

# David Barmherzig

Center for Computational Mathematics  
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## Employment

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**Research Fellow, 2019-**  
**Center for Computational Mathematics, Flatiron Institute**

## Education

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**Doctor of Philosophy, 2013-2019**  
**Stanford University, Institute for Computational and Mathematical Engineering**  
Dissertation: *The Phase Retrieval Problem: Theory, Algorithms, and Applications*  
Principal advisor: Emmanuel J. Candès  
Dissertation committee: Emmanuel J. Candès, Walter Murray, Gordon Wetzstein

**Master of Science, 2013**  
**University of Toronto, Mathematics**  
Thesis: *Polyphase representations in mathematical signal processing*  
Thesis advisors: George A. Elliott and Yue M. Lu (Harvard)

**Bachelor of Applied Science in Engineering Science, 2011**  
**University of Toronto**  
Thesis: *The Uniqueness theorem for the Cuntz algebras*  
Thesis advisor: George A. Elliott

## Visiting Appointments

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**Fellow of Electrical Engineering, 2013**  
**Harvard University, John A. Paulson School of Engineering and Applied Sciences**  
Sponsoring faculty: Yue M. Lu

## Publications

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David A. Barmherzig, Alex H. Barnett, Charles L. Epstein, Leslie F. Greengard, Jeremy F. Magland, and Manas Rachh. *Recovering Missing Data in Coherent Diffraction Imaging*. Submitted to SIAM Journal on Imaging Sciences. 2020.

David Barmherzig and Ju Sun. *Low-Photon Holographic Phase Retrieval*. Computational Optical Sensing and Imaging, Optical Society of America. 2020.

David Barmherzig. *The Phase Retrieval Problem: Theory, Algorithms, and Applications*. Doctoral Dissertation. Dissertation advisor: Emmanuel J. Candès (Stanford University). 2019.

David A. Barmherzig, Ju Sun, Emmanuel J. Candès, T.J. Lane, and Po-Nan Li. *Dual-Reference Design for Holographic Coherent Diffraction Imaging*. 13<sup>th</sup> International Conference on Sampling Theory and Applications. 2019.

David A. Barmherzig, Ju Sun, Emmanuel J. Candès, T.J. Lane, and Po-Nan Li. *Holographic Phase Retrieval and Optimal Reference Design*. *Inverse Problems* **35**(9), pp. 094001, 2019.

David Barmherzig and Ju Sun. *ID Phase Retrieval and Spectral Factorization*. Mathematics in Imaging, Optical Society of America. 2018.

David Barmherzig, Ju Sun, Po-Nan Li, and T.J. Lane. *On Block-Reference Coherent Diffraction Imaging*. Computational Optical Sensing and Imaging, Optical Society of America. 2018.

David Barmherzig and Ju Sun. *A Local Analysis of Block Coordinate Descent for Gaussian Phase Retrieval*. Optimization for Machine Learning, Neural Information Processing Systems. 2018.

David Barmherzig and Moshe Praver. *Applications of Principal Component Analysis to Decentralized Consensus for Accreditation*. 2017.

David Barmherzig, Leonidas J. Guibas, and Justin Solomon. *Functional Maps in Computational Geometry*. 2014.

David Barmherzig. *Polyphase Representations in Mathematical Signal Processing*. M.Sc. Thesis. Thesis advisors: George A. Elliott (University of Toronto, Fields Institute) and Yue M. Lu (Harvard). 2013.

David Barmherzig and George A. Elliott. *Classical Limits of the Feynman Path Integral and Schrodinger Equation*. 2012.

David Barmherzig. *The Uniqueness Theorem for the Cuntz Algebras*. B.A.Sc. Honours Thesis. Thesis advisor: George A. Elliott (University of Toronto, Fields Institute). 2012.

## **Presentations**

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*New Algorithms for Phase Retrieval with Missing and Noisy Data*  
SIAM Conference on Imaging Science. July 6-17, 2020.

*Low-Photon Holographic Phase Retrieval*  
Computational Optical Sensing and Imaging, Optical Society of America Imaging and Applied Optics Congress. June 23, 2020.

***Low-Photon Holographic Phase Retrieval***

Numerical Analysis Seminar, Flatiron Institute. New York, NY, USA. January 15, 2020.

***Holographic Phase Retrieval and Optimal Reference Design***

Numerical Analysis Seminar, Flatiron Institute. New York, NY, USA. October 2, 2019.

***The Phase Retrieval Problem: Theory, Algorithms, and Applications***

Thesis Defense, Stanford University. Stanford, CA, USA. May 23, 2019.

***Holographic Phase Retrieval and Dual-Reference Design***

Candès group meeting, Department of Statistics, Stanford University. Stanford, CA, USA. March 7, 2019.

***Holographic Phase Retrieval and Optimal Reference Design***

Candès group meeting, Department of Statistics, Stanford University. Stanford, CA, USA. December 6, 2018.

***ID Phase Retrieval and Spectral Factorization***

Mathematics in Imaging, Optical Society of America Imaging and Applied Optics Congress. Orlando, FL, USA. June 28, 2018.

***On Block-Reference Coherent Diffraction Imaging***

Computational Optical Sensing and Imaging, Optical Society of America Imaging and Applied Optics Congress. Orlando, FL, USA. June 28, 2018.

***A Local Analysis of Block Coordinate Descent for Gaussian Phase Retrieval***

ICME Xpo, Stanford University. Stanford, CA, USA. May 18, 2018.

***A Matrix Algebra Approach to the Fourier Phase Retrieval Problem***

Operator Algebras Seminar, Fields Institute for Mathematical Research. Toronto, ON, Canada. January 9, 2018.

