

EDUCATION

Ph.D., Mathematical and Computer Sciences, May 2013
Colorado School of Mines
Golden, CO

Dissertation: “Bayes Risk A -optimal Experimental Design Methods For Ill-posed Inverse Problems.”

Summary: I present a general method known as Bayes Risk A -optimal design that can be used to find optimal experimental designs when inverse problems are ill-posed. I demonstrate that the Bayes Risk A -optimal design has a natural connection to Tikhonov regularization. In order to use this method, some generalizations to the linear-optimal design theory must be proven. Finally, I present a computational scheme for solving Bayes Risk A -optimal designs in a relatively efficient manner that allows for high levels of user customization.

Adviser: Luis Tenorio

M.S., Mathematics with Operations Research and Statistics Option, May 2007
New Mexico Institute of Mining and Technology
Socorro, NM

Thesis: “Seismic Moment Rate Function Inversions from Very Long Period Signals Associated with Strombolian Eruptions at Mount Erebus, Antarctica.”

Summary: I present a new solution method for the recovery of the seismic source moment tensor - the mechanism that produces a eruptive event in a volcanic lake in Mount Erebus, Antarctica. The main result highlights an alternative way of approaching this nonlinear inverse problem that allows one to exploit properties of the system and apply techniques that require minimal resources for the solution. In particular, I used Fast Toeplitz Multiplication, the Conjugate Gradient Least Squares (CGLS) method, and Tikhonov regularization to solve this problem.

Adviser: Brian Borchers

B.S. Mathematics, May 2005
New Mexico Institute of Mining and Technology
Socorro, NM

B.S. Physics, May 2002
New Mexico Institute of Mining and Technology
Socorro, NM

EMPLOYMENT HISTORY

Visiting Assistant Professor 8/2013-Present
Indiana University Bloomington
Department of Statistics
Bloomington, IN

Full-time visiting position. Taught graduate and undergraduate courses in Statistics.

Adjunct Faculty 1/2013-5/2013
Colorado School of Mines
Department of Applied Mathematics and Statistics
Golden, CO

Taught 2 sections of Probability & Statistics.

Graduate Teaching Fellow 8/2012-12/2012
Colorado School of Mines
Department of Applied Mathematics and Statistics
Golden, CO

Taught 2 sections of Probability & Statistics.

Graduate Research Assistant 8/2009-8/2012
Colorado School of Mines
Department of Applied Mathematics and Statistics
Golden, CO

Visiting Assistant Professor 8/2008-5/2009
Adams State College
Department of Chemistry, Computer Science, and Mathematics, Alamosa, CO

Full-time visiting position. Taught four courses each semester. Courses include Finite Mathematics, College Algebra, and Trigonometry.

Research Assistant 1/2007-6/2008
Los Alamos National Laboratory
Earth and Environmental Science Division, Los Alamos, NM

Applied efficient algorithms towards the solution of joint inversion problems involving the recovery of geophysical seismic velocity models. My improvements have led to dramatic computational performance increases over previously used methods in terms of both computational time and storage. These improvements have also led to the ability to work on larger problems with more data, additional model constraints, and problems involving more complex physical geometries. Without these improvements, solutions by other methods were impossible. All algorithms were implemented in Fortran77.

Graduate Student Instructor 1/2004-12/2006
New Mexico Institute of Mining and Technology
Department of Mathematics, Socorro, NM

Taught undergraduate lectures in College Algebra, Pre-Calculus, and Trigonometry. I have also instructed laboratories that accompany lecture courses in Calculus and Linear Algebra. This required working with professors and other teaching assistants to provide consistent teaching across several class sections. Additional duties included working as a tutor in the Mathematics help room, which provides tutoring for all undergraduate courses in Mathematics.

Graduate Research Assistant 5/2006-8/2006
New Mexico Institute of Mining and Technology
Department of Hydrology, Socorro, NM

Worked on the development of a MATLAB implementation for the Surface Energy Balance Algorithm for Land (SEBAL). SEBAL is an image-processing model that calculates the evapotranspiration and other energy exchanges at the earth's surface using digital image data collected by Landsat or other remote-sensing satellites measuring visible, near-infrared and thermal infrared radiation.

Graduate Teaching Assistant
New Mexico State University
Department of Physics, Las Cruces, NM

8/2003-12/2003

Served as a laboratory instructor for several sections of the freshman Physics II laboratory which covered topics in electricity and magnetism.

