Xiang Li

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Place of Birth: **China**

Education:

2006	B.E.	Automation	Shanghai Jiaotong University
2016	PhD	Computer Science, Prof. Tianming Liu	University of Georgia

Postdoctoral Training:

09/16-	Research Fellow	Medical Image Analysis, Assoc. Prof. Quanzheng Li	Harvard Medical School and Massachusetts General Hospital

Professional Societies:

2011-	Institute of Electrical and Electronics Engineers	Member
2011-	Engineering in Medicine and Biology Society	Member
2011-	The Medical Image Computing and Computer Assisted Intervention Society	Member, Program Committee
2017-	American Roentgen Ray Society	Member

Editorial Activities:

Ad hoc Reviewer

Array
BMC Bioinformatics
Computer Methods and Programs in Biomedicine
Frontiers in Neural Circuits
IEEE/ACM Transactions on Computational Biology and Bioinformatics
IEEE Transactions on Affective Computing
IEEE Transactions on Biomedical Engineering
IEEE Transactions on Medical Imaging
Neurocomputing
Neuroimage
Pattern Recognition
Physical Communication

Other Editorial Roles

2018-	Editorial Board	Journal of Healthcare Engineering

Honors and Prizes:

2016	Outstanding Graduate Dissertation/Thesis	University of Georgia	Thesis

Report of Regional, National and International Invited Teaching and Presentations

No presentations below were sponsored by outside entities

National

2018 Deep Learning Algorithm for rapid automatic detection of pneumothorax on chest CT (selected oral abstract)
Annual Meeting of American Roentgen Ray Society
Washington, D.C.

International

2016 Big Data Strategies on Neuroimaging Analysis: Challenge in Data Availability and Computation (invited talk)
International Conference on Brain Informatics and Health
Omaha, NE

2014 Dynamic network partition via Bayesian connectivity bi-partition change point model (selected oral full-length paper)
The IEEE International Symposium on Biomedical Imaging
Beijing, China

2013 Discovering common functional connectomics signatures (selected oral full-length paper)
The IEEE International Symposium on Biomedical Imaging
San Francisco, CA

2011 Brain state change detection via fiber-centered functional connectivity analysis (selected oral full-length paper)
The IEEE International Symposium on Biomedical Imaging
Chicago, IL

Report of Technological and Other Scientific Innovations

Automatic pre-screening method for pneumothorax detection	As a research fellow at MGH, I developed a software system for the automatic detection of pneumothorax from CT images. The system has been validated internally by multiple radiologists. The innovation is filed as Invention Disclosure to Partners HealthCare in 2017.

Report of Scholarship

Peer-Reviewed Scholarship in print or other media:

1. Wang H, Xie K, Xie L, **Li X**, Li M, Lyu C, Chen H, Chen Y, Liu X, Tsien J, Liu T. Functional Brain Connectivity Revealed by Sparse Coding of Large-Scale Local Field Potential Dynamics. Brain Topography. 2019; 32(2): 255-270.
2. **Li X**, Guo N, Li Q. Functional Neuroimaging in the New Era of Big Data. Genomics Proteomics and Bioinformatics. 2019 in press.
3. Guo Z*, **Li X***, Huang H, Guo N, Li Q. Deep Learning-based Image Segmentation on Multi-modal Medical Imaging. IEEE Transactions on Radiation and Plasma Medical Sciences. 2019 in press.
4. Zhang W, Lv J, **Li X**, Zhu D, Jiang X, Zhang S, Zhao Y, Guo L, Ye J, Hu D, Liu T. Experimental Comparisons of Sparse Dictionary Learning and Independent Component Analysis for Brain Network Inference from fMRI Data. IEEE Transactions on Biomedical Engineering. 2018; 66:1.

