Ju Sun

Curriculum Vitae

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Jul. 2019 – current **Assistant Professor**, *Department of Computer Science & Engineering || Department of Neurosurgery, University of Minnesota at Twin Cities (UMN)*, Minnesota, USA.
Affiliation: Data Science Graduate Faculty, Institute for Health Informatics, Institute for Engineering in Medicine

Work Experience

Sep. 2016 – Jun. 2019 **Math+X Postdoctoral Scholar**, *Stanford University*, California, USA.
With Prof. Emmanuel Candès

Jul. 2008 – Aug. 2011 **Research Engineer**, *Interactive & Digital Media Institute*, National University of Singapore, Singapore.
With Prof. Loong-Fah Cheong & Prof. Shuicheng Yan & Prof. Lawrence Wong

Education

2011 – 2016 **Doctor of Philosophy**, *Electrical Engineering, Columbia University*, New York, USA.
Advisor: Prof. John Wright

2004 – 2008 **Bachelor of Engineering (ECE, honors) with Minor in Mathematics**, *National University of Singapore*, Singapore.
Advisor: Prof. Loong-Fah Cheong & Prof. Shuicheng Yan

Research Interests

foundations of machine learning, data sciences, and numerical optimization, with application to computer vision, signal/image processing, computational imaging, and healthcare/medicine

Publications

Total citations: 4029, H-index: 12 according to Google Scholar as of 2nd January, 2021. Please refer to my Google scholar page for updated publication list and citation figures.

Preprints

[1] **Ju Sun** *et al*. Artificial Intelligence to Accelerate COVID-19 Identification from Chest X-rays. *In submission*, 2020.

[2] Erich Kummerfeld, Nicholas E. Ingraham, Rachel S. Morris, Christopher J. Tignanelli, Le Peng, Taihui Li, and **Ju Sun**. A ROC-y Start: Modelers Should Evaluate Covid-19 Classifiers Differently. *In submission*, 2020.

[3] Birra Taha, Daniel Boley, **Ju Sun**, and Clark C. Chen. Radiomics in Neuro-Oncology Research. *In submission*, 2020.

[4] Birra Taha, Taihui Li, Daniel Boley, Clark C. Chen, and **Ju Sun**. Detection of Isocitrate Dehydrogenase Mutated Glioblastomas through Anomaly Detection Analytics. *In submission*, 2020.

[5] Taihui Li, Rishabh Mehta, Zecheng Qian, and **Ju Sun**. Rethink Autoencoders: Robust Manifold Learning. 2020.

[6] Kshitij Tayal, Chieh-Hsin Lai, Vipin Kumar, and **Ju Sun**. Inverse Problems, Deep Learning, and Symmetry Breaking. *arXiv preprint arXiv:2003.09077*, 2020.

[7] David Barmherzig, **Ju Sun**, Emmanuel J. Candès, TJ Lane, and Po-Nan Li. Dual-Reference Design for Holographic Coherent Diffraction Imaging . *arXiv preprint arXiv:1902.02492*, 2019.

[8] Yu Bai, Qijia Jiang, and **Ju Sun**. Subgradient Descent Learns Orthogonal Dictionaries. *arXiv preprint arXiv:1810.10702*, 2018.

Journals

[9] Sky C Cheung, John Y Shin, Yenson Lau, Zhengyu Chen, **Ju Sun**, Yuqian Zhang, John N Wright, and Abhay N Pasupathy. Dictionary Learning in Fourier Transform Scanning Tunneling Spectroscopy. *Nature Communications*, 11(1081), 2020.

[10] David Barmherzig, **Ju Sun**, Po-Nan Li, TJ Lane, and Emmanuel J. Candès. Holographic Phase Retrieval and Reference Design. *Inverse Problems*, 35(9):094001, 2019.

[11] Tianjian Lu, **Ju Sun**, Ken Wu, and Zhiping Yang. High-Speed Channel Modeling With Machine Learning Methods for Signal Integrity Analysis. *IEEE Transactions on Electromagnetic Compatibility*, 60(6):1957–1964, 2018.

[12] **Ju Sun**, Qing Qu, and John Wright. A Geometric Analysis of Phase Retrieval. *Foundations of Computational Mathematics*, 18(5):1131–1198, 2018.

