

## Gregory T. Ely

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CONTACT INFORMATION	<i>Email:</i> elyg@mit.edu	<i>Website:</i> <a href="http://www.mit.edu/~elyg/">www.mit.edu/~elyg/</a>
EDUCATION	<b>Massachusetts Institute of Technology</b> Doctor of Philosophy, Geophysics. Area of research: reflection seismology	<b>2013 - 2019</b>
	<b>Tufts University</b> Master of Science, Electrical Engineering. Thesis: Reduced Complexity Regularization of Geophysical Inverse Problems.	<b>2010 - 2013</b>
	<b>Carleton College</b> Bachelor of Arts, <i>Magna cum Laude</i> Physics. Received Distinction for Senior Thesis: The Physics of Traffic and Crowds	<b>2004 - 2008</b>
FELLOWSHIPS	<b>National Science Foundation Graduate Fellowship Program</b> <b>Statoil-MIT Energy Graduate Fellowship</b> <b>Praecis Presidential Graduate Fellowship</b>	<b>2012 - 2016</b> <b>2014</b> <b>2013</b>
RESEARCH EXPERIENCE	<b>Massachusetts Institute of Technology</b> <i>Postdoctoral Associate</i> Device Realization Laboratory, Brian Anthony, Advisor. Exploring applications of seismology techniques to medical ultrasound and uncertainty quantification in medical imaging problems.	<b>2019 March - Present</b>
	<b>Massachusetts Institute of Technology</b> <i>Research Assistant</i> Geophysics department, Alison Malcolm, Advisor. Exploring boundary integral methods for fast acoustic wave simulation and reduced model space. I am combining these fast forward solvers with Markov chain Monte Carlo to quantify uncertainty of seismic velocity models and bone density estimations using medical ultrasound.	<b>2013 September - January 2019</b>
	<b>Philips Research North America</b> <i>Intern</i> Ultrasound beam-forming group. Developed new micro-beamforming algorithms to improve image quality and contrast of channel limited ultrasound systems with 2D element arrays. Designed and tested a slow-time methods for reducing reverberation clutter in sequences of cardiac images.	<b>January 2018 - May 2018</b>
	<b>Schlumberger Doll Research</b> <i>Intern</i> Math & Modeling Department, Sandip Bose, Supervisor. Developed new algorithms for cement evaluation in boreholes using an ultrasonic transducer to image through the borehole casing. Created a new technique that improves the detection and characterization of the bond between cement and the rock formation.	<b>2012 &amp; 2015 Summer</b>
	<b>Tufts University</b> <i>Research Assistant</i>	<b>2010 May - 2013 August</b>

Electrical Engineering department, Shuchin Aeron, Advisor. Examined the application of complexity penalized algorithms to solve a variety of geophysical inverse problems: hydraulic fracture monitoring, hyperspectral imaging, and reflection seismology. Demonstrated how the physics of several systems give rise to sparsity or low-dimensionality when posed in the proper basis and can be exploited to improve inversion.

**MIT Lincoln Laboratory**

**2008 September - 2012 January**

*Researcher*

Tactical Defense Systems, Kevin Cohen, Supervisor. Developed a modular real time radar tracker in C++ to run on multiple ground based radar systems. Wrote and debugged real time imagery and data recording systems in C and C++. Developed MATLAB image processing and tracking tools to perform analyses of infrared imagery. Designed tests of infrared optical systems. Simulated and modeled the performance of optical systems, the atmosphere, and radiation of the viewed images.

**Carleton College**

**2007 January - 2008 June**

*Research Assistant*

LIGO (Laser Interferometer Gravitational Wave Observatory) Scientific Collaboration, Nelson Christensen, Supervisor. Developed and debugged MATLAB programs which analyzed environmental sensor data to diagnose sources of continuous noise in gravitational wave detectors. Wrote and optimized code to run efficiently on distributed grid computers to assess the quality of analyzed sensor and interferometer data.

**Boston University**

**2006 Summer**

*Research Assistant*

Research Assistant, Hearing Research Center, Department of Biomedical Engineering, Boston University. Steven Colburn, Director. Wrote and debugged code modules in C++ for EarLab, a program used to simulate components of the human auditory system. Developed a multi-platform Java graphical user interface to run EarLab simulations.

