Curriculum Vitae

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Name

Yogesh Rathi

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Education

1992-1997	B.E	Electrical and Electronics Engineering	Birla Institute of Technology and Science, Pilani, India
1992-1997	M.Sc.	Mathematics	Birla Institute of Technology and Science, Pilani, India. (Dual-Degree Program)
2003-2006	Ph.D.	Electrical and Computer Engineering (ECE) Advisor: Prof. Allen Tannenbaum	Georgia Institute of Technology, Atlanta, GA

Postdoctoral Training

2006-2007	Research Scientist	Computer Vision Advisor: Allen Tannenbaum	Georgia Institute of Technology, Atlanta, GA
2007-2008	Research Fellow	Medical Image Analysis Advisor: M. E. Shenton	Brigham and Women's Hospital, Boston, MA

Faculty Academic Appointments

2008-2010	Instructor, Department of of Psychiatry	Harvard Medical School
2009-present	Adjunct Assistant Professor, Department of ECE	Georgia Institute of Technology
2010-2016	Assistant Professor, Department of Psychiatry	Harvard Medical School
2016-present	Associate Professor, Department of Psychiatry and Radiology	Harvard Medical School

Appointments at Hospital/Affiliated Institutions

2007- present	Research Associate	Psychiatry Neuroimaging Laboratory, Department of Psychiatry, Brigham and Women's Hospital
2009- present	Research Associate	Laboratory of Neuroscience, Clinical Neuroscience Division, VA Boston Healthcare System, Brockton, MA
2015-present	Assistant in Research	Massachusetts General Hospital

Other Professional Positions

1997-1999	Research Engineer	Scientific Systems Inc
1999-2003	Software Engineer	Teradyne Inc
2006-2007	Scientific Research Consultant	MZA Associates

Major Administrative Leadership Positions

Local:

2012-present Director for Pediatric Image Computing Brigham and Women's Hospital, Harvard Medical School

National and International:

2014	Challenge Organizer	Organized SPARC dMRI challenge at MICCAI, Boston, USA
2014	Workshop Organizer	Workshop on Computational diffusion MRI, Boston, USA
2015	Workshop Organizer	Workshop on Computational diffusion MRI, Munich, Germany
2016	Workshop Organizer	Workshop on Computational diffusion MRI, Athens, Greece

Professional Societies

Institute of Electrical and Electronics Engineers (IEEE):

2005-2008 Member
2008 Program Committee member for workshop on Tensor Processing in Computer Vision

Medical Image Computing and Computer Assisted Intervention (MICCAI):

2007- present Member
2012-2013 Session Chair for Diffusion Weighted Imaging
2012-2013 Program Committee member for workshop on Computational diffusion MRI

International society of Magnetic Resonance in Medicine (ISMRM):

2010-present Member
2013 Diffusion Study Group Presenter

Grant Review Activities

2008	NSF Career Award	National Science Foundation (NSF) Ad-hoc member
2008	Proposal Evaluation	Army Research Office Ad-hoc member
2014	Proposal Reviewer	Natural Sciences and Engineering Research Council of Canada (NSERC) Ad-hoc member

Editorial Activities

Reviewer

2005-present
Medical Image Analysis
IEEE Transactions on Medical Imaging
IEEE Transactions on Information Technology in Biomedicine
IEEE Transactions on Pattern Analysis and Machine Intelligence
Pattern Recognition Letters
SIAM Journal of Applied Mathematics
International Conference on Medical Image Computing and Computer-Assisted Intervention
IEEE Conference on Computer Vision and Pattern Recognition
IEEE Transactions on Image Processing
International Journal for Computer Vision
Neuroimage
Human Brain Mapping

Associate Editor

2015- present Frontiers In Neuroscience, Brain Imaging Methods

Honors and Prizes

1992-1997	BITS Institute Fellowship	Birla Institute of Technology and Science (BITS)
1996	Motorola Best Student Thesis Award	Joint award by Motorola and BITS
2007	O. Hugo Schuck Best Paper Award	American Automatic Control Council.
2009	Winner of Best Tractography algorithm	Fiber Cup Competition held with MICCAI 2009.
2012	NIMH's list of the "new and notable"	`http://tinyurl.com/ou6zngc`
2013	Selected to be in Harvard Medical School's "Leadership program"	
2015	Best ISMRM Abstract	ISMRM Diffusion Study Group

Report of Funded and Unfunded Projects

Funding Information

Past

2007-2012 Investigator - NIMH P50MH080272
Vulnerability to progression in Schizophrenia.
Imaging core PI: Martha E. Shenton
The goal was to study subjects who are at various stages of progression of schizophernia - prodromal, first episode and chronic, giving us a large database on phenotypic markers and predictors of progression.