[13] **Ju Sun**, Qing Qu, and John Wright. Complete Dictionary Recovery over the Sphere II: Recovery by Riemannian Trust-region Method. *IEEE Trans. Information Theory*, 63(2):885–914, 2017.

[14] **Ju Sun**, Qing Qu, and John Wright. Complete Dictionary Recovery over the Sphere I: Overview and the Geometric Picture. *IEEE Trans. Information Theory*, 63(2):853–884, 2017.

[15] Qing Qu, **Ju Sun**, and John Wright. Finding a Sparse Vector in a Subspace: Linear Sparsity Using Alternating Directions. *IEEE Trans. Information Theory*, 62(10):5855–5880, 2016.

[16] **Ju Sun**, Yuqian Zhang, and John Wright. Efficient Point-to-Subspace Query in ℓ^1 with Application to Robust Object Instance Recognition. *SIAM Journal on Imaging Sciences*, 7(4):2105–2138, 2014.

[17] Guangcan Liu, Zhouchen Lin, Shuicheng Yan, **Ju Sun**, Yong Yu, and Yi Ma. Robust Recovery of Subspace Structures by Low-Rank Representation. *IEEE Trans. Pattern Anal. Mach. Intell.*, 35(1):171–184, 2013.

Conferences & Workshops

[18] Raunak Manekar, Zhong Zhuang, Kshitij Tayal, Vipin Kumar, and **Ju Sun**. Deep Learning Initialized Phase Retrieval. In *NeurIPS 2020 Workshop on Deep Learning and Inverse Problems*, 2020.

[19] Kshitij Tayal, Chieh-Hsin Lai, Raunak Manekar, Zhong Zhuang, Vipin Kumar, and **Ju Sun**. Unlocking Inverse Problems Using Deep Learning: Breaking Symmetries in Phase Retrieval. In *NeurIPS 2020 Workshop on Deep Learning and Inverse Problems*, 2020.

[20] Taihui Li, Rishabh Mehta, Zecheng Qian, and **Ju Sun**. Rethink Autoencoders: Robust Manifold Learning. In *ICML workshop on Uncertainty and Robustness in Deep Learning*, 2020.

[21] Zhong Zhuang, Gang Wang, Yash Travadi, and **Ju Sun**. Phase Retrieval via Second-Order Nonsmooth Optimization. In *ICML workshop on Beyond First Order Methods in Machine Learning*, 2020.

[22] Raunak Manekar, Kshitij Tayal, Vipin Kumar, and **Ju Sun**. End-to-End Learning for Phase Retrieval. In *ICML workshop on ML Interpretability for Scientific Discovery*, 2020.

[23] Kshitij Tayal, Chieh-Hsin Lai, Raunak Manekar, Vipin Kumar, and **Ju Sun**. Inverse Problems, Deep Learning, and Symmetry Breaking. In *ICML workshop on ML Interpretability for Scientific Discovery*, 2020.

[24] David Barmherzig and **Ju Sun**. Low-Photon Holographic Phase Retrieval. In *OSA Imaging and Applied Optics Congress*, 2020.

[25] David Barmherzig, **Ju Sun**, Emmanuel J. Candès, TJ Lane, and Po-Nan Li. Dual-Reference Design for Holographic Coherent Diffraction Imaging. In *Sampling Theory and Applications*, 2019.

[26] Yu Bai, Qijia Jiang, and **Ju Sun**. Subgradient Descent Learns Orthogonal Dictionaries. In *International Conference on Learning Representations*, 2019.

[27] David Barmherzig and **Ju Sun**. 1D Phase Retrieval and Spectral Factorization. In *Mathematics in Imaging*, pages JTh1A–4. Optical Society of America, 2018.

[28] David A Barmherzig, **Ju Sun**, TJ Lane, and Po-Nan Li. On Block-Reference Coherent Diffraction Imaging. In *Computational Optical Sensing and Imaging*, pages CTH1B–1. Optical Society of America, 2018.

[29] David Barmherzig and **Ju Sun**. A Local Analysis of Block Coordinate Descent for Gaussian Phase Retrieval. In *NIPS Workshop on Optimization for Machine Learning*, 2017.

[30] **Ju Sun**, Qing Qu, and John Wright. A Geometrical Analysis of Phase Retrieval. In *International Symposium on Information Theory*, 2016.

