Gregory J. Ongie

CONTACT INFORMATION

email: gongie@uchicago.edu
website: https://gregongie.github.io

RESEARCH INTERESTS

Exploring the rich interface between machine learning, computational imaging, and applied mathematics. Solving large-scale inverse problems arising in data science and computational imaging, especially in the case of missing, noisy, or corrupted data. Designing, analyzing, and implementing efficient optimization algorithms to solve these problems. Understanding the mathematical foundations of supervised and unsupervised learning, as seen through the lens of applied algebraic geometry and harmonic analysis.

Applications in biomedical imaging, including image reconstruction in magnetic resonance imaging and computed tomography.

EDUCATION

University of Iowa, Iowa City, IA

Ph.D., Applied Mathematical and Computational Sciences, July 2016

- Thesis Topic: *Off-the-grid Compressive Imaging*
- Advisor: Mathews Jacob, Ph.D.

M.S., Mathematics, Aug 2011

Coe College, Cedar Rapids, IA

B.S., Mathematics and Physics, May 2008

RESEARCH EXPERIENCE

Postdoctoral Scholar - University of Chicago Aug. 2018 – present
Committee on Computational and Applied Mathematics
Department of Statistics
Supervisor: Rebecca Willett, Ph.D.

- Mathematics of learning with neural networks
- Machine learning for inverse problems in imaging
- Applied algebraic geometry for data science

Postdoctoral Scholar - University of Michigan Sept 2016 – July 2018
Department of Electrical Engineering and Computer Science
Supervisors: Laura Balzano, Ph.D & Jeff Fessler, Ph.D.

- Matrix completion with non-linear data models
- Streaming robust principal component analysis
- Efficient optimization algorithms for large-scale medical image reconstruction

Research Assistant - University of Iowa Jan 2013 – July 2016
Department of Electrical and Computer Engineering
Supervisor: Mathews Jacob, Ph.D.

- Continuous domain compressed sensing with applications to MRI reconstruction
- Efficient algorithms for structured low-rank matrix completion
- Extensions of total variation image regularization for inverse problems in imaging
- Non-convex optimization algorithms for image reconstruction in medical imaging

Teaching Experience

Guest Lectures

University of Chicago — Aug 2019
Course: Machine Learning for Biomedical Informatics
- Gave one three-hour lecture introducing deep learning for biomedical image analysis and reconstruction.

University of Michigan — Nov 2017
Course: Matrix Methods for Signal Processing, Data Analysis and Machine Learning.
- Gave two lectures in a graduate-level matrix methods course for engineers on the topic of low-rank matrix completion.

Teaching Assistant – University of Iowa, Mathematics Department

Calculus II	Fall 2013
Multivariable Calculus for Engineers	Spring 2011
Honors Calculus II	Fall 2010
Calculus I	Spring 2010
Calculus I for Biology Students	Fall 2009

Research Experience for Undergraduates Mentor – U. Iowa Summer 2011
Supervisor: Palle Jorgensen, Ph.D.
- Led four upper-level undergraduates on an image processing research project.

Journal and Selected Conference Publications

1. **G. Ongie**, L. Balzano, D.L. Pimentel-Alarcon, R. Willett, R. Nowak. "Tensor Methods for Non-linear Matrix Completion." *In Preparation.*
2. **G. Ongie**, R. Willett, D. Soudry, N. Srebro. "A Function Space View of Bounded Norm Infinite-width ReLU Nets: The Multivariate Case." *Accepted to* International Conference on Representation Learning (ICLR), 2020.
3. **G. Ongie***, D. Gilton*, R. Willett. "Neumann Networks for Linear Inverse Problems in Imaging." *Accepted for publication in* IEEE Transactions on Computational Imaging. **equal authorship*
4. A. Eftekhari, **G. Ongie**, L. Balzano, M. Wakin. "Streaming Principal Component Analysis from Incomplete Data." Journal of Machine Learning Research, 20(86), 1-62, 2019.
5. **G. Ongie** and M. Jacob. "Convex Recovery of Continuous Domain Piecewise Constant Images from Non-Uniform Fourier Samples." IEEE Transactions on Signal Processing, 66(1), 236-250, 2018.
6. **G. Ongie**, R. Willett, R. Nowak, L. Balzano. "Algebraic Variety Models for High-Rank Matrix Completion." International Conference on Machine Learning (ICML). Syndey, Australia. 2017.
7. **G. Ongie** and M. Jacob. "A Fast Algorithm for Convolutional Structured Low-Rank Matrix Recovery." IEEE Transactions on Computational Imaging, 3(4), 535-550. 2017.
8. **G. Ongie** and M. Jacob. "Off-the-grid Recovery of Piecewise Constant Images from Few Fourier Samples." SIAM Journal of Imaging Sciences, 9(3), 1004–1041. 2016.
9. **G. Ongie** and M. Jacob. "Recovery of Discontinuous Signals Using Group Sparse Higher Degree Total Variation." Signal Processing Letters, 22(9), 1414-1418. 2015.

