

Matineh Shaker

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Education

Northeastern University, MA

PhD candidate in Electrical Engineering, July 2012-Present

University of Iowa, IA

M.S. in Computer Engineering, 2008-2010

University of Tehran, Iran

B.S and M.S. in Electrical/Biomedical Engineering with honors, 2002-2007

Work Experience

Predoctoral Fellow, Brigham and Women's hospital, Harvard Medical School

Boston, MA. Jan 2015- Present

Graphical models:

- Proposed a multivariate Gaussian graphical model to represent brain regions dependencies. The sparsities on the estimated data distribution was imposed by lasso norm penalty term and an expert prior graph which enforced a structure on the precision matrix.

Research Assistant, Northeastern University

Boston, MA. July 2012- Present

Thesis: Adding Expert Knowledge in Sparse Learning of High Dimensional Diffusion Data in Traumatic Brain Injury

Manifold and kernel methods:

- Proposed a computationally efficient graph-based algorithm for exact calculation of kernel density derivative estimates. Elimination of redundant computations leads to significantly faster algorithm in higher dimensions and derivative orders.
- Created a general purpose kernel methods library which employs built-in multivariate kernels and derivatives using five bandwidth parameterization methods. The library contains algorithms for density/gradient/Hessian estimation, clustering, ridge regression, kernel regression, dimensionality reduction, manifold unwrapping. Development is ongoing using MATLAB and object-oriented C++.
- Integrating principal curves projection on segmentation and center line extraction of curvilinear objects from images. Application in tracking axons from brainbow images, and segmenting vascular structures from microscopic brain images.

Statistical signal processing:

Improving quantification of intravascular near-infrared fluorescence (iNIRF) imaging. The goal is to detect biomarkers of vascular pathology such as high-risk plaques by processing the fluorescence signal. Matched filter approach is used for maximum likelihood detection of signals with deterministic unknown parameters.

R&D Engineer, Eigen

Grass Valley, CA. June 2011-May 2012

Data fusion and image registration:

- Enhanced the real-time fusion of Ultrasound images and pre-operative MRI, applied to next generation prostate biopsy systems. Applying Rigid 3D mutual information image registration prior to the previously used non-rigid surface-based registration, improved the performance. Development was in C++ and ITK.

Research Assistant, University of Iowa Hospitals and Clinics

Iowa City, IA. Sept 2008- May 2011

MR-Guided internal radiotherapy:

- Resolved a misalignment problem of MR scans acquired over cervical cancer therapy sessions. The radiation source is inserted into the body by an applicator, and is precisely placed at the site of the tumor, when MR scanner is acquiring images. Since organs and tumors are more recognizable in the direction perpendicular to the applicator, the axial scans are saved in a rotated version,

where patient's current anatomy defines the unknown angle. Inverse engineering the problem using a phantom led to finding a 3D rotational transformation which corrects slices back to the axial plane.

- Applied deformable image registration for tracking organ deformations amongst radiation therapy sessions. Voxel-to-voxel correspondences are critical for precise calculation of accumulated dose distribution over several therapy sessions. The Registration technique was large deformation diffeomorphic demons.

Human electronic lung atlas:

- Developed a queryable electronic atlas for quantitatively characterizing the normal human lung airway tree. The airway measurements are from segmentation and volumetry of CT images of lung. The front-end GUI allows rapid retrieval and statistical comparison of 2500 airway and volume measurements among queries on groups of subjects with different demographics and health status. GUI is connected to an SQL back-end database. MySQL, Python, Visual Basic, and Microsoft Access were used in this project.