[31] **Ju Sun**, Qing Qu, and John Wright. When Are Nonconvex Problems Not Scary? In *NIPS Workshop on Non-convex Optimization for Machine Learning: Theory and Practice*, 2015.

[32] **Ju Sun**, Qing Qu, and John Wright. Complete Dictionary Recovery over the Sphere. In *International Conf. on Machine Learning*, 2015. (Also appears in SAMPTA'15 and SPARS'15; Best Student Paper Award at SPARS'15).

[33] Qing Qu, **Ju Sun**, and John Wright. Finding a sparse vector in a subspace: Linear sparsity using alternating directions. In *Advances in Neural Information Processing Systems*, pages 3401–3409, 2014.

[34] **Ju Sun**, Yuqian Zhang, and John Wright. Efficient Point-to-Subspace Query in ℓ^1 with Application to Robust Face Recognition. In *European Conference on Computer Vision (ECCV)*, pages 416–429, 2012.

[35] Guangcan Liu, **Ju Sun**, and Shuicheng Yan. Closed-Form Solutions to A Category of Nuclear Norm Minimization Problems. *NIPS Workshop on Low-Rank Methods for Large-Scale Machine Learning*, `http://arxiv.org/abs/1011.4829`, October 2010.

[36] Yuzhao Ni, **Ju Sun**, Xiaotong Yuan, Shuicheng Yan, and Loong Fah Cheong. Robust Low-Rank Subspace Segmentation with Semidefinite Guarantees. In *ICDM Workshop on Optimization Based Methods for Emerging Data Mining Problems (OEDM)*, 2010.

[37] Yadong Mu, **Ju Sun**, Tony X. Han, Loong Fah Cheong, and Shuicheng Yan. Randomized Locality Sensitive Vocabularies for Bag-of-Features Model. In *European Conference on Computer Vision (ECCV)*, pages 748 – 761, 2010.

[38] **Ju Sun**, Yadong Mu, Shuicheng Yan, and Loong Fah Cheong. Activity Recognition using Dense Long-Duration Trajectories. In *International Conference on Multimedia & Expo (ICME)*, pages 322 – 327, 2010.

[39] **Ju Sun**, Xiao Wu, Shuicheng Yan, Loong Fah Cheong, Tat-Seng Chua, and Jintao Li. Hierarchical Spatio-Temporal Context Modeling for Action Recognition. In *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, pages 2004 – 2011, 2009.

[40] Ching Lik Teo, Shimiao Li, Loong Fah Cheong, and **Ju Sun**. 3D Ordinal Constraint in Spatial Configuration for Robust Scene Recognition. In *International Conference on Pattern Recognition (ICPR)*, pages 1 – 5, 2008.

Thesis

[41] **Ju Sun**. *When Are Nonconvex Optimization Problems Not Scary?* PhD thesis, Columbia University, May 2016.

Unpublished Reports

[42] **Ju Sun**, Qiang Chen, Shuicheng Yan, and Loong Fah Cheong. Selective Image Super-Resolution. *Technical Report*, `http://arxiv.org/abs/1010.5610`, March 2010.

Teaching

- Machine Learning: Analysis and Methods (Spring 2021)
- Think Deep Learning (Fall 2020)
- Think Deep Learning (Spring 2020)

Students

- Yash Travadi(PhD, Stats)
- Le Peng (PhD, CS&E)
- Raunak Manekar (PhD, CS&E)
- Hengkang Wang (PhD, CS&E)
- Zhong Zhuang (PhD, ECE)
- Taihui Li (PhD, CS&E)

Honors/Awards

2018 **Honorable Mention of Doctoral Thesis for New World Mathematics Awards 2017**.

2015 **Best Student Paper Award on SPARS'15**.

Invited Talks/Tutorials/Lectures

Toward practical phase retrieval: to learn or not, and how to learn?

- Keynote, The 5th International Conference on Statistical Optimization and Learning, Virtual (Dec 2020)
- Optimization Forum organized by Operation Research Society of China, Virtual (Sep 2020)

Does Deep Learning Solve the Phase Retrieval Problem?

