Gregory J. Ongie

CONTACT INFORMATION

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RESEARCH INTERESTS

Devising, analyzing, and implementing novel computational solutions for large-scale inverse problems in medical imaging using tools from machine learning. Mathematical foundations of deep learning, as seen through the lens of functional analysis and applied harmonic analysis.

Application areas include image reconstruction in X-ray computed tomography and magnetic resonance imaging.

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

ACADEMIC POSITIONS

Assistant Professor - Marquette University Aug. 2020 – present
Department of Mathematical and Statistical Sciences (MSSC)

Postdoctoral Scholar - University of Chicago Aug. 2018 – July 2020
Committee on Computational and Applied Mathematics
Department of Statistics
Supervisor: Rebecca Willett, Ph.D.

- Deep learning for inverse problems in imaging
- Mathematics of learning with neural networks
- 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.

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

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

Instructor – Marquette University Aug 2020 – present

Differential Equations for Biomedical and Civil Engineers	Fall 2022
Applied Linear Algebra	Fall 2022
Differential Equations	Spring 2022
Mathematics of Medical Imaging	Spring 2022
Differential Equations	Fall 2021
Applied Linear Algebra	Fall 2021
Differential Equations	Spring 2021
Theory of Optimization	Spring 2021
Differential Equations for Biomedical and Civil Engineers	Fall 2020

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. D. Gilton, **G. Ongie**, R. Willett. "Deep Equilibrium Models for Inverse Problems in Imaging."IEEE Transactions on Computational Imaging, Vol 7, 1123- 1133, October 2021.
2. D. Gilton, **G. Ongie**, R. Willett. "Model Adaptation for Inverse Problems in Imaging." IEEE Transactions on Computational Imaging, Vol 7, 661-674, July 2021.
3. E.Y. Sidky, J.P. Phillips, W. Zhou, **G. Ongie**, J. Cruz-Bastida, I.S. Reiser, M.A. Anastasio, X. Pan. "A signal detection model for quantifying over-regularization in non-linear image reconstruction." Medical Physics. 48 (10), 6312-632, January 2021.
4. **G. Ongie**, D. L. Pimentel-Alarcon, L. Balzano, R. Willett, and R. Nowak. "Tensor Methods for Nonlinear Matrix Completion." SIAM Journal on Mathematics of Data Science, 3(1), 253-279, January 2021.
5. **G. Ongie**, A. Jalal, C. Metzler, R. Baraniuk, A. Dimakis, R. Willett. "Deep Learning Techniques for Inverse Problems in Imaging." IEEE Journal on Selected Areas in Information Theory. May 2020.

6. **G. Ongie**, R. Willett, D. Soudry, N. Srebro. “A Function Space View of Bounded Norm Infinite-width ReLU Nets: The Multivariate Case.” International Conference on Representation Learning (ICLR), 2020.
7. **G. Ongie***, D. Gilton*, R. Willett. “Neumann Networks for Linear Inverse Problems in Imaging.” IEEE Transactions on Computational Imaging, 6, 328-343, 2019.
8. 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.
9. **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.
10. **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.
11. **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.
12. **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.
13. **G. Ongie** and M. Jacob. “Recovery of Discontinuous Signals Using Group Sparse Higher Degree Total Variation.” Signal Processing Letters, 22(9), 1414-1418. 2015.
14. Y. Moshin, **G. Ongie**, and M. Jacob, “Iterative Shrinkage Algorithm for Patch Smoothness Regularized Medical Image Recovery.” IEEE Transactions on Medical Imaging. 2015.
15. **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.Y. Sidky, I.S. Reiser, X. Pan. “Evaluation of deep learning-based CT reconstruction with a signal-Laplacian model observer.” International Conference on Image Formation in X-Ray Computed Tomography, 2022.
2. **G. Ongie**, E.Y. Sidky, I.S. Reiser, X. Pan. “Optimizing model observer performance in learning-based CT reconstruction.” SPIE Medical Imaging, 2022
3. D. Gilton, **G. Ongie**, R. Willett. “Model adaptation for inverse problems in biomedical imaging.” IEEE International Symposium on Biomedical Imaging, 2021.
4. J.P. Phillips, E.Y. Sidky, **G. Ongie**, W. Zhou, J. Cruz-Bastida, I.S. Reiser, M.A. Anastasio, X. Pan. “A hybrid channelized Hotelling observer for estimating the ideal linear observer for total-variation-based image reconstruction.” SPIE Medical Imaging, 2021.
5. **G. Ongie**, E. Sidky, I. Reiser, X. Pan. “Supervised Learning of Model Observers for Assessment of CT Image Reconstruction Algorithms.” SPIE Medical Imaging, 2020.

6. 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.

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

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

9. **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.

10. **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.

11. 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.

12. **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.

13. **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.

14. **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.

15. 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.

16. **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.

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

18. **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.*

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

20. 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.