10. Y. Moshin, **G. Ongie**, and M. Jacob, "Iterative Shrinkage Algorithm for Patch Smoothness Regularized Medical Image Recovery." IEEE Transactions on Medical Imaging. 2015.

11. **G. Ongie***, Y. Hu*, S. Ramani, M. Jacob."Generalized Higher Degree Total Variation." IEEE Transactions on Image Processing, 23(6), 2423-2435. 2014. **equal authorship*

Conference Proceedings

1. **G. Ongie**, E. Sidky, I. Reiser, X. Pan. "Supervised Learning of Model Observers for Assessment of CT Image Reconstruction Algorithms." SPIE Medical Imaging, 2020.

2. D. Gilton, **G. Ongie**, R. Willett. "Learned Patch-based Regularization for Inverse Problems in Imaging." IEEE International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP). 2019.

3. D. Gilton, **G. Ongie**, R. Willett. "Learning to Regularize with Neumann Networks." IEEE Data Science Workshop. Minneapolis, Minnesota. 2019.

4. **G. Ongie**, D. Hong, D. Zhang, L. Balzano. "Online Estimation of Coherent Subspaces with Adaptive Sampling." IEEE Statistical Signal Processing Workshop. Freiburg, Germany. 2018.

5. **G. Ongie**, N. Murthy, L. Balzano, J. Fessler. "A Memory-efficient Algorithm for Large-scale Sparsity Regularized Image Reconstruction." The Fifth International Conference on Image Formation in X-Ray Computed Tomography. Salt Lake City, Utah. 2018.

6. **G. Ongie**, D. Hong, D. Zhang, L. Balzano. "Enhanced Online Subspace Estimation via Adaptive Sensing" Asilomar Conference on Signals, Systems, and Computers. Pacific Grove, CA. 2017.

7. D.L. Pimentel-Alarcon, **G. Ongie**, L. Balzano, R. Willett, R. Nowak. "Low Algebraic Dimension Matrix Completion" Allerton Conference on Communication, Control, and Computing. Urbana-Champaign, IL. 2017.

8. **G. Ongie**, S. Dewangan, J. Fessler, L. Balzano. "Online Dynamic MRI Reconstruction via Robust Subspace Tracking." IEEE Global Conference on Signal and Information Processing (GlobalSIP). Montreal, Canada. 2017.

9. **G. Ongie**, J. Shi, & J. Fessler. "Efficient Computation of Regularized Field Map Estimates in 3D." IEEE International Symposium on Biomedical Imaging (ISBI). Melbourne, Australia. 2017.

10. **G. Ongie**, S. Biswas, & M. Jacob. "Structured Low-rank Recovery of Piecewise Constant Signals with Performance Guarantees." IEEE International Conference on Image Processing (ICIP). Phoenix, AZ. 2016.

11. A. Balachandrasekaran, **G. Ongie**, & M. Jacob. "Accelerated Dynamic MRI Using Structured Low Rank Matrix Completion." IEEE International Conference on Image Processing (ICIP). Phoenix, AZ. 2016.

12. **G. Ongie** and M. Jacob. "A Fast Algorithm for Structured Low-Rank Matrix Recovery with Applications to Undersampled MRI Recovery." IEEE International Symposium on Biomedical Imaging (ISBI). Prague, Czech Republic. 2016.

13. **G. Ongie** and M. Jacob. "Recovery of Piecewise Smooth Images from Few Fourier Samples." Sampling Theory and Applications (SampTA). Washington, D.C. 2015.

14. **G. Ongie** and M. Jacob. "Super-resolution MRI Using Finite Rate of Innovation Curves." IEEE International Symposium on Biomedical Imaging (ISBI). Brooklyn, NY. *Best student paper award winner.*

15. **G. Ongie**, Y. Hu, M. Jacob. "Higher Degree Total Variation for 3-D Image Recovery." International Symposium on Biomedical Imaging (ISBI). Beijing, China. 2014.

16. Y. Moshin, **G. Ongie**, M. Jacob. Accelerated MRI Using Iterative Non-local Shrinkage. Annual Conference of the Engineering in Medicine and Biology Society (EMBC). Chicago, IL. 2014.

