Saurabh Jain

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Research Interests

Signal and Image Processing, Medical Image Analysis, and Pattern Recognition. Strong theoretical and applied background in Wavelet Analysis, Harmonic Analysis, Markov Random Fields, Frame Theory, Image Segmentation, and Diffeomorphic Registration.

Education

PhD in Mathematics August 2009 University of Houston, Texas

GPA 4.0

Thesis: Isotropic Multiresolution analysis and Rotational Invariance in Image Analysis.

Advisor: Prof. M. Papadakis.

Coursework included Wavelet Analysis, Harmonic Analysis, Data-Mining and Automatic Learning (SVMs), Gibbs-Markov Random Fields, Functional Analysis, Information Theory.

MS in Applied Mathematics December 2005 University of Houston, Texas

GPA 4.0

Coursework included Numerical Analysis, Optimization, Partial Differential Equations, Basic scientific computing, Probability and Statistics.

Bachelor of Science May 2003 St. Stephen's College, Delhi University, India

Computing Skills

- Extensive programming experience in C/C++, FORTRAN, and MATLAB®.
- Applied solid background in JAVA, Python, and Parallel computing (MPI/ OpenMP).
- Experience with LINUX, MACINTOSH and WINDOWS environments.
- Knowledge of special purpose software: MATHEMATICA®, Latex, Octave, GNUPlot, 3D-Slicer, Paraview.
- Knowledge of large scale C/C++ libraries: ITK/VTK, Boost, GTS, Blitz++, Qt.

Recent Positions

Research Scientist, Advanced Products November 2014 - Present Think Surgical Inc., Fremont, CA

- Development of automatic and semi-automatic segmentation algorithms.
- Development of the next generation 3D surgical planning system for robotic hip and knee replacement surgery.

Visiting Scientist February 2015 - present Johns Hopkins Univ., Center for Imaging Science

- Development of remote processing pipeline for Shape Analysis.
- Development of pattern recognition framework for the study of Parkinson's disease progression.

Assistant Research Scientist January 2014 - November 2014 Johns Hopkins Univ., Center for Imaging Science

- Development of remote processing pipeline for Shape Analysis.
- Cardiac motion simulation based on fiber tracks obtained from DTI images.

Past Professional Experience

Post-doctoral Research Fellow January 2011 - January 2014 Johns Hopkins Univ., Center for Imaging Science

- Research and development of diffeomorphic image registration and shape matching techniques for Neuroscience and Cardiac imaging.
- Software development for various flavors of Large Deformation Diffeomorphic Metric Mapping (LDDMM) in C++.

Post-doctoral Research Fellow September 2009 - December 2010 Univ. of Houston, Dept. of Mathematics

- Project 1: 3D texture classification: applications in biomedical diagnostic imaging.
- Project 2: 3D-echocardiographic image sequences: software development to generate dynamic models of human mitral valve.
- Full responsibility for the development and maintenance of software for the two projects.
- Effective communication of ideas between a multidisciplinary team of mathematicians, engineers, and cardiac surgeons.

Graduate Research Assistant January 2005 - August 2009 Univ. of Houston, Dept. of Mathematics

- Development of theory and code for isotropic wavelet transforms for directionally unbiased processing of medical and seismic data.
- Development of parallel FORTRAN code for migration of huge seismic datasets using isotropic wavelet frames.
- Segmentation of $\mu-$CT scans of coronary arteries for the detection of atherosclerotic plaque.

Research & Technology Intern June 2007 - August 2007 Total E & P USA Inc., Houston, TX.

- Application of downsampling methods for improving the computational efficiency of seismic imaging techniques (Fourier Finite Differences and Reverse Time Migration).

Geophysical Research Intern June 2006 - August 2006 Total E & P USA Inc., Houston, TX.

- Application of new isotropic wavelet based techniques to seismic imaging for improving the efficiency of the so-called explicit schemes.
- Implementation of filter design techniques (McClellan and Soubaras transforms) for integration into Total E& P's proprietary software.

Undergraduate Research Assistant Sep 2001 - May 2003 ICMS, St. Stephen's College, Delhi, India.

- Development of JAVA based code to perform PCA for an image recognition project.
- Development of JAVA based simulation of dynamics of gas molecules enclosed in a container. The empirical velocity distribution, obtained from the simulation, matched the theory very closely.

