vishwesh Nath, Walter Schneider, BV Rathish Kumar, Arnav Bhavsar, and Aditya Nigam. Vrfrnet: Volumetric roi fodf reconstruction network for estimation of multi-tissue constrained spherical deconvolution with only single shell dmri. *Magnetic Resonance Imaging*, 90:1–16, 2022
4. Sourabh P Bhat, BV Rathish Kumar, Shainath Ramesh Kalamkar, Vinay Kumar, Sudhir Pathak, and Walter Schneider. Modeling and simulation of the potential indoor airborne transmission of sars-cov-2 virus through respiratory droplets. *Physics of Fluids*, 34(3):031909, 2022
5. Susie Y Huang, Thomas Witzel, Boris Keil, Alina Scholz, Mathias Davids, Peter Dietz, Elmar Rummert, Rebecca Ramb, John E Kirsch, Anastasia Yendiki, et al. Connectome 2.0: Developing the next-generation ultra-high gradient strength human mri scanner for bridging studies of the micro-, meso-and macro-connectome. *NeuroImage*, 243:118530, 2021
6. David O Okonkwo, Ross C Puffer, Davneet S Minhas, Sue R Beers, Kathryn L Edelman, Jane Sharpless, Charles M Laymon, Brian J Lopresti, Steven Benso, Ava M Puccio, et al. Pet imaging of neurodegeneration in two subjects with a history of repetitive trauma and cognitive decline. *Neurotrauma Editor's Pick 2021*, 2021
7. Vishwesh Nath, Karthik Ramadass, Kurt G Schilling, Colin B Hansen, Rutger Fick, Sudhir K Pathak, Adam W Anderson, and Bennett A Landman. Dw-mri microstructure model of models captured via single-shell bottleneck deep learning. In *Computational Diffusion MRI*, pages 147–157. Springer, Cham, 2021
8. Vishwesh Nath, Sudhir K Pathak, Kurt G Schilling, Walt Schneider, and Bennett A Landman. Deep learning estimation of multi-tissue constrained spherical deconvolution with limited single shell dw-mri. volume 11313, page 113130S. International Society for Optics and Photonics, 2020
9. Sandip Panesar, Vishwesh Nath, Sudhir Pathak, Walter Schneider, Bennett Landman, Michael Iv, Diana Anthony, Tatiana Jansen, Kumar Abhinav, and Juan Fernandez-Miranda. Deep learning improves pre-surgical white matter visualization in glioma patients. *medRxiv*, 2020
10. Kristofer Pomiecko, Carson Sestili, Kate Fissell, Sudhir Pathak, David Okonkwo, and Walter Schneider. 3d convolutional neural network segmentation of white matter tract masks from mr diffusion anisotropy maps. *2019 IEEE 16th International Symposium on Biomedical Imaging (ISBI 2019)*, pages 1–5, 2019
11. Ashley L Ware, Brian Biekman, Rebecca Hachey, Marianne MacLeod, William Bird, Sudhir Pathak, Emily Clarke, Allison Borrasso, Ava M Puccio, Kelly Glavin, et al. A preliminary high-definition fiber tracking study of the executive control network in blast-induced traumatic brain injury. *Journal of neurotrauma*, 36(5):686–701, 2019
12. David O Okonkwo, Ross C Puffer, Davneet S Minhas, Sue R Beers, Kathryn L Edelman, Jane M Sharpless, Charles M Laymon, Brian J Lopresti, Steven Benso, Ava M Puccio, et al. [18f] fdg,[11c] pib, and [18f] av-1451 pet imaging of neurodegeneration in two subjects with a history of repetitive trauma and cognitive decline. *Frontiers in neurology*, 10:831, 2019
13. Elisabeth A Wilde, James M Provenzale, Brian A Taylor, Michael Boss, Anthony Zuccolotto, Rebecca Hachey, Sudhir Pathak, David F Tate, Tracy J Abildskov, and Walter Schneider. Assessment of quantitative magnetic resonance imaging metrics in the brain through the use of a novel phantom. *Brain injury*, 32(10):1265–1275, 2018