**SKILLS**

- Programming Languages: MATLAB, Python, C, C++, Java
- Computational Tools: Mathematica, L<sup>A</sup>T<sub>E</sub>X, CVS, Subversion, Git

**GRADUATE  
RESEARCH**

**Journal Publications**

Gregory Ely, Alison Malcolm, and David Nicholls. "Global Optimization for Full Waveform Inversion: Understanding Trade-offs and Parameter Choices," Geophysics (Submitted)

Gregory Ely, Alison Malcolm, Guillaume Renaud and Didier Cassereau. "Imaging the Interior of Bone" Transactions on Ultrasonics, Ferroelectrics, and Frequency Control (Submitted)

Gregory Ely, Oleg Poliannikov, Alison Malcolm; "Assessing uncertainties in velocity models and images with a fast nonlinear uncertainty quantification method," Geophysics Vol 83:2, R43-R55, 2018

Gregory Ely, Shuchin Aeron, Ning Hao, and Misha E. Kilmer. "5D seismic data completion and de-noising using a novel class of tensor decompositions," Geophysics, Vol 80, No 4, 2015

Bo Fan, Gregory Ely, Shuchin Aeron, and Eric Miller. "Exploiting algebraic and structural complexity for single snapshot computed tomography hyperspectral imaging systems," IEEE Journal on Selected Topics in Signal Processing: Special issue on Advances in Hyperspectral Data Processing and Analysis, 2015

## Conference Proceedings

Maria Kotsi, Alison Malcolm, Gregory Ely; “4D Multiparameter Adaptive Metropolis Hastings Inversion,” September 2019 SEG Annual meeting, San Antonio, TX (Submitted)

Gregory Ely, Alison Malcolm, Guillaume Renaud; “Suppression of internal multiples with a group sparse radon transform for imaging the interior of bone,” October 2018 SEG Annual meeting, Anaheim, CA

Maria Kotsi, Alison Malcolm, Gregory Ely; “4D full-waveform metropolis hasting inversion using a local acoustic solver,” October 2018 SEG Annual meeting, Anaheim, CA

Gregory Ely, Oleg Poliannikov, Alison Malcolm. “Fast nonlinear uncertainty quantification for velocity model building and imaging,” September 2017 SEG Annual meeting, Houston, Texas

Gregory Ely, Alison Malcolm, and David Nicholls. “Combining global optimization and boundary integral methods to robustly estimate subsurface velocity models”, October 2015 SEG Annual meeting, New Orleans, Louisiana

Zemin Zhang, Gregory Ely, Shuchin Aeron, Ning Hao and Misha Kilmer. “Novel factorization strategies for higher order tensors: Implications for compression and recovery of multilinear data,” Computer Vision and Pattern Recognition, June 2014, Columbus, Ohio; Oral Presentation & Paper!; Oral Presentation Acceptance Rate 5.75%

Gregory Ely and Shuchin Aeron. “Methods for Large Scale Hydraulic Fracture Monitoring,” 2013 December IEEE CAMSAP, Saint Martin, French West Indies, France

Gregory Ely, Shuchin Aeron, Ning Hao, and Misha E. Kilmer. “5D and 4D pre-stack seismic data completion using tensor nuclear norm (TNN),” 2013 September SEG Annual Meeting, Houston, Texas

Gregory Ely and Shuchin Aeron. “Complexity Penalized Hydraulic Fracture Localization and Moment Tensor Estimation Under Limited Model Information,” 2013 June, International Congress on Acoustics, Montreal, Canada

Gregory Ely, Shuchin Aeron, and Eric Miller. “Exploiting Structural Complexity For Robust and Rapid Hyperspectral Imaging,” 2013 May IEEE ICASSP, Vancouver, Canada

Gregory Ely and Shuchin Aeron. “Robust Hydraulic Fracture Monitoring (HFM) of multiple time overlapping events using a generalized discrete radon transform,” 2012 July, IEEE IGARSS Symposium, Munich, Germany