Invited Presentations

- **Optimal Control Problems in Computational Anatomy.** Presented at Applied and Computational Math Seminar, George Mason University, Fairfax, VA, Nov 2013.
- **Optimal Control Problems in Computational Anatomy.** Presented at Shape Focus Research Group Meeting, Baltimore, MD, May 2013.
- **Using Wavelets, Random Fields, and Diffeomorphisms to Tackle Challenges in Medical Imaging.** Presented at Sony Electronics Research, San Jose, CA, May 2012.
- **Matching Surface To Sparse Cross Sections using Euclidean Distance.** Presented at Shape Focus Research Group Meeting, ENS Cachan, France, May 2012.
- **A Few Computational Challenges in 3D Biomedical Imaging.** Presented at Center for Imaging Science Seminar, Johns Hopkins University, September 2010.
- **Rigid Motion Invariant Classification of 3D-Textures.** Presented at 2009 Fall Southeastern Meeting of AMS, Special Session on Inverse Problems and Signal Processing.
- **Isotropic Multiresolution Analysis: Theory and Applications.** Presented at the March 2009 workshop on "Frames from first principles: Error correction, symmetry goals, and numerical efficiency" held at Banff International Research Station, Banff, Alberta, Canada.
- **Multiscale 3-D texture segmentation: Isotropic Representations.** Presented at 2008 Spring Southeastern Meeting of AMS, Special Session on Wavelets, Frames, and Multi-Scale Constructions.

Journal and Conference Publications

- **Towards Real-time Simulation of Cardiac Hemodynamics for the Diagnosis and Treatment of Heart Diseases** - *joint with Young Joon Choi, Rajat Mittal, Laurent Younes et. al.* in preparation, 2015.
- **Shape Analysis of Hypertrophic and Hypertensive Cardiomyopathies Using MRI based 3D Surface Models of Left Ventricular Geometry** - *joint with Siamak Ardekani, Michael Miller, Laurent Younes, et. al.* in preparation, 2015.
- **Investigating the regional correlation of subcortical structures as imaged by DAT SPECT with clinical phenotypes in Parkinson's disease** -*A. Rahmim Y. Salimpour, S. Jain, G. Smith, Z. Mari, V. Sossi.* accepted SNMMI annual meeting, 2015.
- **Novel Parameters of Global and Regional Mitral Annulus Geometry** - *joint with Sagit Ben-Zekry, Robert Azencott et. al.* accepted in European Heart Journal - Cardiovascular Imaging, 2015.
- **Application of Pattern Recognition Framework for Quantification of Parkinson's Disease in DAT SPECT Imaging** - *Saurabh Jain, Laurent Younes, Gwenn Smith, Zoltan Mari, Vesna Sossi, Arman Rahmim.* In proceedings IEEE Nucl. Sci. Symp. Conf. Record, 2014.
- **OpenCL Acceleration of Large Deformation Diffeomorphic Metric Mapping** - *Daniel Tward, Saurabh Jain, Tilak Ratnanather, Laurent Younes, and Michael Miller.* In proceedings of the MICCAI High Performance Computing Workshop, 2014.
- **Estimating Dense Cardiac 3D Motion Using Sparse 2D Tagged MRI Cross-sections** - *Siamak Ardekani, Geoffrey Gunter, Saurabh Jain, Robert G. Weiss, Michael Miller, Laurent Younes.* In proceedings of the 36th Annual IEEE-Engineering in Medicine and Biology Conference, Pages 5101-5104, 2014.
- **Computational Anatomy Gateway: Leveraging XSEDE Computational Resources for Shape Analysis** - *Saurabh Jain, Daniel Tward, David Lee, Anthony Kolasny, Timothy Brown, Tilak Ratnanather, Laurent Younes and Michael Miller.* In proceedings of the 2014 Annual Conference on Extreme Science and Engineering Discovery Environment (XSEDE14), ACM, New York, NY, USA, Article 54, 2014, 6 Pages.
- **Comparative Evaluation of Mitral Valve Strain by Deformation Tracking in 3D-Echocardiogarphy** - *S. Ben-Zekry, G. Lawrie, S. Little, W. Zoghbi, J. Freeman, A. Jajoo, S. Jain, J. He, A. Martynenko, and R. Azencott.* Cardiovascular Engineering and Technology, Springer, Volume 3, Issue 4, 2012, Pages 402-412.
- **Semi-Automatic Discrimination of Normal Tissue and Liver Cancer Lesions in Contrast Enhanced X-Ray CT-Scans** - *Sanat Upadhyay, Manos Papadakis, Saurabh Jain, Gregory Gladish, Ioannis Kakadiaris, Robert Azencott.* In proceedings MICCAI Oct 2012 - Abdominal Imaging. Computational and Clinical Applications. LNCS 7601, Pages 158-167, Springer, 2012.
- **Rigid Motion Invariant Classification of 3D-Textures** - *S. Jain, S.Upadhyay, M. Papadakis, and R. Azencott.* IEEE - Transactions on Image Processing, Volume 21, Issue 5, 2012, Pages 2449-2463.
- **Matching Sparse Sets of Cardiac Image Cross-sections Using Large Deformation Diffeomorphic Metric Mapping Algorithm** - *Siamak Ardekani, Aastha Jain, Saurabh Jain, Theodore P. Abraham, Maria R. Abraham, Stefan Zimmerman, Raimond L. Winslow, Michael I. Miller, and Laurent Younes.* Workshop on Statistical Atlases and Computational Models of the Heart, MICCAI Sep, 2011. *(Poster Presentation)*. In Proceedings LNCS 7085, Pages 234-243, Springer, 2012.
- **3D-Rigid Motion Invariant Discrimination and Classification of 3D-Textures** - *S.Upadhyay, S. Jain, M. Papadakis, and R. Azencott.* Wavelets and Sparsity XIV, Proceedings of SPIE 8138, M. Papadakis, D.V.D. Ville, V. Goyal (Editors) 813821, Sep 2011.
- **Novel Parameters of Global and Regional Mitral Annulus Geometry: Comparison Among Healthy, Organic Mitral Regurgitation and Following Mitral Valve Repair Surgery** - *Sagit Ben Zekry, Saurabh Jain, Simon K. Alexander, Yipeng*