5. Thrall JH, **Li X**, Li Q, Cruz C, Do S, Dreyer K, Brink J. Artificial Intelligence and Machine Learning in Radiology: Opportunities, Challenges, Pitfalls, and Criteria for Success. Journal of the American College of Radiology. 2018;15(3):504-8.
    - Topics. Michael W. To become leaders in AI, radiologists must address a variety of challenges. 2018 Feb 16.
6. Makkie M*, **Li X***, Quinn S, Lin B, Ye J, Mon G, Liu T. A Distributed Computing Platform for fMRI Big Data Analytics. IEEE Transactions on Big Data. 2018 in press.
7. Ge B, **Li X**, Jiang X, Sun Y, Liu T. A Dictionary Learning Approach for Signal Sampling in Task-based fMRI for Reduction of Big Data. Frontiers in Neuroinformatics. 2018;12:17.
8. Jiang X, **Li X**, Lv J, Zhao S, Zhang S, Zhang W, Zhang T, Han J, Guo L, Liu T. Temporal dynamics assessment of spatial overlap pattern of functional brain networks reveals novel functional architecture of cerebral cortex. IEEE Transactions on Biomedical Engineering. 2016;65(6):1183-92.
9. Yuan J, **Li X**, Zhang J, Luo L, Dong Q, Lv J, Zhao Y, Jiang X, Zhang S, Zhang W, Liu T. Spatio-temporal modeling of connectome-scale brain network interactions via time-evolving graphs. NeuroImage. 2017;180(Pt B):350-369.
    - Editorial. Florence T. New ways of understanding brain neurocircuitry. 2018 Aug.
10. Li Y, Chen H, Jiang X, **Li X**, Lv J, Peng H, Tsien JZ, Liu T. Discover mouse gene coexpression landscapes using dictionary learning and sparse coding. Brain Struct Funct. 2017;222(9):4253-70.
11. Li Y, Chen H, Jiang X, **Li X**, Lv J, Li M, Peng H, Tsien JZ, Liu T. Transcriptome Architecture of Adult Mouse Brain Revealed by Sparse Coding of Genome-Wide In Situ Hybridization Images. Neuroinformatics. 2017;15(3):285-95.
12. Farhadi H, Xiang Y, Jeong S, **Li X**, Guo N, Sepulcre J, Tarokh V, Li Q. Inferring the causality network of Abeta and Tau accumulation in the aging brain: a statistical inference approach. Journal of Nuclear Medicine. 2017;58(supplement 1):803.
13. Zhang S*, **Li X***, Lv J, Jiang X, Guo L, Liu T. Characterizing and differentiating task-based and resting state fMRI signals via two-stage sparse representations. Brain Imaging and Behavior. 2016;10(1):21-32.
14. Hou Y, Xiao T, Zhang S, Jiang X, **Li X**, Hu X, Han J, Guo L, Miller LS, Neupert R. Predicting Movie Trailer Viewer's “Like/Dislike” via Learned Shot Editing Patterns. IEEE Transactions on Affective Computing. 2016;7(1):29-44.
15. Ou J, Xie L, **Li X**, Zhu D, Terry DP, Puente AN, Jiang R, Chen Y, Wang L, Shen D. Atomic connectomics signatures for characterization and differentiation of mild cognitive impairment. Brain Imaging and Behavior. 2015;9(4):663-77.
16. Ou J, Xie L, Jin C, **Li X**, Zhu D, Jiang R, Chen Y, Zhang J, Li L, Liu T. Characterizing and differentiating brain state dynamics via hidden Markov models. Brain Topogr. 2015;28(5):666-79.
17. Makkie M, Zhao S, Jiang X, Lv J, Zhao Y, Ge B, **Li X**, Han J, Liu T. HAFNI-enabled largescale platform for neuroimaging informatics (HELPNI). Brain Inf. 2015;2(4):225-38.
18. Lv J, Jiang X, **Li X**, Zhu D, Zhao S, Zhang T, Hu X, Han J, Guo L, Li Z. Assessing effects of prenatal alcohol exposure using group-wise sparse representation of fMRI data. Psychiatry Research: Neuroimaging. 2015;233(2):254-68.
19. Lv J*, Jiang X*, **Li X***, Zhu D, Zhang S, Zhao S, Chen H, Zhang T, Hu X, Han J. Holistic atlases of functional networks and interactions reveal reciprocal organizational architecture of cortical function. IEEE Transactions on Biomedical Engineering. 2015;62(4):1120-31.
20. Lv J*, Jiang X*, **Li X***, Zhu D, Chen H, Zhang T, Zhang S, Hu X, Han J, Huang H. Sparse representation of whole-brain fMRI signals for identification of functional networks. Medical image analysis. 2015;20(1):112-34.
21. Jiang X, **Li X**, Lv J, Zhang T, Zhang S, Guo L, Liu T. Sparse representation of HCP grayordinate data reveals novel functional architecture of cerebral cortex. Human brain mapping. 2015;36(12):5301-19.
22. Zhang X*, **Li X***, Jin C, Chen H, Li K, Zhu D, Jiang X, Zhang T, Lv J, Hu X. Identifying and characterizing resting state networks in temporally dynamic functional connectomes. Brain Topogr. 2014;27(6):747-65.
23. Zhang J*, **Li X***, Li C, Lian Z, Huang X, Zhong G, Zhu D, Li K, Jin C, Hu X. Inferring functional

