

# Eileen R. Martin

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<b>Education</b>	<b>Ph.D. Computational and Mathematical Engineering, Stanford University</b>	
	Dissertation: <i>Passive Imaging and Characterization of the Subsurface with Distributed Acoustic Sensing</i>	expected June 2018
	Reading committee:	
	<ul style="list-style-type: none"><li>– Biondo Biondi, advisor (Geophysics and ICME, Stanford)</li><li>– Jonathan Ajo-Franklin (Geophysics, Lawrence Berkeley National Laboratory)</li><li>– George Papanicolaou (Mathematics and ICME, Stanford)</li></ul>	
	<b>M.S. Geophysics</b>	<b>Stanford University</b>
	Masters research presentation: <i>Stanford DAS Array: Ambient Noise and Earthquake Recordings</i>	June 2017
	Oral exam committee: Biondo Biondi and Greg Beroza (Geophysics, Stanford)	
	<b>B.S. Dean’s Scholars Honors Mathematics, University of Texas at Austin</b>	
	Dean’s Honored Graduate, graduated with high honors	May 2012
	Honors thesis: <i>Global Coordinate Systems: Continuously Moving Finite-Dimensional Unit Norm Tight Frames on Smooth Manifolds</i>	
	Advisor: Daniel Freeman (now Mathematics & Statistics, St. Louis University)	
	<b>B.S. Computational Physics</b>	<b>University of Texas at Austin</b>
	Graduated with high honors	May 2012
<b>Honors, Awards, Fellowships</b>	<b>Schlumberger Innovation Fellowship</b>	2016-2017
	Award value \$10,000	
	1 Ph.D. student and 4 M.S. students selected by ICME faculty committee	
	<b>DOE Computational Science Graduate Fellowship</b>	2012-2016
	Award value over \$300,000	
	Approximately 20 students selected in 2012 throughout the United States	
	<b>ICME Xpo Best Poster Design</b>	2016
	<b>Travel Grant to attend SEG Annual International Meeting</b>	2015
	<b>ICME Student Leadership Award</b>	2014
Annually awarded cash prize and plaque recognizing service to the institute		
<b>NSF Graduate Research Fellowship Program</b> award offered	2012	
<b>Dean’s Honored Graduate</b>	2012	
Fewer than 1% of students in UT-Austin College of Natural Sciences receive this award, selected through faculty panel vote		
<b>Barry M. Goldwater Scholarship</b>	2011-2012	

**Teaching,  
Mentoring**

- ICME Teaching Fellow** since 2016, status to recognize students with significant experience teaching, both formal TA or instructor positions and organizing informal reviews for younger students
- Mentor**, ICME first-year mentoring program Sep. 2017-Jun. 2018
- Mentor**, Stanford Women in Math Mentoring Oct. 2016-Jun. 2017
- Project Mentor**, Stanford Earth Summer Undergraduate Research Program  
Co-mentored geophysics undergraduate E. Williams Summer 2016  
Project on targeted detection/removal of infrastructure noise from ambient noise
- Course assistant**, Introduction to Scientific Computing Winter 2016  
CME 108/MATH 114 taught by Eric Dunham at Stanford
- Project Mentor**, Projects in App. & Comp. Math (CME 181) Spring 2015  
Undergrad project on statistical analysis of bicycle sharing network data
- Instructor of Record**, Introduction to Scientific Python Winter 2015  
CME 193, Stanford: 1 credit hr. pass/fail course for 46 undergrads and grads
- Instructor**, Short course on Python at SIAM Conference on Geosciences, June 2015  
Developed course with hands-on analysis and visualization of real geoscience data
- Project Mentor**, Projects in App. & Comp. Math (CME 181) Winter 2014  
Undergrad project on tsunami modeling using Hawaiian bathymetry
- STEM Tutor**, Longhorn Center for Academic Excellence, UT-Austin Division of Diversity and Community Engagement Aug. 2011-May 2012  
Tutored students in introductory math, statistics, physics, and chemistry courses  
Documented tutoring and workshops for grant application materials