14. Sandip S Panesar, Fang-Cheng Yeh, Christopher P Deibert, David Fernandes-Cabral, Vijayakrishna Rowthu, Pinar Celtikci, Emrah Celtikci, William D Hula, Sudhir Pathak, and Juan C Fernández-Miranda. A diffusion spectrum imaging-based tractographic study into the anatomical subdivision and cortical connectivity of the ventral external capsule: uncinate and inferior fronto-occipital fascicles. *Neuroradiology*, 59(10):971–987, 2017

15. Catarina Guise, Margarida M Fernandes, Joao M Nobrega, Sudhir Pathak, Walter Schneider, and Raul Fangueiro. Hollow polypropylene yarns as a biomimetic brain phantom for the validation of high-definition fiber tractography imaging. *ACS Applied Materials & Interfaces*, 8(44):29960–29967, 2016

16. Ahmad Alhourani, Thomas A Wozny, Deepa Krishnaswamy, Sudhir Pathak, Shawn A Walls, Avniel S Ghuman, Donald N Krieger, David O Okonkwo, R Mark Richardson, and Ajay Niranjan. Magnetoencephalography-based identification of functional connectivity network disruption following mild traumatic brain injury. *Journal of Neurophysiology*, 116(4):1840–1847, 2016

17. Masanori Yoshino, Kumar Abhinav, Fang-Cheng Yeh, Sandip Panesar, David Fernandes, Sudhir Pathak, Paul A Gardner, and Juan C Fernandez-Miranda. Visualization of cranial nerves using high-definition fiber tractography. *Neurosurgery*, 2016

18. Xuhui Wang, Sudhir Pathak, Lucia Stefaneanu, Fang-Cheng Yeh, Shiting Li, and Juan C Fernandez-Miranda. Subcomponents and connectivity of the superior longitudinal fasciculus in the human brain. *Brain Structure and Function*, pages 1–18, 2015

19. Nora Presson, Deepa Krishnaswamy, Lauren Wagener, William Bird, Kevin Jarbo, Sudhir Pathak, Ava M Puccio, Allison Borasso, Steven Benso, David O Okonkwo, et al. Quantifying white matter structural integrity with high-definition fiber tracking in traumatic brain injury. *Military medicine*, 180(3S):109–121, 2015

20. Amir H Faraji, Kumar Abhinav, Kevin Jarbo, Fang-Cheng Yeh, Samuel S Shin, Sudhir Pathak, Barry E Hirsch, Walter Schneider, Juan C Fernandez-Miranda, and Robert M Friedlander. Longitudinal evaluation of corticospinal tract in patients with resected brainstem cavernous malformations using high-definition fiber tractography and diffusion connectometry analysis: preliminary experience. *Journal of neurosurgery*, 123(5):1133–1144, 2015

21. Kumar Abhinav, Fang-Chang Yeh, Sudhir Pathak, Robert M Friedlander, and Juan C Fernandez-Miranda. Advanced diffusion mri fiber tracking in neurosurgical and neurodegenerative disorders and neuroanatomical studies: A review. *Biochimica et Biophysica Acta (BBA)-Molecular Basis of Disease*, 2014

22. Kumar Abhinav, Sudhir Pathak, R Mark Richardson, Johnathan Engh, Paul Gardner, Fang-Cheng Yeh, Robert M Friedlander, and Juan C Fernandez-Miranda. Application of high-definition fiber tractography in the management of supratentorial cavernous malformations: A combined qualitative and quantitative approach. *Neurosurgery*, 74(6):668–681, 2014

23. Juan C Fernández-Miranda, Yibao Wang, Sudhir Pathak, Lucia Stefaneau, Timothy Verstynen, and Fang-Cheng Yeh. Asymmetry, connectivity, and segmentation of the arcuate fascicle in the human brain. *Brain Structure and Function*, pages 1–16, 2014

24. Greg Bowden, Ajay Niranjan, Erika Laing, Sudhir Pathak, John Flickinger, and L Dade Lunsford. Integration of magnetoencephalography-generated functional brain maps into dose planning during arteriovenous malformation radiosurgery. *Stereotactic and functional neurosurgery*, 92(2):103–108, 2014