interaction and transition patterns via dynamic bayesian variable partition models. Human brain mapping. 2014;35(7):3314-31.
24. Sabatinelli D, Frank D, Wanger T, Dhamala M, Adhikari B, **Li X**. The timing and directional connectivity of human frontoparietal and ventral visual attention networks in emotional scene perception. Neuroscience. 2014;277:229-38.
25. Ou J, Lian Z, Xie L, **Li X**, Wang P, Hao Y, Zhu D, Jiang R, Wang Y, Chen Y. Atomic dynamic functional interaction patterns for characterization of ADHD. Human brain mapping. 2014;35(10):5262-78.
26. **Li X**, Zhu D, Jiang X, Jin C, Zhang X, Guo L, Zhang J, Hu X, Li L, Liu T. Dynamic functional connectomics signatures for characterization and differentiation of PTSD patients. Human brain mapping. 2014;35(4):1761-78.
27. Zhang X, Guo L, **Li X**, Zhang T, Zhu D, Li K, Chen H, Lv J, Jin C, Zhao Q. Characterization of task-free and task-performance brain states via functional connectome patterns. Medical image analysis. 2013;17(8):1106-22.
28. **Li X**, Lim C, Li K, Guo L, Liu T. Detecting brain state changes via fiber-centered functional connectivity analysis. Neuroinformatics. 2013;11(2):193-210.
29. Sun J, Hu X, Huang X, Liu Y, Li K, **Li X**, Han J, Guo L, Liu T, Zhang J. Inferring consistent functional interaction patterns from natural stimulus FMRI data. NeuroImage. 2012;61(4):987-99.