**Research  
Experience**

- Stanford Distributed Acoustic Sensing Array** 2016-present  
*Led by PI Biondo Biondi at Stanford University funded by Stanford Exploration Project affiliates, and equipment donated by OptaSense, Inc.*  
Computational and theoretical data analysis:  
Developing theory and modeling to understand sensitivity to body and surface waves  
Analyzing convergence and time-lapse saturation effects on virtual source response estimates from ambient noise data spanning more than one year  
Leading development of open-source software for streaming DAS arrays  
Investigated DAS recordings of teleseismic and regional earthquakes and quarry blasts  
Experimental design, deployment, and field work:  
Coordinated 1 week of simultaneous on-campus recording by 2 DAS interrogator units and 3 portable broadband (from USGS) for comparison  
Co-organized active survey of Stock Farm Monocline with C. Castillo, conducted by 22 volunteers over 4 days in March 2017: 37 betsy gun shots and 106 x 4 sledgehammer hits recorded on DAS array and 98 3C nodes (from UUSS)  
Collaborated with Stanford IT, B. Biondi, and OptaSense to design 2.5 km long array following Stanford's existing telecomm conduits within budget  
Arranged material purchases and scheduling labor for array installation  
Mentoring junior students:

Mentored new student, S. Yuan, as he developed automated earthquake analysis tools  
Led weekly seminar on projects using the DAS array data, summer 2017  
Guided undergrad S. Sawasdee processing Stock Farm Monocline DAS & node data  
Assisted graduate students F. Huot, Y. Ma and R. Cieplicki developing machine  
learning tools to automate exploration/filtering of seismic noise in urban areas

**Permafrost Thaw Monitoring with DAS and ambient noise** 2014-present  
*Led by PI Jonathan Ajo-Franklin at Lawrence Berkeley National Lab and co-PI Anna Wagner at US Army Cold Regions Research and Engineering Lab, funded by DOD under SERDP grant RC-2437 "Developing Smart Infrastructure for a Changing Arctic Environment Using Distributed Fiber-Optic Sensing Methods"*  
Calculating ambient noise cross-correlations throughout 2016 Fairbanks, AK 2D DAS array during thaw test to compare predicted and actual sensitivities  
In process of regular collaboration, became LBL affiliate in 2016  
Based on results of Rayleigh-wave interferometry on ambient noise recorded in 2015 at Fairbanks, AK DAS array, identified and developed model for artifacts due to vehicle-related noise recorded by passive arrays near roadways  
Developed and implemented embarrassingly parallel, scalable method for dispersion image calculation in arrays of many sensors  
Performed early investigation of ambient noise interferometry pre-processing along linear segments of 2014 passive data from Richmond Field Station  
Field work helping deploy trenched fiber array for pilot at Richmond Field Station

**High-performance solver libraries for seismic inversion** 2013, 2017  
*Small group software development led by Robert Clapp in Stanford Exploration Project*  
Coded and tested parts of SEPVector, a C++ library of data storage objects easily adaptable to new architectures for inverse problems (2013)  
Coding and testing non-linear solver for C++ in-core solver library with Python wrappers, built on top of SEPVector-like-objects and designed to mimic existing out-of-core solver library (2017)

**Butterfly Factorization** 2013-2014  
*Collaboration with H. Yang and Y. Li led by PI Lexing Ying*  
Coded and tested parts of serial implementation of multi-scale-type factorization scheme that is fast to apply and inexpensive to store

**Improving memory performance of laser-plasma simulations** Summer 2014  
*DOE CSGF Practicum supervised by S. Langer in Weapons & Complex Integration at Lawrence Livermore National Laboratory*  
Improved memory performance of pf3D code by combining physics operators  
Evaluated hardware compression needs

**Finite Unit Norm Tight Frames (FUNTF) Research** 2010-2012  
*Participated in NSF REU on Matrix Analysis and Wavelets at Texas A&M University, led by D. Larson and mentored by D. Freeman, then continued research supervised by D. Freeman at UT-Austin in Mathematics Department*  
Found and proved method to automatically create a continuously moving FUNTF on any odd-dimension sphere using equivalent graph problem