Computer Skills

Programming	C, C++, MATLAB, Visual Basic, Shell-Scripting, Python
Operating Systems	MS/DOS, Windows, UNIX/LINUX, Macintosh
Version Control	Git, SVN, CVS
Database/Web	SQL, Microsoft Access, XML, HTML
Text Editor	vi, gedit, LaTeX, Word
Miscellaneous:	ITK, VTK, 3D Slicer, Dicom, Mex Functions

Publications

- M. Shaker, D. Erdogmus, J. Dy, S. Bouix, "Adding Expert Knowledge in Sparse Learning of High Dimensional Diffusion Data in Traumatic Brain Injury," Submitted to MICCAI 2015.
- M. Shaker, J. N. Myhre, M. D. Kaba, D. Erdogmus, "Invertible Nonlinear Cluster Unwrapping," *IEEE International Workshop on Machine Learning and Signal Processing (MLSP)*, pp. 1-6, 2014.
- M. Shaker, J. N. Myhre, D. Erdogmus, "Computationally Efficient Exact Calculation of Kernel Density Derivative Estimates," *Journal of Signal Processing Systems* (2014): 1-12.
- G.E. Christensen, N. E. Burnette, W. Gao, M. Shaker, J. M. Reinhardt, J. E. Cook-Granroth, G. McLennan, E. A. Hoffman, "Human Airway Tree Structure Query Atlas", *Proceedings of SPIE Medical Imaging Conference*, San Diego, California, USA, February 13-18, 2010.
- M. Shaker, H. Soltanian-Zadeh, "Atlas-Based Segmentation of Brain Structures in Temporal Lobe Epilepsy Using Optimized Voxel-Based Morphometry," *Proceedings of 22nd International Congress and Exhibition of Computer Assisted Radiology and Surgery*, Barcelona, June 25-28, 2008.
- M. Shaker, H. Soltanian-Zadeh, "Automatic Segmentation of Brain Structures from MRI integrating Atlas-Based Labeling and Level Set Method", *Proceedings of IEEE Canadian Conference on Electrical and Computer Engineering*, Niagara Falls, Ontario, Canada, May 4-7, 2008, pp. 1755-1758.
- M. Shaker, H. Soltanian-Zadeh, "Voxel-Based Morphometric Study of Brain Regions from Magnetic Resonance Images in Temporal Lobe Epilepsy", *Proceedings of IEEE Southwest Symposium on Image Analysis and Interpretation*, Santa Fe, New Mexico, USA, March 24-26, 2008, pp. 209-212.
- M. Shaker, C. Lucas, A. H. Jafari, "A Neuro-Fuzzy Approach for Trajectory Tracking of Two-Link Robot Manipulators", *8th Congress on Intelligent Systems*, Iran, August 29-31, 2007.

Selected Courses

Stochastic processes
 Detection and estimation
 Discrete-time signal processing
 Information theory and coding
 Advanced image processing
 Pattern recognition
 Numerical optimization
 Graph algorithms and combinatorial optimization
 High performance computer architecture
 Concepts of object-oriented design with C++

<p>Honors</p>	<p>University of Iowa college of engineering scholarship (2008-2010). Best poster award in Iranian imaging informatics conference (2008). Recognized as honor student during undergraduate studies (2003-2006). Ranked 144 among approximately 300,000 in national university entrance exam (2002). National mathematics Olympiads semifinalist in high school (2001).</p>
<p>Academic Activities</p>	<p>IEEE Transaction on Medical Imaging reviewer (TMI) IEEE Transaction on Image Processing reviewer (TIP) IEEE Signal Processing Letters reviewer (SPL) Pattern Recognition Letters (PRL) International Conference on Image Processing (ICIP) IEEE International Symposium on Biomedical Imaging (ISBI) High-performance computing for medical imaging using GPU workshop (SPIE 2012). Workshop on modeling boundaries of objects by IPAM (UCLA 2013).</p>
<p>Leadership</p>	<p>President of Iranian Student Association at Northeastern. Repository manager and developer across a group of 15 PhD students.</p>
<p>Extracurricular Activities</p>	<p>Piano Vocal (solo performer) Ping-Pong (Northeastern's intramurals champion) Volleyball</p>