Other peer-reviewed scholarship

30. Zhao J, Li Q, **Li X**, Li H, Zhang L. Automated Segmentation of Cervical Nuclei in Pap Smear Images using Deformable Multi-path Ensemble Model. 2019 IEEE 16th International Symposium on; 2019: IEEE.
31. Zhao X*, **Li X***, Guo N, Zhou Z, Meng X, Li Q. Multi-Size Computer-Aided Diagnosis of Positron Emission Tomography Images Using Graph Convolutional Networks. 2019 IEEE 16th International Symposium on; 2019: IEEE.
32. Bao H*, Ren H*, Zhou Z*, **Li X***, Guo N, Li Q. 3D Regional Shape Analysis of Left Ventricle Using MR Images: Abnormal Myocardium Detection and Classification. 2019 IEEE 16th International Symposium on; 2019: IEEE.
33. Zhou Z, Guo N, Cui J, Meng X, Hu Y, Bao H, **Li X**, Li Q. Novel Radiomic Features Based on Graph Theory for Pet Image Analysis. 2019 IEEE 16th International Symposium on; 2019: IEEE.
34. Zhang M*, **Li X***, Xu M, Li Q. Image Segmentation and Classification for Sickle Cell Disease using Deformable U-Net. International Conference on Medical Image Computing and Computer-Assisted Intervention; 2018: Springer.
35. Zhao Y*, **Li X***, Zhang W, Zhao S, Makkie M, Zhang M, Li Q, Liu T. Modeling 4D fMRI Data via Spatio-Temporal Convolutional Neural Networks (ST-CNN). International Conference on Medical Image Computing and Computer-Assisted Intervention; 2018: Springer.
36. Liu J*, **Li X***, Ren H*, Li Q. Multi-Estimator Full Left Ventricle Quantification through Ensemble Learning. Statistical Atlases and Computational Modelling of the Heart Workshop; 2018: Springer.
37. Guo Z*, **Li X***, Huang H, Quo N, Li Q, Medical image segmentation based on multi-modal convolutional neural network: Study on image fusion schemes. Biomedical Imaging (ISBI 2018), 2018 IEEE 15th International Symposium on; 2018: IEEE.
38. Zhao Y*, **Li X***, Makkie M, Quinn S, Lin B, Ye J, Liu T, Template-guided Functional Network Identification via Supervised Dictionary Learning. Biomedical Imaging (ISBI 2017), 2017 IEEE 14th International Symposium on; 2017: IEEE.
39. Zhang S*, **Li X***, Guo L, Liu T, Exploring human brain activation via nested sparse coding and functional operators. Biomedical Imaging (ISBI 2017), 2017 IEEE 14th International Symposium on; 2017: IEEE.
40. **Li X**, Zhong A, Lin M, Guo N, Sun M, Sitek A, Ye J, Thrall J, Li Q, Self-paced Convolutional Neural Network for Computer Aided Detection in Medical Imaging Analysis. International Workshop on Machine Learning in Medical Imaging; 2017: Springer.
41. Jeong S*, **Li X***, Yang J, Li Q, Tarokh V. Dictionary Learning and Sparse Coding-based Denoising for High-Resolution Task Functional Connectivity MRI Analysis. International Workshop on Machine Learning in Medical Imaging; 2017: Springer.