**Moncrief Undergraduate Summer Research Internship** Summer 2011  
*Supervised by O. Ghattas and G. Stadler at UT-Austin ICES*  
Implemented methods for seismic imaging using blended sources

**Numerical Analysis Research Assistant** 2009-2011

*Supervised by R. van de Geijn in UT-Austin CS Department*  
Helped implement solvers for Lyapunov equation  
Developed proofs of linear algebra error results for graduate course materials

**Refereed  
Journal  
Papers**

E.R. Martin, F. Huot, Y. Ma, R. Cieplicki, S. Cole, M. Karrenbach, B.L. Biondi, 2018, *A Seismic Shift in Scalable Acquisition Demands New Processing: Fiber-Optic Seismic Signal Retrieval in Urban Areas with Unsupervised Learning for Coherent Noise Removal*, IEEE Signal Processing Magazine, **35**(2), pp. 31-40.

N.J. Lindsey, E.R. Martin, S. Cole, D. Dreger, S. James, B. Freifeld, B. Biondi, J. Ajo-Franklin, 2017, *Fiber-Optic Network Observations of Earthquake Wavefields*, Geophysical Research Letters, **44**(23), pp. 11792-11799, (featured on cover of issue).

S. Dou, N. Lindsey, A. Wagner, T. Daley, B. Freifeld, M. Robertson, J. Peterson, C. Ulrich, E.R. Martin, J. Ajo-Franklin, 2017, *Distributed Acoustic Sensing for Seismic Monitoring of the Near Surface: A Traffic-Noise Interferometry Example*, Scientific Reports, 7, article 11620.

Y. Li, H. Yang, E.R. Martin, K.L. Ho, L. Ying, 2015, *Butterfly Factorization*, Multi-scale Model. Simul., 13, pp. 714-732.

D. Freeman, R. Hotovy, E.R. Martin, 2014, *Moving Finite Unit Norm Tight Frames for  $S^n$* , Illinois J. of Math, 58, pp. 311-322.

**Professional  
Magazines**

E.R. Martin, C. Castillo, S. Cole, S. Sawasdee, S. Yuan, R. Clapp, M. Karrenbach, B. Biondi, 2017, *Seismic Monitoring Leveraging Existing Telecomm Infrastructure at the Stanford Distributed Acoustic Sensing Array: Active, Passive and Ambient Noise Analysis*, The Leading Edge, 36(12), pp. 1025-1031.

**Submitted or  
in Preparation**

E.R. Martin, B. Biondi, *A Linear, Parallelizable Algorithm for Dispersion Images from Ambient Noise* (in preparation, code at <https://github.com/eileenmartin/FastDispersionImages>).

E.R. Martin, N.J. Lindsey, B. Biondi, J.B. Ajo-Franklin, *Introduction to Interferometry of Fiber Optic Strain Measurements* (in preparation as book chapter).

E.R. Martin, B. Biondi, *Eighteen Months of Near-Surface Monitoring with Ambient Noise at the Stanford Fiber Optic Seismic Observatory* (in preparation).

**Conference  
Papers**

E.R. Martin and B.L. Biondi, *Ambient noise interferometry across two-dimensional DAS arrays*, 2017, 87th Ann. Internat. Mtg. SEG Expanded Abstracts.

B. Biondi, E.R. Martin, S. Cole, M. Karrenbach, N. Lindsey, *Earthquakes analysis using data recorded by the Stanford DAS array*, 2017, 87th Ann. Internat. Mtg. SEG Expanded Abstracts.

F. Huot, Y. Ma, R. Cieplicki, E.R. Martin, B. Biondi, *Automatic noise exploration in urban areas*, 2017, 87th Ann. Internat. Mtg. SEG Expanded Abstracts.

J.B. Ajo-Franklin, S. Dou, N. Lindsey, T. Daley, B. Freifeld, E.R. Martin, C. Ulrich,

T. Wood, I. Eckblaw, A. Wagner, M. Robertson, *Timelapse surface wave monitoring of permafrost thaw using distributed acoustic sensing and a permanent automated seismic source*, 2017, 87th Ann. Internat. Mtg. SEG Expanded Abstracts.