2008-2009 **Principal Investigator** - Partners Information Systems Research Council
Real-time registration of multi-modality images using graphics processor unit (GPU)
PI: **Yogesh Rathi**
The main goal of this project was to develop algorithms using CUDA language and use the GPU for real-time registration of images (affine and non-rigid) for use in the clinical workflow.

2009-2014 Investigator - VA Merit
White matter analyses in schizophrenia
PI: Martha E. Shenton
The goal of this project is to evaluate the changes in white matter diffusion measures affected in schizophrenia.

2009-2014 Investigator - VA Merit
Disease progression in schizophrenia
PI: Robert McCarley, Core PI: Martha Shenton
This project is focussed on looking at the progression of disease at various stages for various sub-types.

2009-2014 Investigator - NIMH R01 MH 082918
Computational Morphometry in Schizophrenia and Related Disorders
PI: Sylvain Bouix
The goal of the project is to develop, evaluate and apply novel computational tools for the purpose of understanding morphometric changes in neuroanatomical structures related to schizophrenia.

2012-2012 **Principal Investigator** - Bridge Funding from Brigham and Women's Hospital
Taking advanced diffusion imaging to the clinic
PI : **Yogesh Rathi**
The project involved development of compressed sensing techniques to accelerate acquisition of diffusion MRI scans.

2014-2015 **Principal Investigator** - INTRuST (DoD) Grant - W81XWH-08-2-0159
Harmonizing diffusion MRI data from multiple scanners
PI: **Yogesh Rathi**
The goal of this project is to harmonize the diffusion MRI data acquired from several MR scanners so that all subjects can be analyzed together to increase statistical power.

Current

2012-2017 **Principal Investigator** - NIMH R01 MH097979
Taking advanced diffusion imaging to the clinic for pediatric patients with ADHD
PI: **Yogesh Rathi**
Total Direct Cost - $1.25M
The goal of this grant is to use compressed sensing based techniques for designing fast diffusion imaging techniques for applying it to study brain structure and function in ADHD.

2012-2017 Investigator - NIMH R01 MH 074794
Novel DT-MRI analyses of white matter in schizophrenia
PI: C-F Westin
Total Direct Cost - $1.75M
This grant is focussed on developing new gradient acquisition schemes for imaging brain tissue microstructure not accessible with standard techniques.

2013-2018 Investigator - NIH P41 EB015902
Neuroimage Analysis Center (NAC)
Overall PI: Ron Kikinis, Core PI: C-F Westin
Total Direct Cost - $3.75M
The goal of the "algorithm core" is to develop new algorithms to process MR spectroscopy data and apply it to study diseases like mild TBI.

2013-2018 Investigator - NIH R01 AG042512
Neural substrates of diffusion imaging in cognitively aging rhesus monkeys
PI: Marek Kubicki And Nikos Makris
Total Direct Cost - $1.1M
The goal is to study the relation between diffusion MRI based and histology based markers of aging in rhesus monkeys.

2014-2016 Key personnel and Investigator - NIH U01 NS083223
Characterization of white matter in Huntington's disease
PI: C-F Westin
Total Direct Cost - $360K
The goal is to use advanced tractography algorithm to study motor tracts in HD.

2014-2019 Investigator - NIH R01MH 102377
Diffusion Imaging Biomarkers for Risk, Onset and Outcome in Schizophrenia
PI: Marek Kubicki
Total Direct Cost - $1.1M
The main goals of this project is to use diffusion MRI, along with the newest MRI acquisition and analysis methods, and to a apply them to study schizophrenia.

2015-2017 **PI** - NIH, Supplement to R01MH097979
Fast perfusion imaging and analysis in ADHD
PI: **Yogesh Rathi**
Total Direct Cost: $120K
The goal is develop fast perfusion imaging technique for estimating cerebral blood flow and volume in ADHD

2016-2019 Key Personnel - NIH, Supplement - R01MH 102377S1
Harmonizing diffusion MRI data from multiple scanners with different acquisition parameters
PI: Marek Kubicki
Total Direct Cost - $255K
The goal of this project is to harmonize the diffusion MRI data acquired from several MR scanners with varying acquisition parameters.

Current Unfunded and Pending Projects

2016-2020 **PI** - NIH, First review in June, 2016
Connectome Based Programming of Deep Brain Stimulators in Parkinson's Disease
The goal of this project is to develop advanced high resolution diffusion imaging protocol and optimize the IPG programming for DBS in Parkinson's patients.