25. Yibao Wang, Juan C Fernández-Miranda, Timothy Verstynen, Sudhir Pathak, Walter Schneider, and Fang-Cheng Yeh. Rethinking the role of the middle longitudinal fascicle in language and auditory pathways. *Cerebral cortex*, 23(10):2347–2356, 2013

26. Jeffrey S Phillips, Adam S Greenberg, John A Pyles, Sudhir K Pathak, Marlene Behrmann, Walter Schneider, Michael J Tarr, et al. Co-analysis of brain structure and function using fMRI and diffusion-weighted imaging. *J. Vis. Exp*, 69:4125, 2012

27. Juan C Fernandez-Miranda, Sudhir Pathak, Johnathan Engh, Kevin Jarbo, Timothy Verstynen, Fang-Cheng Yeh, Yibao Wang, Arlan Mintz, Fernando Boada, Walter Schneider, et al. High-definition fiber tractography of the human brain: neuroanatomical validation and neurosurgical applications. *Neurosurgery*, 71(2):430–453, 2012

28. Samuel S Shin, Timothy Verstynen, Sudhir Pathak, Kevin Jarbo, Allison J Hricik, Megan Maserati, Sue R Beers, Ava M Puccio, Fernando E Boada, David O Okonkwo, et al. High-definition fiber tracking for assessment of neu-

rological deficit in a case of traumatic brain injury: finding, visualizing, and interpreting small sites of damage: Case report. *Journal of neurosurgery*, 116(5):1062–1069, 2012

29. Timothy Verstynen, Kevin Jarbo, Sudhir Pathak, and Walter Schneider. In vivo mapping of microstructural somatotopies in the human corticospinal pathways. *Journal of neurophysiology*, 105(1):336–346, 2011

30. Michael W Cole, Sudhir Pathak, and Walter Schneider. Identifying the brain's most globally connected regions. *Neuroimage*, 49(4):3132–3148, 2010

31. Juan C Fernandez-Miranda, Johnathan A Engh, Sudhir K Pathak, Ricky Madhok, Fernando E Boada, Walter Schneider, and Amin B Kassam. High-definition fiber tracking guidance for intraparenchymal endoscopic port surgery: Technical note. *Journal of neurosurgery*, 113(5):990–999, 2010

32. B V Rathish Kumar, S K Pathak, Vivek Sangwan, Mohit Nigam, and S K Murthy. A numerical simulation of cardiac electric activity in left ventricle based on mono-domain model. *Journal of Mechanics in Medicine and Biology*, 10(03):431–444, 2010

Paper in Preparation

1. Sudhir K Pathak and Walter Schneider. Assessment of diffusion reconstruction and derived anisotropic metric using a novel hollow textile fiber based phantom. Manuscript in preparation, 2023

2. Sudhir Pathak, Vishwesh Nath, Kurt G Schilling, Bennett A Landman, and Walter Schneider. Null-space deep learning based diffusion mr imaging data harmonization across the scanner at multiple sites. Manuscript in preparation, 2023

Book Chapters

1. Ajay Niranjan, Sudhir Pathak, Kevin Fallon, Jong Oh Kim, and L Dade Lunsford. Imaging techniques for leksell radiosurgery. In *Leksell Radiosurgery*, volume 34, pages 28–39. Karger Publishers, 2019

2. Samuel S. Shin, Sudhir Pathak, Nora Presson, William Bird, Lauren Wagener, Walter Schneider, David O. Okonkwo, and Juan C. Fernandez-Miranda. Detection of white matter injury in concussion using High-Definition Fiber Tractography. In Niranjan A. and Lunsford L.D., editors, *Concussion*. Karger, Medical and Scientific Publishers, 2014

3. Sudhir Pathak and JC Fernandez-Miranda. Structural and functional connectivity of the Claustrum in human brain. In J. Smythies, L. Edelstein, and V.S. Ramachandran, editors, *The Claustrum: Structural, Functional, and Clinical Neuroscience*. Academic Press, Academic Press, 2013

Conference Publications

1. Brian T Nixon, Sayantani Bhattacharjee, Benjamin Graybill, Constantinos Costa, Sudhir Pathak, Walter Schneider, and Panos K Chrysanthis. Healthdist: a context, location and preference-aware system for safe navigation. In *2021 22nd IEEE International Conference on Mobile Data Management (MDM)*, pages 250–253. IEEE, 2021