E.R. Martin, B. Biondi, M. Karrenbach, S. Cole, *Ambient noise interferometry from DAS array in underground telecommunications conduits*, 2017, EAGE Annual Meeting Proceedings.

E.R. Martin, B.L. Biondi, M. Karrenbach, S. Cole, *Continuous Subsurface Monitoring by Passive Seismic with Distributed Acoustic Sensors- The "Stanford Array" Experiment*, 2017, Extended Abstracts of the First EAGE Workshop on Practical Reservoir Monitoring, Amsterdam.

E.R. Martin, P. Wills, D. Hohl, J.L. Lopez, *Using machine learning to predict production at a Peace River thermal EOR site*, Proceedings of the 2017 SPE Reservoir Simulation Conference. SPE-192696-MS.

E.R. Martin, N.J. Lindsey, S. Dou, J.B. Ajo-Franklin, A. Wagner, K. Bjella, T.M. Daley, B. Freifeld, M. Robertson, C. Ulrich, *Interferometry of a roadside DAS array in Fairbanks, AK*, 2016, 86th Ann. Internat. Mtg. SEG Expanded Abstracts.

E.R. Martin, J. Ajo-Franklin, N. Lindsey, T.M. Daley, B. Freifeld, M. Robertson, C. Ulrich, S. Dou, A. Wagner, *Interferometry of ambient noise from a trenched distributed acoustic sensing array*, 2015, 85th Ann. Internat. Mtg. SEG Expanded Abstracts.

J. Ajo-Franklin, N. Lindsey, T.M. Daley, B. Freifeld, E.R. Martin, M. Robertson, C. Ulrich, A. Wagner, *A field test of distributed acoustic sensing for ambient noise recording*, Expanded Abstracts of the 2015 SEG Ann. Internat. Mtg.

## Technical Reports

E.R. Martin, B. Biondi, G. Fabient-Ouellet, R.G. Clapp, *Sensitivity analysis of distributed acoustic sensing arrays*, SEP 170, 2017.

E.R. Martin, B. Biondi, *Time-lapse changes in ambient noise interferometry and dispersion analysis at the Stanford DAS Array*, SEP 170, 2017.

R. Clapp, S. Farris, T. Dahlke, E.R. Martin, *C++11 non-linear solver*, SEP 170, 2017.

E.R. Martin, B. Biondi, S. Cole, M. Karrenbach, *Overview of the Stanford DAS Array-1 (SDASA-1)*, SEP 168, 2017.

B. Biondi, E.R. Martin, S. Cole, M. Karrenbach, *Earthquakes analysis using data recorded by the Stanford DAS Array*, SEP 168, 2017.

E.R. Martin, B. Biondi, *Ambient noise interferometry on two-dimensional DAS arrays*, SEP 168, 2017.

F. Huot, Y. Ma, R. Cieplicki, E.R. Martin, B. Biondi, *Automatic noise exploration in urban areas*, SEP 168, 2017.

E. Williams, E.R. Martin, *Detection and removal of coherent anthropogenic noise from passive seismic data*, SEP 165, 2016.

E.R. Martin, N. Lindsey, S. Dou, J. Ajo-Franklin, A. Wagner, K. Bjella, T. Daley, B. Freifeld, M. Robertson, C. Ulrich, *Interferometry of a roadside DAS array in Fairbanks, AK*, SEP 163, 2016.

E.R. Martin, J. Ajo-Franklin, N. Lindsey, T. Daley, B. Freifeld, M. Robertson, C. Ulrich, S. Dou, A. Wagner, *Applying interferometry to ambient seismic noise recorded by a trenched distributed acoustic sensing array*, SEP 158, 2015.

E.R. Martin, *Compression for effective memory bandwidth use in forward modeling*, SEP 152, 2014.

E.R. Martin, R. Clapp, H. Le, C. Leader, D. Nichols, *SEPVector: a C++ inversion library*, SEP 152, 2014.

M. Denolle, S. de Ridder, J. Chang, E.R. Martin, T. Dahlke, H. Arevalo-Lopez, Sr., S. Levin, *Scholte-wave excitation*, SEP 150, 2013.