2016-2018 **PI** - NIH, First review in June 2016
Patient-specific, Effective and Rational Connectivity Targeting for DBS in OCD
The goal of this project is to develop better tools to determine the best set of white matter fibers to stimulate in severe OCD patients using DBS.

2017-2022 **PI** - NIH, Percentile score at first submission: 37%
Fast diffusion imaging of brain microstructure at the submillimeter level to study CTE
The goal of this project is to develop advanced and fast ultra-high resolution diffusion imaging protocol to study brain abnormalities in CTE.

Report of Local Teaching and Training

Birla Institute of Technology and Science

1997 *Cicuits and Systems*
Undergraduate level, Teaching Assistant, 3hrs per wk for 16 wks

Georgia Institute of Technology

2006-2007 *Problem based learning*
Undergraduate level, Guest Lecturer, 2hrs per wk for 6 wks

2006-2007 *Fundamentals of Computer Vision*
Undergraduate/Graduate level, Guest Lecturer, 1.5hrs per wk for 3 wks

Brigham and Women's Hospital

2009- *Tractography – do's and don'ts, A course for neuroscientists and research assistants*
Biannual training seminar, 4 hours per year

2012- *Diffusion MRI - basics, A course for early post-doctoral fellows, research assistants, graduate students*
Biannual training seminar, 4 hours per year

Laboratory and Other Research Supervisory and Training Responsibilities

2006-2007	Supervision and training of graduate students	Daily mentorship of two students
2008-2009	Supervision and training of one research assistant	Weekly mentorship
2008-	Supervision of graduate students	Weekly mentorship (1 hour per student)
2009-	Training of two post-doctoral fellows	Weekly mentorship (2 hours per fellow)
2010-2014	Supervision and training of one software engineer	Weekly mentorship
2012-	Train 1 High school student in neuroimaging	Daily mentorship (8-12 weeks in summer)
2012-	Train a research assistant in MR scanning procedures	Monthly mentorship

Formally Supervised Students/Fellows

2007-2010	James G Malcolm, PhD Student. Published several peer-reviewed manuscripts. Currently pursuing MD at Emory University.
2007-2007	Gallagher Pryor, Ph.D Student. Designed a real-time multi-object tracking system for tracking objects in deep turbulence. Working for Accelereyes Inc.
2008-2009	Jalpa Patel, M.S. in Biomedical Engineering. Quantitative analysis of various rigid and non-rigid registration algorithms from Slicer. Validation Engineer at Q Pharma, NY.
2008-2009	Padmapriya Srinivasan, M.S. in Biomedical Engineering. Designed a software module for group registration of labeled images. Data Analyst at Quanttus Inc.
2009-2010	Hsiao Piau Ng, Post-doctoral reseacher Use multi-tensor tractography for locating abnormal fiber bundles in schizophrenia. Researcher at ASTAR Singapore.
2009-2011	Takeshi Asami, Post-doctoral researcher Use histogram analysis and two-tensor tractography for fiber tract analysis. Assistant Professor, Yokohama City University, Japan
2010-2011	Po-Chang Hsu, Graduate Student Utilizing tractography methods for analyzing thalamic connections in the brain. Master's student at Harvard University.
2010-2014	Ryan Eckbo, Software Engineer Provide supervision and training in all aspects of software engineering at the PNL. Consultant, Brigham and Women's Hospital, PNL.
2010-2011	Stefan Leinhard, Masters thesis Student False positive detection for filtered two/three tensor tractography. PhD student at EPFL, Zurich.
2011-2012	Christian Baumgartner, Graduate Student Unscented Kalman filter based estimation of free water in diffusion MRI. Currently, PhD student at King's College, London.
2011-	Peter Savadjiev, Instructor Mentor on several scientific projects. Brigham and Women's Hospital, PNL.
2013-	Lipeng Ning, Post-doctoral fellow Advisor and Mentor - Compressed sensing. Brigham and Women's Hospital, PNL.
2014-2016	Pradyumna Reddy, Under-graduate student Bachelors thesis advisor - novel diffusion MRI models. Birla Institute of Technology and Science, Goa, India.
2014-	Madhura Bakshi, Masters/PhD Student Master's thesis advisor - EPI distortion correction. Currently pursuing PhD at Boston University.
2014-	Hengameh Dastardi, Post-doctoral fellow Advisor and Mentor - Diffusion MRI data harmonization. Brigham and Women's Hospital, Boston.
2015-	Weining Wu, Post-doctoral fellow Advisor and Mentor – Neuroimage machine learning Brigham and Women's Hospital, Boston.
2015	Come Carquex, Master's Student Master's thesis advisor - Artifact detection in diffusion MRI Brigham and Women's Hospital, Boston.
2015-2016	Efe Carabeyli, Master's Student Master's thesis advisor - Multi-scale tractography for multi-value data Brigham and Women's Hospital, Boston.