- SIAM Conference on Imaging Science, Virtual (Jul 2020)

Rapid and Robust COVID-19 Identification from Chest X-rays

- AIME2020: International Conference on Artificial Intelligence in Medicine , Virtual (Aug 2020)

When Computer Vision and Deep Learning Meet Healthcare?

- Surgery Grand Rounds, Department of Surgery, UMN (May 2020)

Toward Practical Phase Retrieval

- SIAM Conference on Mathematics of Data Science at Cincinnati, Ohio (May 2020)

Taming Nonconvexity: from Smooth to Nonsmooth Problems

- SINE Seminar at CSL, University of Illinois at Urbana–Champaign (Nov 2018)
- Center for Signal and Information Processing (CSIP) Seminar, Georgia Tech (Nov 2018)

When Nonconvexity Meets Nonsmoothness

- INFORMS Annual Meeting at Seattle, USA (Oct 2019)
- Annual Allerton Conference on Communication, Control, and Computing at Urbana, USA (Oct 2018)

When Are Nonconvex Optimization Problems Not Scary?

- IDeAS Seminar, Princeton University (Dec 2015)
- ITA Graduation Day, University of California, San Diego (Poster, Feb 2016)
- Prof. Emmanuel Candes' group seminar, Stanford University (Feb 2016)
- Microsoft Research at New York (Feb 2016)
- Prof. Qiang Du's group seminar, Columbia University (Mar 2016)
- ShanghaiTech University, SIST seminar series (Jun 2016)
- Modeling and optimization: theory and applications, Lehigh University (Aug 2016)
- SIAM Conference on Optimization at Vancouver, Bristish Columbia, Canada. (May 2017)
- Harvard ISS Seminar (Jun 2017)
- 2017 Meeting of the International Linear Algebra Society at Iowa State U. (Jul 2017)
- 2017 Asilomar Conference on Signals, Systems, and Computers at Asilomar Grounds in Pacific Grove (Oct 2017)
- SIAM Conference on Applied Linear Algebra at Hong Kong, China (May 2018)
- International Symposium on Mathematical Programming at Bordeaux, France (Jul 2018)

What's Happening in Provable Dictionary Learning?

- SIAM Conference on Imaging Sciences at Bologna, Italy (Jun 2018)

Complete Dictionary Learning over the Sphere

- Statistics student seminar, Columbia University (Mar 2015)
- DTC Seminar Talk, University of Minnesota (Apr 2015)
- Signal Processing with Adaptive Sparse Structured Representations (SPARS'15), University of Cambridge (Jul 2015)

Professional Activities/Services

Professional Association

- IEEE/ACM/SIAM/INFORMS/OSA

Event Organization

- Area Chair, International Conference on Artificial Intelligence and Statistics (AISTATS), 2021
- Co-Organizer, Exploiting Low-Complexity Structures in Data Analysis: Theory and Algorithms (A mini-symposium in SIAM Conference on Applied Linear Algebra 2018)

Review for Journals

- IEEE Transactions: Information Theory (T-IT), Pattern Analysis and Machine Intelligence (T-PAMI), Circuits and Systems for Video Technology (T-CSVT), Image Processing (T-IP), Signal Processing (T-SP), Selected Topics in Signal Processing (JSTSP), Systems, Man, and Cybernetics (T-SMC)
- SIAM Journals: Imaging Sciences (SIIMS), Matrix Analysis and Applications (SIMAX), Optimization (SIOPT), Mathematics of Data Science (SIMODS), Scientific Computing (SISC)
- Journal of Machine Learning Research (JMLR)
- Neural Computation
- International Journal of Computer Vision (IJCV)
- Information and Inference (a Journal of the IMA)
- Applied and Computational Harmonic Analysis
- Mathematical Programming
- Journal of Visual Communication and Image Representation (JVIS)
- Neurocomputing (Elsevier)
- PLOS ONE

Review for Conferences

- Computer Vision: International Conference on Computer Vision (ICCV), European Conference on Computer Vision (ECCV), Computer Vision and Pattern Recognition (CVPR), Asian Conference on Computer Vision (ACCV)
- Machine Learning: Neural Information Processing Systems (NIPS), International Conference on Machine Learning (ICML), International Conference on Learning Representation (ICLR), Algorithmic Learning Theory (ALT)
- Information Theory: International Symposium on Information Theory (ISIT)

(update: 2nd Jan, 2021)