Awards

- D.C. Spriestersbach Outstanding Dissertation Prize in the Mathematical, Physical Sciences and Engineering, University of Iowa, 2018.
- Small Groups funding at the Alan Turing Institute: "Theoretical and computational aspects of super-resolution in higher dimensions," with A. Eftekhari, J. Tanner, and H. Tyagi, 2017.
- Travel Grant for IEEE International Conference on Image Processing (ICIP), 2016.
- Best Student Paper Award: "Super-resolution MRI using finite rate of innovation curves," IEEE/EMBS International Symposium on Biomedical Imaging, 2015.
- Presidential Fellowship, University of Iowa. 2008–2013
  Five year fellowship, including three full years of financial support.
- Phi Beta Kappa Membership, Coe College. 2008.

Presentations

Invited Talks

- "Neumann Networks for Inverse Problems in Imaging," Sept 2019
  Great Lakes Workshop on Data Science, University of Notre Dame.
- "Matrix Completion with Non-Linear Models," Oct 2017
  CMO-BIRS Workshop: "Beyond Convexity", Oaxaca, Mexico.
- "Learning Non-linear Models with Missing Data" Sept 2017
  Alan Turing Institute, London, UK.
- "Low Algebraic Dimension Matrix Completion" Sept 2017
  Numerical Analysis Seminar, Oxford University, Oxford, UK.
- "Off-the-grid Compressive Imaging," Aug 2016
  Applied Math Seminar, Michigan State University, East Lansing, MI.
- "Improved Multi-dimensional MRI with Co-prime Sampling," May 2015
  Co-Prime Sensing Basic Research Challenge Program Review.
  George Mason University, Fairfax, Virginia.
- "Off-the-grid Compressive Imaging," April 2016
  CSP Seminar, University of Michigan, Ann Arbor, MI.
- "Off-the-grid Compressive Imaging," March 2016
  ICES Seminar, University of Texas, Austin, TX.

Conference Talks

- Allerton Conference on Communication, Control, and Computing. Sept 2019
  Champaign, IL.
- AMS Fall Central Sectional Meeting. Sept 2019
  Madison, WI.
- SIAM Applied Algebraic Geometry (SIAM AG19). July 2019
  Bern, Switzerland.
- Image Processing: Algorithm and Systems (IPAS). Jan 2019
  Burlingame, CA.
- SIAM Annual Meeting (SIAM AN18). July 2018
  Portland, Oregon.

- International Symposium on Mathematical Programming (ISMP). July 2018
  Bordeaux, France.
- Global Conference on Signal and Information Processing (GlobalSIP). Nov 2017
  Montreal, Quebec.
- Asilomar Conference on Signals, Systems, and Computers. Oct 2017
  Monterrey, CA.
- International Conference on Machine Learning (ICML). Aug 2017
  Sydney, Australia.
- International Conference on Image Processing (ICIP). Sept 2016
  Phoenix, AZ.
- SIAM Imaging Sciences (SIAM IS16). May 2016
  Albuquerque, NM.
- International Symposium on Biomedical Imaging (ISBI). April 2016
  Prague, Czech Republic.
- Sampling Theory and Applications (SampTA), May 2015
  Washington, D.C.
- International Symposium on Biomedical Imaging (ISBI). May 2015
  Brooklyn, NY.
- International Symposium on Biomedical Imaging (ISBI). May 2014
  Beijing, China.

Professional Activities

Conference organization:

- Student Activities Liaison for the 2020 International Symposium on Biomedical Imaging (ISBI) in Iowa City, IA. Responsibilities include organizing: a student hackathon, a career panel for students, and a special session on successful paper/grant writing.

Conference special sessions:

- "Smart Imaging Systems". International Symposium on Biomedical Imaging (ISBI), 2018. Co-organized with S. Ravishankar & J. Fessler.
- "Structured and Covariance Matrix Recovery". Asilomar Conference on Signals and Systems, 2017. Co-organizer with L. Balzano.

Technical paper reviewer:

- Conference proceedings of NeurIPS, COLT, AISTATS, ICCV 2018–2020
- Journal publications:
  - Journal of Machine Learning Research
  - Applied and Computational Harmonic Analysis
  - IEEE Transactions on: Signal Processing, Pattern Analysis and Machine Intelligence, Medical Imaging, Computational Imaging
  - IEEE Selected Topics in Signal Processing & Signal Processing Letters
  - Magnetic Resonance in Medicine
  - PLOS ONE

Service

Seminar Co-organizer, U. Chicago Oct 2019 – Present

- Helped to organize a local weekly seminar on inverse problems in imaging.
- Served as postdoc liaison for weekly CCAM graduate student seminar.

Heartland Talks Liaison, U. Iowa Oct 2011—Feb 2012

- Coordinated graduate student talks at nearby universities.

Graduate and Undergraduate Student Seminar Co-chair, U. Iowa Jan 2011 – Dec 2011

- Organized a student-run seminar to engage undergraduates in advanced mathematics.