Local Invited Presentations

None of the following presentations were sponsored by outside entities.

2006 *A filtering approach to tracking highly deforming objects*
Air-force office of scientific research (AFOSR),
Dept. of Mechanical Engineering, Georgia Institute of Technology

2007 *Affine registration of richly labeled images*
Laboratory of Mathematics in Imaging (LMI)- BWH

2008 *Directional functions for fiber-orientation distribution estimation*
Laboratory of Mathematics in Imaging (LMI) - BWH

2009 *Neural Tractography using a Filtering Approach*
Golby Lab, Dept. of Neurosurgery - BWH

2009 *Multi-tensor tractography and its applications*
Laboratory of Mathematics in Imaging (LMI) - BWH

2010 *Multi-fiber tractography and statistical analysis of first-episode schizophrenia patients*
Genetics and Schizophrenia Seminar - BWH

2011 *Compressed Sensing for diffusion MRI*
Martinos Center for Biomedical Imaging - MGH

2012 *Fast diffusion imaging for the clinic*
Children's Hospital Boston - BCH

2012 *Diffusion MRI – processing and analysis*
McLean Hospital

2013 *Gray matter heterogeneity in early aging*
Laboratory of Mathematics in Imaging - BWH

2013 *Fast diffusion imaging using compressed sensing and model based techniques*
Fetal-Neonatal Neuroimaging and Development Science Center - Children's Hospital Boston

2013 *Thriving in a research hospital*
Career Research Training Program - Judge Baker Children's Center, Boston

2014 *Diffusion imaging for cancer research*
Mass. General Hospital (MGH), Boston

2014 *Career planning in a research hospital*
Career Research Training Program - Judge Baker Children's Center, Boston

2015 *Critique on orthogonal fiber crossing in the brain*
Laboratory of Mathematics in Imaging (LMI) - BWH

2016 *Revisiting the fundamental diffusion equation*
Surgical Planning Laboratory - BWH

Report of Regional, National and International Invited Presentations

Regional Presentations

None of the following presentations were sponsored by outside entities.

2010 *A unified framework for multi-fiber tractography using the unscented Kalman Filter*
CSAIL - MIT (Massachusetts Institute of Technology)

2014 *Image processing in Medical Imaging*
Northeastern University, Boston, MA

National Presentations

None of the following presentations were sponsored by outside entities.

2005 *Particle Filtering for Geometric Active Contours with Application to Tracking Moving and Deforming Objects*
IEEE Conference on Computer Vision and Pattern Recognition, San Diego, CA

2006 *Segmenting Images on the Tensor Manifold*
Harvard Journal Club, Surgical Planning Laboratory - BWH

2008 *Orientation distribution estimation using directional functions*
IEEE Workshop on Tensor computing in computer vision, Anchorage, Alaska

2008 *Orientation distribution estimation using the Watson directional function*
Minerva Research Group, Georgia Institute of Technology, Atlanta, GA

2008 *Orientation distribution estimation using directional functions in the context of Q-ball imaging*
Mathematical Biosciences Institute, Ohio State University, Columbus, OH

2011 *Compressed sensing in diffusion MRI*
NIH - Clinical Center, Bethesda, Maryland

2012 *Fast diffusion imaging using compressed sensing and model based techniques*
University of North Carolina, Chapel Hill, NC

2013 *Diffusion imaging based markers of abnormal brain tissue*
Quantitative Medical Imaging, Arlington, VA

2014 *A dual spherical model for multi-shell diffusion imaging*
SPIE Medical, San Diego, CA

International Presentations

None of the following presentations were sponsored by outside entities.

2006 *Comparative Analysis of Kernel Methods for Statistical Shape Learning*
Workshop on Computer Vision Approaches for Medical Image Analysis, Graz, Austria.