## Presentations

Gregory Ely, Oleg V. Poliannikov and Alison Malcolm. “Rapid Non-Gaussian Uncertainty Quantification of Seismic Velocity Models and Images,” American Geophysical Union Fall 2017 meeting, Oral presentation

Gregory Ely, Oleg V. Poliannikov, Alison Malcolm and David Nicholls. “Uncertainty Quantification of Velocity Models and Seismic Imaging,” 13th International Conference on Mathematical and Numerical Aspects of Wave Propagation 2017; Minneapolis, MN

Gregory Ely, Alison Malcolm, and David Nicholls. “Applications of Boundary Integral Methods for Robust Seismic Velocity Inversion and Error Estimation,” SIAM Annual Meeting 2016, Oral

presentation; Boston, MA

Shuchin Aeron and Gregory Ely. “Compressibility of 5D Seismic Data Under Various Tensor Decompositions,” SEG 2015 New Orleans Post Convention Workshop, Oral presentation

Gregory Ely, Alison Malcolm, and David Nicholls. “Combining Global Optimization and Boundary Integral Methods to Robustly Estimate Seismic Velocity Models,” SIAM Conference on Mathematical and Computational Issues in the Geosciences 2015, Poster presentation

Gregory Ely and Tom Herring. “Separation of continuous GPS transients using independent component analysis and low rank methods,” American Geophysical Union Fall 2014 meeting, Oral presentation

UNDERGRADUATE  
PUBLICATIONS

B. J. Abadie *et al.* (LIGO Scientific Collaboration & Virgo Collaboration). “Search for gravitational waves from binary black hole inspiral, merger and ringdown,” *Phys. Rev. D* 83, 122005 (2011).

B. J. Abadie *et al.* (LIGO Scientific Collaboration & Virgo Collaboration). “Search for Gravitational Waves from Compact Binary Coalescence in LIGO and Virgo Data from S5 and VSR1,” *Phys. Rev. D* 82, 102001 (2010)

B. Abbott *et al.* (LIGO Scientific Collaboration). “Search for gravitational waves from low mass compact binary coalescence in 186 days of LIGO’s fifth science run,” *Phys. Rev. D* 80 047101 (2009)

B. Abbott *et al.* (LIGO Scientific Collaboration & Virgo Collaboration). “An upper limit on the stochastic gravitational-wave background of cosmological origin,” *Nature*, Vol. 460, p. 990 (2009)

B. Abbott *et al.* (LIGO Scientific Collaboration). “Einstein@Home search for periodic gravitational waves in early S5 LIGO data,” *Phys. Rev. D* 80 042003 (2009)

B. Abbott *et al.* (LIGO Scientific Collaboration). “Search for gravitational waves from low mass binary coalescences in the first year of LIGO’s S5 data,” *Phys. Rev. D* 79 122001 (2009)

B. Abbott *et al.* (LIGO Scientific Collaboration). “All-Sky LIGO Search for Periodic Gravitational Waves in the Early Fifth-Science-Run Data,” *Physical Review Letters* 102 111102 (2009)

B. Abbott *et al.* (LIGO Scientific Collaboration). “Einstein@Home search for periodic gravitational waves in LIGO S4 data,” *Phys. Rev. D* 79 022001 (2009)

L. Blackburn, L. Cadonati, S. Caride, S. Caudill, S. Chatterji, N. Christensen, J. Dalrymple, S. Desai, A. Di Credico, G. Ely, J. Garofoli, L. Goggin, G. Gonzalez, R. Gouaty, C. Gray, A. Gretarsson, D. Hoak, T. Isogai, E. Katsavounidis, J. Kissel, S. Klimenko, R. A. Mercer, S. Mohapatra, S. Mukherjee, F. Raab, K. Riles, P. Saulson, R. Schofield, P. Shawhan, J. Slutsky, J. R. Smith, R. Stone, C. Vorvick, M. Zanolin, N. Zotov and J. Zweizig. “The LSC glitch group: monitoring noise transients during the fifth LIGO science run,” *Classical and Quantum Gravity*, Vol. 25, 184004 (2008)