Li, Aanchal Aggarwal, Aarti Jajoo, Stephen H. Little, Gerald M. Lawrie, William A. Zoghbi. American Society of Echocardiography, 21st Annual Scientific Sessions, June 12-15, 2010, San Diego, CA, P3-26. *(Poster Presentation)*.

- **Quantitative Dynamic Curvature Changes of the Normal Mitral Valve Leaflets During Systole: Insights from Novel Mitral Valve Modeling** - *Sagit Ben-Zekry, Simon K. Alexander, Saurabh Jain, Yipeng Li, Aanchal Aggarwal, Robert Azencott, Gerald M. Lawrie, Stephen H. Little, William A. Zoghbi.* American Society of Echocardiography, 21st Annual Scientific Sessions, June 12-15, 2010, San Diego, CA, P3-53. *(Poster Presentation)*.
- **The Geometry and the Analytic Properties of Isotropic Multiresolution Analysis** - *Juan R. Romero, Simon K. Alexander, Shikha Baid, Saurabh Jain, and Manos Papadakis.* in Special issue on "Mathematical Methods for Image Processing", Advances in Computational Mathematics, Volume 31, Springer, 2009, Pages 283-328.
- **Texture-Based Tissue Characterization for High-resolution CT Scans of Coronary Arteries** - *Manos Papadakis, Bernhard G. Bodmann, Simon K. Alexander, Deborah Vela, Shikha Baid, Alex A. Gittens, Donald J. Kouri, S. David Gertz, Saurabh Jain, Juan R. Romero, Xiao Li, Paul Cherukuri, Dianna D. Cody, Gregory W. Gladish, Ibrahim Aboshady, Jodie L. Conyers, and S. Ward Casscells.* Communications in Numerical Methods in Engineering, Volume 25, Wiley, 2009, Pages 597-613.
- **Explicit Schemes in Seismic Migration and Isotropic Multi-scale Representations** - *S. Jain, M. Papadakis and E. Dussaud.* Radon Transforms, Geometry and Wavelets, Contemporary Mathematics, Volume 464, AMS, 2008, Pages 177-200.

Awards

- UH, Department of Mathematics scholarship during the year 2006-07 for academic and teaching excellence.
- SANWA bank scholarship during the year 2002-03 for the best student in my undergraduate class at St. Stephen's College.
- Prize for the best student in the B.Sc. class of 2003 at St. Stephen's College.
- EXMA scholarship during the year 1998-99 for the best performance at high school public examinations.

Service

- Reviewer for IEEE-TPAMI, CVPR 2014, 2015, MICCAI 2013, 2014, 2015, IEEE-EMBC 2015, and ICCV 2015.
- Co-organizer, with Casey Richardson, for the Shape Analysis Meeting, hosted by Center for Imaging Science, at Sheraton, Towson, MD, May 2013.