2008 *Registration and Segmentation of Medical Images*
GE Research, Bangalore, India

2008 *Tracking objects in deep turbulence*
IBM Research Laboratories, India

2009 *Validation on Physical Phantom: Two-Tensor Tractography*
Workshop on computational diffusion MRI, London, UK

2010 *Building an average population HARDI atlas*
Workshop on computational diffusion MRI, Beijing, China

2012 *A unified framework for comparing diffusion models on clinical scans*
Workshop on Computational diffusion MRI, Nice, France

2014 *Fast diffusion imaging using compressed sensing*
Danish Research Center for Magnetic Resonance, Copenhagen, Denmark

2014 *Results from the SPARC diffusion MRI Challenge*
Workshop on Computational diffusion MRI, Boston, MA

2015 *Compressed sensing for ultra high-resolution diffusion imaging*
Center for Addiction and Mental Health, Univ. of Toronto, Canada

2015 *Compressed sensing and Super-resolution for high-resolution diffusion imaging*
Information Processing in Medical Imaging (IPMI), Scotland, UK

2016 *Harmonizing diffusion MRI data acquired from multiple scanners*
International Society for Magnetic Resonance in Medicine, Singapore

Report of Technological and Other Scientific Innovations

Developed and distributed several software packages as part of open-source and open-science initiative.

- Lead the development of a GPU CUDA based software for affine and non-rigid registration of 3D medical imaging data.
- A module to perform curvature based affine-invariant smoothing of medical images (as part of 3D Slicer)
- An unscented Kalman filter based tractography algorithm with several different features to trace neural fibers of the brain.
- A semi-automatic method for artifact detection and correction in diffusion MRI images.

Report of Scholarship

Research Investigations

1. S. Kumar, **Y. Rathi** and R. C. Jain, "An efficient lapped orthogonal transform image coding technique", *IEEE Transactions on Consumer Electronics*, 43:993–1002, 1997.
2. **Y. Rathi**, N. Vaswani and A. Tannenbaum, "A generic framework for tracking using particle filter with dynamic shape prior", *IEEE Transactions on Image Processing*, 16(5):1370, 2007.
3. T. Georgiou, O. Michailovich, **Y. Rathi**, J. Malcolm and A. Tannenbaum, "Distribution metrics and image segmentation", *Linear algebra and its applications*, 425(2-3):663–672, 2007.
4. **Y. Rathi**, N. Vaswani, A. Tannenbaum and A. Yezzi, "Tracking deforming objects using particle filtering for geometric active contours", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 29(8):1470–1475, 2007.
5. O. Michailovich, **Y. Rathi** and A. Tannenbaum, "Image segmentation using active contours driven by the bhattacharyya gradient flow", *IEEE Transactions on Image Processing*, 16(11):2787–2801, 2007.
6. S. Dambreville, **Y. Rathi** and A. Tannenbaum, "A Framework for Image Segmentation Using Shape Models and Kernel Space Shape Priors", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 30(8):1385–1399, 2008.
7. **Y. Rathi**, O. Michailovich, M. E. Shenton and S. Bouix, "Directional functions for orientation distribution estimation", *Medical Image Analysis*, 13(3):432–444, 2009.
8. N. Vaswani, **Y. Rathi**, A. Yezzi and A. Tannenbaum, "Deform PF-MT: Particle Filter with Mode Tracker for Tracking Non-Affine Contour Deformations", *IEEE Transactions on Image Processing*, 19:841–857, 2010.
9. J. Malcolm, O. Michailovich, S. Bouix, C.-F. Westin, M. E. Shenton and **Y. Rathi**, "A filtered approach to neural tractography using the Watson directional function", *Medical Image Analysis*, 14(1):58–69, 2010.
10. **Y. Rathi**, J. Malcolm, S. Bouix, A. Tannenbaum and M. E. Shenton, "Affine registration of label maps in label space", *Journal of Computing*, 2(4):1–11, 2010.
11. **Y. Rathi**, J. Malcolm, O. Michailovich, C-F Westin, M.E. Shenton and S. Bouix, "Tensor-kernels for simultaneous fiber model estimation and tractography", *Magnetic Resonance in Medicine*, 64(1):138–148, 2010.
12. O. Michailovich and **Y. Rathi**, "On approximation of orientation distributions by means of spherical ridgelets", *IEEE Transactions on Image Processing*, 19(3):1–17, March 2010.
13. J. G. Malcolm, M. E. Shenton and **Y. Rathi**, "Filtered multi-tensor tractography", *IEEE Trans. on Medical Imaging*, 29:1664–1675, 2010.
14. **Y. Rathi**, M. Kubicki, S. Bouix, C-F Westin, J. Goldstein, L. Seidman, R. Mesholam-Gately, R. W. McCarley and M.E. Shenton, "Statistical Analysis of Fiber Bundles using Multi-tensor Tractography: Application to First-episode Schizophrenia", *Magnetic Resonance Imaging*, 29(4):507–515, 2011.
15. J. G. Malcolm, **Y. Rathi** and C.-F. Westin, *Processing and Visualization of Diffusion MRI*, in: T. Deserno, (ed.), *Recent Advances in Biomedical Image Processing and Analysis*, chapter 16, pp. 387–410. Springer, 2011.
16. S. Lienhard, J. Malcolm, C-F Westin and **Y. Rathi**, "A full bi-tensor neural tractography algorithm using the unscented Kalman filter", *EURASIP journal on Advances in signal processing: Reproducible Research in Signal Processing*, 1:1–10, 2011.
17. O. Michailovich, S. Dolui and **Y. Rathi**, "Spatially Regularized Compressed Sensing for High Angular Resolution Diffusion Imaging", *IEEE Transactions on Medical Imaging*, 30:1100–1115, 2011.
18. A. Venkataraman, **Y. Rathi**, M. Kubicki, C-F Westin and P. Golland, "Joint modeling of anatomical and functional connectivity for population studies", *IEEE Transactions on Medical Imaging*, 31:164–182, 2012.
19. M.E. Shenton, H. Hamoda, J. Schneiderman, S. Bouix, O. Pasternak, **Y. Rathi**, M-A Vu, M. Purohit, K. Helmer, I. Koerte, A. Lin, C-F Westin, R. Kikinis, A. Stern and R. Zafonte, "A Review of Magnetic Resonance Imaging and Diffusion Tensor Imaging Findings in Mild Traumatic Brain Injury", *Brain Imaging and Behavior*, 6:137–192, 2012.
20. Y. Gao, **Y. Rathi**, S. Bouix and A. Tannenbaum, "Filtering in the Diffeomorphic group and Registration of point sets", *IEEE Transactions on Image Processing*, 21:4383–4396, 2012.
21. S. Bouix, O. Pasternak, **Y. Rathi**, P.E. Pelavin, R. Zafonte and M.E.Shenton, "Increased Gray Matter Diffusion Anisotropy in Patients with Persistent Post-Concussive Symptoms following Mild Traumatic Brain Injury", *PLoS ONE*, 8:e66205, 2013.