42. Mon G, Makkie M, **Li X**, Liu T, Quinn S. Implementing dictionary learning in Apache Flink. Big Data (Big Data), 2016 IEEE International Conference on; 2016: IEEE.
43. Makkie M*, **Li X***, Liu T, Quinn S, Lin B, Ye J. Distributed rank-1 dictionary learning: Towards fast and scalable solutions for fMRI big data analytics. Big Data (Big Data), 2016 IEEE International Conference on; 2016: IEEE.
44. Lyu C, **Li X**, Lv J, Hu X, Han J, Quo L, Liu T. Identifying group-wise consistent sub-networks via spatial sparse representation of natural stimulus FMRI data. Biomedical Imaging (ISBI), 2016 IEEE 13th International Symposium on; 2016: IEEE.
45. **Li X**, Makkie M, Lin B, Fazli MS, Davidson I, Ye J, Liu T, Quinn S. Scalable Fast Rank-1 Dictionary Learning for fMRI Big Data Analysis. Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining; 2016.
46. **Li X**, Lin B, Lv J, Ye J, Liu T. Modeling functional network dynamics via multi-scale dictionary learning and network continuums. 2016 IEEE International Symposium on Biomedical Imaging: From Nano to Macro; 2016.
47. **Li X**, Dong Q, Jiang X, Lv J, Liu T. Multple-demand system identification and characterization via sparse representations of fMRI data. Biomedical Imaging (ISBI), 2016 IEEE 13th International Symposium on; 2016: IEEE.
48. Jiang X, **Li X**, Lv J, Zhao S, Zhang S, Zhang W, Zhang T, Liu T. Modeling Functional Dynamics of Cortical Gyri and Sulci. International Conference on Medical Image Computing and Computer-Assisted Intervention; 2016: Springer.
49. Lian Z, **Li X**, Pan Y, Guo X, Chen L, Chen G, Wei Z, Liu T, Zhang J. Dynamic Bayesian brain network partition and connectivity change point detection. Computational Advances in Bio and Medical Sciences (ICCABS), 2015 IEEE 5th International Conference on; 2015: IEEE.
50. **Li X**, Zhou Z, Keller P, Zeng H, Liu T, Peng H. Interactive exemplar-based segmentation toolkit for biomedical image analysis. Biomedical Imaging (ISBI), 2015 IEEE 12th International Symposium on; 2015: IEEE.
51. Ge B, Wang J, Lv J, Zhang S, Zhao S, Zhang W, Zhao Q, **Li X**, Jiang X, Han J. Signal sampling for efficient sparse representation of resting state FMRI data. 2015 IEEE 12th International Symposium on Biomedical Imaging (ISBI); 2015: IEEE.
52. Zhu D, **Li X**, Liu T. Sparse representation of working memory processes based on fMRI data. Biomedical Imaging (ISBI), 2014 IEEE 11th International Symposium on; 2014: IEEE.
53. Zhang S, Hu X, Lv J, Zhang T, **Li X**, Jiang X, Guo L, Liu T. Learning fMRI-guided predictor of video shot changes. Biomedical Imaging (ISBI), 2014 IEEE 11th International Symposium on; 2014: IEEE.
54. Lyu C, Hu X, Han J, Cheng G, **Li X**, Guo L, Liu T. Exploring consistent functional brain networks during free viewing of videos via sparse representation. Biomedical Imaging (ISBI), 2014 IEEE 11th International Symposium on; 2014: IEEE.
55. Lian Z, Lv J, Xing J, **Li X**, Jiang X, Zhu D, Xu J, Potenza MN, Liu T, Zhang J. Generalized fMRI activation detection via Bayesian magnitude change point model. Biomedical Imaging (ISBI), 2014 IEEE 11th International Symposium on; 2014: IEEE.
56. Lian Z*, **Li X***, Zhang H, Kuang H, Xie K, Xing J, Zhu D, Tsien JZ, Liu T, Zhang J. Detecting cell assembly interaction patterns via Bayesian based change-point detection and graph inference model. Biomedical Imaging (ISBI), 2014 IEEE 11th International Symposium on; 2014: IEEE.
57. Lian Z*, **Li X***, Young T, Hao Y, Xing J, Lv J, Jiang X, Zhu D, Liu T, Zhang J. Dynamic network partition via Bayesian connectivity bi-partition change point model. Biomedical Imaging (ISBI), 2014 IEEE 11th International Symposium on; 2014: IEEE.
58. Lian Z*, **Li X***, Xing J, Lv J, Jiang X, Zhu D, Zhang S, Xu J, Potenza MN, Liu T. Exploring functional brain dynamics via a Bayesian connectivity change point model. Biomedical Imaging (ISBI), 2014 IEEE 11th International Symposium on; 2014: IEEE.
59. Jiang X, Lv J, Zhu D, Zhang T, **Li X**, Hu X, Guo L, Liu T. Discovering network-level functional interactions from working memory fMRI data. Biomedical Imaging (ISBI), 2014 IEEE 11th International Symposium on; 2014: IEEE.
60. Zhu D*, **Li X***, Jiang X*, Chen H, Shen D, Liu T. Exploring high-order functional interactions via structurally-weighted LASSO models. International Conference on Information Processing in