***A Local Analysis of Block Coordinate Descent for Gaussian Phase Retrieval***

10<sup>th</sup> NIPS Workshop on Optimization for Machine Learning, Neural Information Processing Systems. Long Beach, CA, USA. December 9, 2017.

***ADMM for Phase Retrieval***

Candès group meeting, Department of Statistics, Stanford University. Stanford, CA, USA. October 25, 2017.

***The Phase Retrieval Problem: Theory and Algorithms***

Operator Algebras Seminar, Fields Institute for Mathematical Research. Toronto, ON, Canada. December 29, 2016.

***Recent Advances on the Phase Retrieval Problem***

Operator Algebras Seminar, Fields Institute for Mathematical Research. Toronto, ON, Canada. December 15, 2015.

***Analyzing Fienup Algorithms for Phase Retrieval***

Candes group meeting, Department of Statistics, Stanford University. Stanford, CA, USA.  
November 13, 2015.

***Functional Map Methods in Computational Geometry***

Operator Algebras Seminar, Fields Institute for Mathematical Research. Toronto, ON, Canada.  
December 18, 2014.

***Functional Maps in Computational Geometry***

Guibas group meeting, Department of Computer Science, Stanford University. Stanford University, Stanford, CA, USA. November 19, 2014.

***Mathematical Signal Processing and Operator Algebras***

Operator Algebras Seminar, Fields Institute for Mathematical Research. Toronto, ON, Canada.  
Series of three talks - August 1, September 3, and September 10, 2013.

***Classical Limits of the Feynman Path Integral and Schrodinger Equation***

Operator Algebras Seminar, Fields Institute for Mathematical Research. Toronto, ON, Canada.  
August 14, 2012.

***The Uniqueness Theorem for the Cuntz Algebras***

Operator Algebras Seminar, Fields Institute for Mathematical Research. Toronto, ON, Canada.  
August 18, 2011.

**Awards and Honors**

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**Stanford Teaching Assistantship**, 2016

**Simons Math+X Fellow**, Simons Foundation, 2015-2016

**Stanford Research Assistantship**, Stanford University, 2014-2015

**Stanford Departmental Fellowship**, Institute for Computational and Mathematical Engineering, School of Engineering, Stanford University, 2013

**Alexander Graham Bell Canada Graduate Scholarship**, Natural Sciences and Engineering Research Council of Canada, 2013

**NSERC Postgraduate Scholarship**, Natural Sciences and Engineering Research Council of Canada, 2013

**Ontario Graduate Scholarship**, Ontario Ministry of Training, Colleges and Universities, 2012

**University of Toronto Tuition Fellowship**, University of Toronto, 2012

**Graduated with Honours**, Bachelor of Applied Science in Engineering Science, Faculty of Applied Science and Engineering, University of Toronto, 2012

**Dean's Honour List**, Faculty of Applied Science and Engineering (Engineering Science), University of Toronto, 2007 - 2012

**Undergraduate Student Research Award**, Natural Sciences and Engineering Research Council of Canada, 2010

**University of Toronto Excellence Award**, University of Toronto, 2007

**University of Toronto Scholars Program National Scholarship**, University of Toronto, 2006  
**George Roderick Fraser Scholarship in Mathematics**, University of Toronto, 2006

**Millennium Excellence Award**, Canadian Millennium Scholarship Foundation, 2006

### **Teaching**

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**Course Instructor**, ICME Refresher Course – Multivariable Calculus, Stanford University, 2016

**Teaching Assistant**, CME106/ENGR155C Introduction to Probability and Statistics for Engineers, Stanford University, 2016

**Interim Teaching Assistant**, MAT137Y1 Calculus!, University of Toronto, 2012

### **Conferences Attended**

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**Computational Optical Sensing and Imaging**, Optical Society of America Imaging and Applied Optics Congress. June 22-26, 2020.

**Flatiron-Wide Algorithms and Mathematics**, Simons Foundation. New York, NY, USA. October 30 – November 1, 2019.

**Computational Optical Sensing and Imaging**, Optical Society of America Imaging and Applied Optics Congress. Orlando, FL, USA. June 25-29, 2018.

**10<sup>th</sup> NIPS Workshop on Optimization for Machine Learning**, Neural Information Processing Systems. Long Beach Convention Center. December 9, 2017.

**Neural Information Processing Systems**. Long Beach Convention Center. December 4-9, 2017.

**Phaseless Imaging in Theory and Practice: Realistic Models, Fast Algorithms, and Recovery Guarantees**, Institute for Mathematics and its Applications, University of Minnesota. August 14 - 18, 2017.

**Bay Area Vision Meeting.** Stanford University, October 3, 2014.

**ONR Workshop on Structured Learning for Scene Understanding.** Stanford University. October 2, 2014.

**Canadian Operator Symposium.** University of Toronto. May 27-31, 2013.

**Workshop on Applications to Operator Algebras.** Fields Institute for Mathematical Research, University of Toronto. September 10-14, 2012.

**Canadian Operator Symposium.** Queen's University. May 21-25, 2012.

**Workshop on Positivity.** University of Toronto. August 2-4, 2011.

### **Professional Services**

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Organizer: *The Phase Retrieval Problem: Advances from Theory, Computation, and Design*, Minisymposium at the SIAM Conference on Imaging Science. July 6-17, 2020.

Publication Reviewer for:

- IEEE Transactions on Signal Processing
- IEEE International Symposium on Information Theory 2020
- Information and Inference: A Journal of the IMA
- Applied Physics B: Lasers and Optics

Technical Consultant, MedX Protocol.

### **Professional Affiliations**

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Member, Society of Industrial and Applied Mathematics

Student Member, IEEE

Member, American Mathematical Society

Member, Canadian Mathematical Society

Member, Optical Society of America

Member, Engineering Intern, Professional Engineers Ontario