22. N Makris, MG Preti, D Wassermann, **Y. Rathi**, GM Papadimitriou, C Yergatian, BC Dickerson, ME Shenton and M Kubicki, "Human middle longitudinal fascicle: segregation and behavioral-clinical implications of two distinct fiber connections linking temporal pole and superior temporal gyrus with the angular gyrus or superior parietal lobule using multi-tensor tractography", *Brain imaging and behavior*, 7(3):335–352, 2013.
23. Meina Quan, Sang-Hyuk Lee, Marek Kubicki, Zora Kikinis, **Y. Rathi**, Larry J Seidman, Raquelle I Mesholam-Gately, Jill M Goldstein, Robert W McCarley and Martha E Shenton, "White matter tract abnormalities between rostral middle frontal gyrus, inferior frontal gyrus and striatum in first-episode schizophrenia", *Schizophrenia research*, 145(1):1–10, 2013.
24. **Y. Rathi**, O. Pasternak, P. Savadjiev, O. Michailovich, S. Bouix, M. Kubicki, C-F Westin, N. Makris and M.E.Shenton, "Gray matter alterations in early aging: A diffusion magnetic resonance imaging study", *Human Brain Mapping*, 35:3841–3856, 2014.
25. **Y. Rathi**, O. Michailovich, F. Laun, K. Setsompop and C-F Westin, "Multi shell diffusion signal recovery from sparse measurements", *Medical Imaging Analysis*, 18(7):1143–1156, 2014.
26. P. Savadjiev, **Y. Rathi**, S. Bouix, A. Smith, R. Schultz, R. Verma and C-F Westin, "Fusion of white and gray matter geometry: A framework for investigating brain development", *Medical Imaging Analysis*, 18(8):1349–1360, 2014.
27. J Yang, G Papadimitriou, R Eckbo, E Yeterian, L Liang, D Dougherty, S Bouix, **Y. Rathi**, M Shenton, M Kubicki and N Makris, "Multi-tensor investigation of orbitofrontal cortex tracts affected in subcaudate tractotomy", *Brain imaging and behavior*, pp. 1–11, 2014.
28. Arash Nazeri, M Mallar Chakravarty, David J Rotenberg, Tarek K Rajji, **Y. Rathi**, Oleg V Michailovich and Aristotle N Voineskos, "Functional Consequences of Neurite Orientation Dispersion and Density in Humans across the Adult Lifespan", *The Journal of Neuroscience*, 35(4):1753–1762, 2015.
29. Zhenrui Chen, Yanmei Tie, Olutayo Olubiyi, Laura Rigolo, Alireza Mehrtash, Isaiah Norton, Ofer Pasternak; **Y. Rathi**, Alexandra J Golby and L. O'Donnell, "Reconstruction of the arcuate fasciculus for surgical planning in the setting of peritumoral edema using two-tensor unscented kalman filter tractography", *Neuroimage - clinical*, 7:815–822, 2015.
30. L. Ning, C-F Westin and **Y. Rathi**, "Estimating diffusion propagator and its moments using directional radial basis functions", *IEEE Trans. on Medical Imaging*, 1:1–18, 2015.
31. L. Ning, F. Laun, Y. Gur, E. DiBella, S. Deslauriers-Gauthier, T. Megherbi, A. Ghosh, M. Zucchelli, G. Menegaz, R. Fick, S. St-Jean, M. Paquette, R. Aranda, M. Descoteaux, R. Deriche, L. O'Donnell and **Y. Rathi**, "Sparse reconstruction challenge for diffusion mri: Validation on a physical phantom to determine what acquisition scheme and analysis method to use?", *Medical Image Analysis*, 2015.
32. N. Makris, **Y. Rathi**, P. Mouradian, G. Bonmassar, G. Papadimitriou, W. Ing, E. Yeterian, M. Kubicki, E. Eskandar, L. Wald, F. Qiuyun, A. Nummenmaa, A. Widge and D. Dougherty, "Variability and anatomical specificity of the orbitofrontothalamic fibers of passage in the ventral capsule/ventral striatum (vc/vs): precision care for patient-specific tractography-guided targeting of deep brain stimulation (dbs) in obsessive compulsive disorder (ocd)", *Brain imaging and behavior*, pp. 1–14, 2015.
33. L. Ning, K. Setsompop, O. Michailovich, N. Makris, M. E. Shenton, C-F Westin and **Y. Rathi**, "A joint compressed-sensing and super-resolution approach for very high-resolution diffusion imaging", *Neuroimage*, 125:386–400, 2016.
34. Zhenrui Chen, Yanmei Tie, Olutayo Olubiyi, Laura Rigolo, Alireza Mehrtash, Isaiah Norton, Ofer Pasternak; **Y. Rathi**, Alexandra J Golby and L. O'Donnell, "Corticospinal tract modeling for neurosurgical planning by trackng through regions with peritumoral edema and crossing fibers using two-tensor unscented kalman filter tractography", *International Journal of Computer Assisted radiology and surgery*, 13:1–12, 2016.
35. D. Wassermann, N. Makris, **Y. Rathi**, M. E. Shenton, R. Kikinis, M. Kubicki and C-F Westin, "The white matter query language (wmql): a novel approach for describing human white matter anatomy", *Brain structure and function*, 1:1–17, 2016.
36. L. Ning, C-F Westin and **Y. Rathi**, "Estimation of bounded and unbounded trajectories in diffusion mri", *Frontiers in Neuroscience - Brain Imaging Methods*, 2016.
37. Chinthala Pradyumna Reddy and **Y. Rathi**, "Joint Multi-Fiber NODDI Parameter Estimation and Tractography using the Unscented Information Filter", *Frontiers in Neuroscience - Brain Imaging Methods*, 2016.