Medical Imaging; 2013: Springer.
61. Zhang S, Lv J, **Li X**, Jiang X, Guo L, Liu T. Activated cliques: Network-based activation detection in task-based FMRI. Biomedical Imaging (ISBI), 2013 IEEE 10th International Symposium on; 2013: IEEE.
62. Zhang S, **Li X**, Lv J, Jiang X, Zhu D, Chen H, Zhang T, Guo L, Liu T. Sparse representation of higher-order functional interaction patterns in task-based FMRI data. International Conference on Medical Image Computing and Computer-Assisted Intervention; 2013: Springer.
63. Xing J, Lv J, Lian Z, **Li X**, Zhu D, Liu T, Zhang J. Group-wise change point detection in task FMRI data by Bayesian methods. Neural Engineering (NER), 2013 6th International IEEE/EMBS Conference on; 2013: IEEE.
64. Ou J, Xie L, Wang P, **Li X**, Zhu D, Jiang R, Wang Y, Chen Y, Zhang J, Liu T. Modeling brain functional dynamics via hidden Markov models. Neural Engineering (NER), 2013 6th International IEEE/EMBS Conference on; 2013: IEEE.
65. Lv J, Jiang X, **Li X**, Zhu D, Chen H, Zhang T, Zhang S, Hu X, Han J, Huang H. Identifying functional networks via sparse coding of whole brain FMRI signals. Neural Engineering (NER), 2013 6th International IEEE/EMBS Conference on; 2013: IEEE.
66. Wang P, Zhu D, **Li X**, Chen H, Jiang X, Sun L, Cao Q, An L, Liu T, Wang Y. Identifying functional connectomics abnormality in attention deficit hyperactivity disorder. Biomedical Imaging (ISBI), 2013 IEEE 10th International Symposium on; 2013: IEEE.
67. Lv P, Guo L, Hu X, **Li X**, Jin C, Han J, Li L, Liu T. Modeling dynamic functional information flows on large-scale brain networks. International Conference on Medical Image Computing and Computer-Assisted Intervention; 2013: Springer.
68. Lv J, **Li X**, Zhu D, Jiang X, Zhang X, Hu X, Zhang T, Guo L, Liu T. Sparse representation of group-wise fMRI signals. International Conference on Medical Image Computing and Computer-Assisted Intervention; 2013: Springer.
69. **Li X**, Zhu D, Jiang X, Jin C, Guo L, Li L, Liu T. Discovering common functional connectomics signatures. Biomedical Imaging (ISBI), 2013 IEEE 10th International Symposium on; 2013: IEEE.
70. Zhang X, Guo L, **Li X**, Zhu D, Li K, Sun Z, Jin C, Hu X, Han J, Zhao Q. Characterization of task-free/task-performance brain states. International Conference on Medical Image Computing and Computer-Assisted Intervention; 2012: Springer.
71. Lim C*, **Li X***, Li K, Guo L, Liu T. Brain state change detection via fiber-centered functional connectivity analysis. Biomedical Imaging: From Nano to Macro, 2011 IEEE International Symposium on; 2011: IEEE.
72. **Li X**, Li K, Guo L, Lim C, Liu T. Fiber-centered granger causality analysis. International Conference on Medical Image Computing and Computer-Assisted Intervention; 2011: Springer.

PhD Thesis:

"Machine Learning Approaches towards Holistic Brain Functional Space Discovery from fMRI Big Data"

Narrative Report

As a research fellow at MGH, my research includes on two main fields which are interlinked: 1) development of new machine learning and artificial intelligence methodologies, mainly for the purpose of medical image analysis, and 2) applying these methods for solving practical clinical/scientific problems. With more than 10 years of experience in algorithm development/implementation and a doctoral degree in computer science, I have been working on new tools to support efficient large-scale data analytics, including matrix decomposition under different regularizations, new network architectures for deep learning models and distributed computing platforms. My work presented in 2016 ACM SIGKDD conference, "Scalable Fast Rank-1 Dictionary Learning for fMRI Big Data Analysis", is the first system that performs computation of terabytes-level neuroimaging data without relying on supercomputers. My current work on methodology development focuses on building a unified framework to integrate the analysis across multi-modal, multi-scale and multi-view images, as well as co-analysis of those images in a single model. This framework is particularly useful for medical image

analysis, as usually there exists multiple scans of the same patient under different protocols (e.g. modalities, scanning parameters, etc.) and it is often desired for analyzing them together.
From the application perspective, I have been working on the processing and analysis of medical images in two main categories: lung CT and brain MR. By collecting and analyzing CT images >300 patients within the institution, I have developed a deep learning-enabled system for pneumothorax detection (i.e. screening) with high sensitivity and very fast running speed. The system is among the four finalists of the 2018 NVIDIA Global Impact Award, for its potential impact on application of AI in healthcare. Currently I'm working on the alpha testing for the system's integration into the clinical workflow of MGH, as well as extending its applicability to other critical conditions such as pulmonary embolism. On the other hand, analysis of brain MR images especially functional MRI data is a continuation of my PhD research. Being among the first researchers who utilized mathematic models to characterize brain functional dynamics in both normal and abnormal populations (since 2011), my works on diagnosis of post-traumatic stress disorder (PTSD), attention deficit hyperactivity disorder (ADHD), and mild cognitive impairment (MCI) are the pioneers in this field and inspired many later works. My current project on functional brain modeling involves using dynamic graph representation combined with geometric deep learning to achieve holistic and efficient characterization of functional brain states.