## Selected Talks

Upcoming: *Pushing for Continuous, Dense, Urban Seismic Monitoring at the Stanford Fiber Optic Seismic Observatory* (invited plenary talk) IRIS Workshop: Foundations, Frontiers and Future Facilities for Seismology  
Albuquerque, NM, Jun. 2018

*Scalable seismic monitoring with fiber optics beneath our feet*, Heiland Lecture at Colorado School of Mines  
Golden, CO, Jan. 2018

*Earthquake recording at the Stanford DAS Array with fibers in existing telecomm conduits* (invited talk) AGU Fall Meeting  
New Orleans, LA, 2017

*Active and passive recording at the Stanford DAS Array*, SEG Annual Meeting  
Workshop: DAS, a vision of the future?  
Houston, TX, 2017

*DAS in existing telecommunications conduits on the Stanford campus*, SPE Workshop on Distributed Fiber-Optic Sensing for Well, Reservoir and Facilities Management  
Denver, CO, 2017

*Urban ambient noise: from dense nodes to DAS*, EAGE Annual Meeting: workshop on linking active and passive seismics  
Paris, France, 2017

*Repurposing our Telecommunications Infrastructure for Seismology*, Lawrence Livermore National Laboratory Seismology Seminar  
Livermore, CA, 2017

*Dirt Cheap Surveys: near surface monitoring with ambient seismic noise collected by DAS*, EAGE Annual Meeting: workshop on reservoir monitoring with distributed fibre-optic sensing  
Vienna, Austria, 2016

*Near-surface monitoring using DAS + ambient noise*, SEG Annual Meeting: distributed acoustic sensing workshop  
New Orleans, LA, 2015

## Professional Service

Special section associate editor, *Interpretation* to appear Nov. 2018  
Special issue on 'Distributed Acoustic Sensing and its Oil Field Potential'

Reviewer for:

- Geophysics
- Computers & Geosciences
- Journal of Computational Science
- Journal of Environmental & Engineering Geophysics
- Interpretation

Co-organizer, Computational Geosciences Seminar, EARTH 310 Jan.-Mar. 2018

Session co-chair Sep. 2017  
"Earth Model Building Strategies and Inputs" at SEG Annual International Mtg.

Helped organize SEG Data Analytics Post-Convention Workshop Sep. 2017  
Invited early-career speakers and moderated panel on data science education

Student panel for Stanford Aeronautics & Astronautics faculty search, Spring 2017

Stanford SEG student chapter president 2014-2015  
Coordinated event times and advertising with Bay Area Geophysical Society

Consultative Committee Member Jul. 2011- Apr. 2012  
Group of roughly 15 students, faculty, staff and donors tasked with recommending  
UT-Austin Dean of Natural Sciences after conducting candidate interviews

Chair, Dean's Scholars Distinguished Lecture Series, Jun. 2011-May 2012  
Hosted astronaut/physician Michael Barratt and mathematician Richard Tapia

## Industry Experience

**High Performance Computing Internship** Summer 2016  
Schlumberger, Menlo Park, CA  
*Mentored by A. Lichnewsy and R.G. Clapp, and supervised by C. Boneti*  
Benchmarked, co-developed, and tested compression scheme for HPC applications

**Areal Monitoring Internship** Summer 2015  
Shell Projects & Technology, Houston, TX  
*Mentored by J. Lopez and supervised by P. Wills*  
Applied machine learning techniques to analyze data and predict production at  
steam-driven bitumen field in Peace River  
Regularly consulted with reservoir engineer to develop useful products

**Computational Physics Internship** 2010-2011  
Nanohmics, Inc. Austin, TX  
*Project funded through U.S. Department of Defense, PI B. Zollars*  
Implemented unstructured adaptive mesh methods for finite element code to model  
liquid erosion of coated lenses

## Skills

Preferred programming languages: C/C++ and Python  
HPC tools: MPI, openMP, CUDA, TBB  
Profiling tools: Tau, HPM, NVCC, Vampir  
Scientific tools: MATLAB, Mathematica, COMSOL, IDL  
Environment and development tools: Google Cloud Compute Engine, Docker,  
Singularity, Doxygen, Git, Jupyter Notebooks