Other Peer-Reviewed Articles

Note: International Conferences publications presented here are full length peer-reviewed articles. International Conferences such as ICCV, ECCV, CVPR and MICCAI are viewed as important as journal publications in the computer science community.

1. **Y. Rathi**, N. Vaswani, A. Tannenbaum and A. Yezzi, *Particle filtering for geometric active contours with application to tracking moving and deforming objects*, in: *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, volume 2, pp. 2–9, 2005.
2. **Y. Rathi**, S. Dambreville and A. Tannenbaum, "Comparative analysis of kernel methods for statistical shape learning", *Lecture Notes in Computer Science*, 4241:96, 2006.
3. **Y. Rathi**, P. Olver, G. Sapiro and A. Tannenbaum, *Affine invariant surface evolutions for 3D image segmentation*, in: *SPIE Proceedings on Electronic Imaging*, volume 6064, pp. 1–5, 2006.
4. **Y. Rathi**, S. Dambreville and A Tannenbaum, "Particle Filtering with Dynamic Shape Priors", *Lecture Notes in Computer Science*, 4141:886, 2006.
5. **Y. Rathi**, S. Dambreville and A. Tannenbaum, *Statistical shape analysis using kernel PCA*, in: *SPIE Proceedings on Electronic Imaging*, volume 6064, pp. 425–432, 2006.
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Thesis