2. Ranjeet Ranjan Jha, Hritik Gupta, Sudhir K Pathak, Walter Schneider, BV Rathish Kumar, Arnav Bhavsar, and Aditya Nigam. Enhancing hardi reconstruction from undersampled data via multi-context and feature interdependency gan. In *2021 IEEE 18th International Symposium on Biomedical Imaging (ISBI)*, pages 1103–1106. IEEE, 2021

3. Ranjeet Ranjan Jha, Aditya Nigam, Arnav Bhavsar, Gaurav Jaswal, Sudhir K Pathak, and Rathish Kumar. Hlgsnet: Hierarchical and lightweight graph siamese network with triplet loss for fmri-based classification of adhd. In *2020 International Joint Conference on Neural Networks (IJCNN)*, pages 1–7. IEEE, 2020

4. Walter Schneider, Sudhir Pathak, Kristofer Pomiecko, Cahterine Fissell, David Busch, Anthony Zuccolotto, and Elisabeth Wilde. Calibrated quantitative mri of tbi across space, vendor, site, and time for diffusion quantification of diffuse axonal injury dai. *Neurotrauma*, 36(13):A11–A11, 2019
5. Ahmad Alhourani, Sudhir K Pathak, Michael J Randazzo, Tom Wozny, Efstathios Kondylis, Shawn Walls, Michael Ward, Stephen Foldes, Donald Krieger, David O Okonkwo, et al. 183 meg identification of reduced functional connectivity following concussion. *Neurosurgery*, 62:227–227, 2015
6. Walter Schneider, Sudhir K Pathak, Jeff S Phillips, and Michael W Cole. High Definition Fiber Tracking exposes circuit diagram for brain showing triarchic representation, domain general control, and metacognitive subsystems. In *2009 AAAI Fall Symposium Series*, 2009
7. BS Martins, SK Pathak, AG Bleicher, and W Schneider. Mimimizing brain network damage via fMRI and diffusion weighted imaging in neurosurgical planning. *Neuroimage*, 47:S141, 2009
8. Walter Schneider, Michael Cole, and Sudhir Pathak. Reverse engineering the brain with a circuit diagram based on a segmented connectome and system dynamics. *Proceedings of AAAI Fall Symposium on Biologically Inspired Cognitive Architectures, Washington, DC*, 2008

Oral Presentation

1. Sudhir Pathak. Computational modeling of the human brain tissue, estimation and quantifying tissue type. Society for Mathematical Biology 2021 Annual Meeting (SMB2021), June 2021
2. Sudhir Pathak. High definition fiber tracking and its clinical application in traumatic brain injury and presurgical planning. Centre for Brain Research (CBR), Indian Institute of Sciences, Bangalore, India, February 2020
3. Sudhir Pathak and Walter Schneider. Idealized axon phantom for validation and calibration of dmri: Testing compartmental models and fiber tractography. New York University, New York, November 2017
4. Sudhir Pathak and Walter Schneider. Hollow nanotube textile based phantoms for ground validation of truth measurement of diffusion mr images: Testing compartmental models and fiber tractography. Computational Brain Connectivity Mapping Winter School Workshop, Antibes, Juan les Pins, France, November 2017
5. Sudhir Pathak and Walter Schneider. High definition fiber tracking - a pipeline of computational methods to map white matter tracts and support clinically viable tract analysis. National Institute of Health, Washington, DC., March 2013
6. Sudhir Pathak, Timothy Verstynen, Kevin Jarbo, Walter Schneider, and Juan Fernandez-Miranda. High definition fiber tracking (HDFT) in neurosurgery and traumatic brain injury. Cognitive Neuroscience Society, San Francisco, CA, April 2012
7. Schneider W. and Pathak S. High definition fiber tracking in neurosurgery and traumatic brain injury. NIH Neuroimaging group, Wastington DC, December 2010
8. Schneider W., Sudhir Pathak, Timothy Verstynen, Jeff Phillips, Juan Fernandez-Miranda, and Frank Yeh. High definition fiber tracking in visual system to quantify human connectivity and aid neurosurgery to preserve vision. Multi-modal Neuroimaging Training Program (MNTP), Pittsburgh, PA, July 2010
9. Schneider W., Pathak S., and Yeh F. Mapping brain circuits with High Definition Fiber Tracking (HDFT) data mining fiber tracts to identify the cables and chipset of the human brain. Data Mining Group, CMU, Pittsburgh, PA., September 2009
10. Schneider W. and Pathak S. Roadmap for mapping the human connectome. Intel Research, Pittsburgh, PA, December 2009
11. Schneider W., Pathak S., Fernandez-Miranda J., Bleicher A., Davis D., and Boada F. Mapping brain circuits with high definition fiber tracking (HDFT) for medical imaging in neurosurgery and tbi plus human connectome. Radiology Seminar Series, Pittsburgh, PA, September 2009
12. Schneider W., Pathak S., and Phillips J. Adventures in research at LRDC mapping brain architecture actionable neuroscience for learning and support. LRDC Senior Scientists Meeting, Pittsburgh, PA, November 2009