GRANTS

NSF CISE Research Initiation Initiative Grant (CRII):
Coordinate-based Neural Networks for Inverse Problems in Computational Imaging.
Awarded March 2022. Duration: June 2022–May 2024. Amount: $173,184.

- Includes funding for 1 1/2 graduate student research assistantships for two academic years and summer salary.

AWARDS

- Way Klinger Early Career Award, Marquette University, 2023.
- 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

- "Model-based deep learning for image reconstruction" Aug 2022
  Medical College of Wisconsin. Milwaukee, WI. [Virtual]
- "A function space view of infinite-width neural networks." April 2022
  Johns Hopkins MINDS/CIS Seminar. Baltimore, MD.
- "Optimizing model observer performance in learning-based April 2022
  CT reconstruction." U. Chicago Medical Physics Seminar. Chicago, IL.
- "Learning to solve inverse problems in computational imaging" Oct 2021
  Mitsubishi Electric Research Labs (MERL). [Virtual]
- "A function space view of infinite-width neural networks." Oct 2020
  iLunch Seminar Series, University of Maine, Orono, ME. [Virtual]
- "A function space view of infinite-width neural networks." Oct 2020
  Applied Mathematics Seminar, University of Wisconsin-Milwaukee [Virtual].
- "Neumann networks for inverse problems in imaging." Aug 2020
  Imaging Seminar, Michigan State University, East Lansing, MI. [Virtual]
- "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

- Asilomar Conference on Signals, Systems, and Computers. Nov 2022
  Monterey, CA. Virtual Talk.
- SIAM Conference on the Mathematics of Data Science. Sept 2022
  San Diego, CA.
- SIAM Conference on Imaging Science. March 2022
  Virtual conference.
- SPIE Medical Imaging. Feb 2022
  San Diego, CA
- Asilomar Conference on Signals, Systems, and Computers. Nov 2021
  Monterey, CA. Virtual Talk.
- IEEE International Symposium on Biomedical Imaging (ISBI). April 2021
  Nice, France. Virtual Talk.
- SIAM Conference on Computational Science and Engineering March 2021
  Fort Worth, TX. Virtual Talk.
- International Conference on Machine Learning (ICML) April 2020
  Vienna, Austria (virtual).
- SPIE Medical Imaging Conference. Feb 2020
  Houston, TX.
- Allerton Conference on Communication, Control, and Computing. Sept 2019
  Champaign, IL.
- AMS Fall Central Sectional Meeting. Sept 2019
  Madison, WI.
- SIAM Applied Algebraic Geometry. July 2019
  Bern, Switzerland.
- Image Processing: Algorithm and Systems (IPAS). Jan 2019
  Burlingame, CA.
- SIAM Annual Meeting. 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

Technical committees:

- Member of the IEEE Computational Imaging Technical Committee (2021-present)

Conference special sessions:

- "Implicit bias and regularized in overparametrized deep networks". SIAM Conference on Mathematics of Data Science (MDS22), 2022. Co-organized with R. Willett.
- "Smart Imaging Systems". IEEE 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.

Conference organization:

- Area Chair for 2021 and 2022 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP) in the Biomedical Signal Processing Track.
- Student Activities Liaison for the 2020 IEEE International Symposium on Biomedical Imaging (ISBI) in Iowa City, IA (held virtually).

Grant reviewer:

- NSF Grant Review Panelist (2022 & 2023)

Technical paper reviewer:

- AI/ML journals and conferences
  - International Conference on Artificial Intelligence and Statistics (AISTATS) 2020
  - Workshop on Learning for Computational Imaging at ICCV 2019
  - Neural Information Processing Systems (NeurIPS) 2019
  - Conference on Learning Theory (COLT) 2019
  - International Conference on Artificial Intelligence and Statistics (AISTATS) 2018
  - Journal of Machine Learning Research
- Medical imaging/computational imaging journals
  - IEEE Trans. on Medical Imaging
  - IEEE Trans. on Computational Imaging
  - Magnetic Resonance in Medicine
  - Medical Physics
- Applied math journals
  - Applied and Computational Harmonic Analysis
  - SIAM Journal on Mathematics of Data Science
  - SIAM Journal on Imaging Science
- Signal processing journals
  - IEEE Trans. Signal Processing
  - IEEE Trans. Pattern Analysis and Machine Intelligence
  - IEEE Selected Topics in Signal Processing
  - IEEE Signal Processing Letters

Service

MSSC Department Graduate Committee, Marquette University Aug 2022 – present

- Helped to manage gradate program, including recruitment and admissions.

Colloquium Coordinator, Marquette University Aug 2020 – May 2022

- Organized MSSC department colloquium series.

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

- Helped to organize a local weekly seminar on inverse problems in imaging.

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

- Coordinated graduate student talks at nearby universities.

Graduate and Undergraduate Student Seminar Org., U. Iowa Jan 2011 – Dec 2012

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