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Narrative Report

As the Director for Pediatric Image Computing at the Psychiatry Neuroimaging Laboratory (PNL), I lead (and co-lead) several scientific research projects which are at the interface of neuroscience and computer science, such as: 1) Fast diffusion MRI imaging for network abnormality detection in ADHD, 2). Geometric tissue layout abnormalities in Autism, 3). Motor tract deterioration in Huntington's disease, 4). Accurate placement of electrodes for deep brain stimulation in Parkinson's disease and in OCD, 5). Connectome in neonates and its impact in congenital heart disease, 6). Region-specific abnormalities in mild traumatic brain injury (mTBI), 7). Age-related gray and white matter structural changes in human and primate brains and 8). Microstructural tissue abnormalities in diseases such as schizophrenia, depression etc.

My research focus is to design novel mathematical algorithms that enable next generation of neuroimaging and neuroscience studies. I have developed award-winning algorithms that allow to trace complex neural fiber bundles in the brain from diffusion MRI data, which plays a very important role in the field of "connectomics". My work has also focused on the translational aspect of neuroimaging, where I applied compressed sensing theory to dramatically reduce diffusion MRI (dMRI) scan time by a factor of 4. Thus, advanced scans that were impractical before (took about an hour to scan) can now be easily done in a few minutes (5-10 minutes). This technology was considered be a significant development by the NIH, leading to the NIMH recognizing me among the NIMH's "new and notable"

principal investigators. I am currently a PI on an R01 grant funded to use this technology to image ADHD children (who tend to move a lot) for better understanding of the structural and functional brain differences in ADHD.

My recent work has also focused on more basic scientific enquiry such as designing sophisticated mathematical algorithms to determine the microstructural layout of the brain tissue at the micrometer level. Complementary to this work, I am also developing novel algorithms to obtain estimates of cerebral blood flow and blood volume from diffusion MRI data without the use of radioactive tracers. This method can be quite useful to determine the abnormalities in blood flow in a number of disorders from vascular dementia to congenital heart disease.

Image analysis methods are intricately linked to the acquisition methodology. In collaboration with my colleagues in the field of MR physics, neuroanatomy, and psychiatry, I am currently developing methods for ultra-high resolution diffusion imaging, which will be quantum leap from the existing state-of-the-art technology. This technique will dramatically improve the spatial resolution of dMRI data by an order of magnitude to provide unprecedented detail about the structure and layout of the brain tissue. This will have a wide impact on the entire field of neuroscience since it will lead to a significantly better understanding of several neuro-psychiatric disorders. The fiber bundles traced from such images will significantly alter the field of deep brain stimulation, allowing the neurosurgeon to accurately place the electrode in the brain accounting for the variability in the anatomy of each individual subject (as opposed to a one size fits all approach). I am also working with collaborators at the Boston Children's Hospital to design an optimal (fast and accurate) imaging protocol for diffusion imaging of neonate subjects.

Another major challenge faced by the neuroimaging scientific community is the difficulty in pooling diffusion MRI data acquired from multiple scanners and sites. This significantly hampers our ability to obtain statistically robust results due to low sample size at each site. One of my research directions has been to harmonize diffusion MRI data acquired from multiple sites, so that the data can be pooled together for large-scale data analysis. I am currently developing new algorithms to harmonize data despite changes in the acquisition parameters. This will enable pooling of a large amount of already acquired data from different parts of the world.

While scientific research is exciting, I also enjoy mentoring students and post-doctoral fellows on developing the right scientific acumen so that they can become good researchers. As such, I typically devote atleast 2 hours everyday in mentoring a few undergraduate/graduate students and post-doctoral fellows. Additionally, I am actively involved in organizing workshops on "computational diffusion MRI" every year in collaboration with researchers of international repute. I have also organized a "Sparse Reconstruction Challenge for diffusion MRI", where more than 9 teams from around the world participated, contributing 16 different algorithms to be compared on data acquired from a single diffusion MRI phantom. Organizing such challenges is critical for providing an informed decision to neuroscientists on the best algorithm and acquisition scheme to use for their studies. Along with being actively involved in peer-reviewing for major scientific journals, I am also an Associate Editor for the journal "Frontiers in Neuroscience, Brain Imaging Methods".

To summarize, my research interest spans several fields and lies at the interface of neuroscience, neurobiology, computer science and mathematics. My goal is to develop technology for transforming our understanding of the brain from the microstructure to the macrostructure and anatomical level. Further, developing new mathematical methods that allow for pushing the frontiers of technology, both for understanding the brain structure as well as guiding and monitoring clinical interventions is my key focus for significantly improving our current understanding of mental disorders.