13. Pathak S., Martins B., Cole M.W., and Schneider W. Anatomical and functional segmentation of the cognitive control network: Supporting a preliminary cognitive control network connectome. Cognitive Neuroscience Society, San Francisco, CA, April 2008

Conference Abstract and Posters

1. Ranjeet Ranjan Jha, Hritik Gupta, Sudhir K Pathak, Ankita Joshi, Walter Schneider, BV Rathish Kumar, Arnav Bhavsar, and Aditya Nigam. Pa-gan: Parallel attention based gan for enhancement of fodf. In *2023 IEEE 19th International Symposium on Biomedical Imaging (ISBI)*. IEEE, 2023
2. Sudhir Kumar Pathak, Yijen L Wu, Vijay Saradhi Gorantla, Fatih Zor, Yalcin Kulahci, Alan Watson, Yongxin Zhao, and Walter Schneider. Fasciculus axonal connective tissue (fact) mapping of porcine optic nerve for accurate connectome mapping at viable cost. In *Annual Meeting and Exhibition ISMRM 2022*, 2022
3. Ranjeet Ranjan Jha, Sudhir K Pathak, Walter Schneider, BV Rathish Kumar, Arnav Bhavsar, and Aditya Nigam. Lfanet: Transforming 3t single-shell to 7t multi-shell dmri using deep learning based leapfrog and attention. In *2022 IEEE 19th International Symposium on Biomedical Imaging (ISBI)*, pages 1–5. IEEE, 2022
4. Sudhir Kumar Pathak, Vishwesh Nath, B V Rathish Kumar, and Walter Schneider. A novel clinically viable method to quantify t2 of intra and extra axonal compartmental tissue properties. In *Annual Meeting and Exhibition ISMRM 2021*, 2021
5. Sudhir Kumar Pathak, Vishwesh Nath, Sandip Panesar, Kurt G. Schilling, Juan Carlos Fernandez-Miranda, Bennett A. Landman, and Walter Schneider. Clinical recovery of intracellular volume fraction and fiberodf for a patient with asymptomatic temporal-occipital lesion using deep learning. Joint Annual Meeting ISMRM 2020, Virtural Conference, August 2020
6. Sudhir Pathak, Walter Schneider, Anthony Zuccolotto, Susie Huang, Qiuyun Fan, Thomas Witzel, Lawrence Wald, Els Fieremans, Michal E. Komlosh, Dan Benjamini, Alexandru V Avram, and Peter J. Basser. Diffusion ground truth quantification of axon scale phantom: Limits of diffusion mri on 7t, 3t and connectome 1.0. Joint Annual Meeting ISMRM 2020, Virtural Conference, August 2020
7. Sudhir Kumar Pathak, Vinod Jangir Kumar, and Walter Schneider. Validation and estimation of crossing angles of fiber bundle with different density using hollow textile-based phantom. Joint Annual Meeting ISMRM 2019, Montreal, Quebec, Canada, May 2019
8. Walter Schneider, Sudhir Pathak, Yijen Wu, David Busch, and John Dzikiy. Taxon anisotropic phantom delivering human scale parametrically controlled diffusion compartments to advance cross laboratory research and calibration. Joint Annual Meeting ISMRM 2019, Montreal, Quebec, Canada, May 2019
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