Graduate Teaching Assistant
New Mexico Institute of Mining and Technology
Department of Physics, Socorro, NM

1/2002-6/2003

Served as a laboratory instructor for freshman Physics laboratories which accompany Physics I and II lectures. I additionally served as a tutor in the Physics department help room.

Graduate Teaching Assistant
New Mexico Institute of Mining and Technology
Department of Mathematics, Socorro, NM

8/2001-12/2001

Instructed laboratories that accompany lecture courses in Calculus. This required working with professors and other teaching assistants to provide consistent teaching across several class sections. Additional duties included working as a tutor in the Mathematics help room, which provides tutoring for all undergraduate courses in Mathematics.

**REFEREED
PUBLICATIONS**

L. Tenorio, **C. Lucero**, V. Ball, and L. Horesh. "Experimental design in the context of Tikhonov regularized inverse problems." *Statistical Modeling*. October 2013, Vol 13 (5 & 6): 481-507.

E. Haber, Z. Magnant, **C. Lucero**, and L. Tenorio. "Numerical methods for A -optimal designs with a sparsity constraint for ill-posed inverse problems." *Computational Optimization and Applications*., Springer Netherlands, April 2011.

Rowe, C., W. Phillips, M. Maceira, M. Begnaud, L. Steck, X. Yang, **C. Lucero**, H. Hartse, R. Stead, K. Mackey, K. Fujita, and C. Ammon (2007). "Geophysical Imaging of Asia and Siberia: Tomography for Seismic Velocity, Upper Mantle Gradient, Lg Attenuation, and Joint Inversion of Surface Wave Dispersion, Receiver Functions and Satellite Gravity Data." *27th Monitoring Research Review (MRR2007)*, Denver, CO, Sept. 25-27, 2007.

**CONFERENCE
TALKS**

C. Lucero and L. Tenorio. "Data Analysis for Uncertainty Quantification of Inverse Problems." *SIAM Conference on Computational Science and Engineering (CSE11)*, MS153, February 2011.

Lucero, C., M. Maceira, C. Rowe, L. Steck and B. Borchers (2007). "Computational improvements for deriving a 3-D shear wave model for the Tarim Basin, China, from multiple geophysical observations." *EOS Trans. AGU Fall Meet. Suppl.* Abstract T23F-08. December 2007

Aster, R., Kyle, P., McIntosh, W., **Lucero, C.**, Borchers, B., Very long period Strombolian eruption-associated seismic signals observed in the near field at Mount Erebus volcano, *The Physics of Fluid Oscillations in Volcanic Systems Workshop*, Lancaster, U.K., 7-8 September, 2006.

Lucero, C., Borchers, B., Aster, R., “An iterative approach to seismic moment tensor inversion.” *SIAM Conference on Mathematical and Computational Issues in the Geosciences*, 2007.

CONFERENCE POSTERS

Maceira, M., L.K. Steck, C.A. Rowe, **C. Lucero** and B. Borchers (2007). “Three-dimensional shear velocity model for the Asian continent from surface wave dispersion, receiver functions and gravity observations.” *Seismol. Res. Lett.*, Abstracts, SSA Spring 2007 meeting.

Lucero, C., Aster, R., Borchers, B., Kyle, P., “Moment Rate Function Inversions from Very Long Period Signals Associated with Strombolian Eruptions at Mount Erebus, Antarctica.” Fall, 2005 AGU meeting, *EOS trans. AGU*, 86(52), 2005.

WORKSHOPS

Institute for Mathematics and its Applications. IMA Thematic Year on Simulating Our Complex World: Modeling, Computation and Analysis. *Large-scale Inverse Problems and Quantification of Uncertainty.*, June 6-10, 2011.

AWARDS AND FELLOWSHIPS

Awarded a NM-AGEP Fellowship Fall 2003 - Fall 2006
NM-AGEP - New Mexico Alliance for Graduate Education and the Professoriate
Funded by the National Science Foundation, the program lost funding in 2006.

COMMITTEES AND SERVICE

Wellness Center Planning Committee Fall 2007 - Fall 2008
Served on the committee that oversees the planning of a new wellness center for New Mexico Tech.

Interdisciplinary Science for the Environment Summer 2005
A research experience for undergraduates program at New Mexico Tech. I served as a program mentor for the students in this REU program.

SACNAS 2006 National Conference October 26-29, 2006
SACNAS is the Society for Advancement of Chicanos and Native Americans in Science. Served on a speaker panel where participants discussed their experiences to help enhance the minority pipeline in science, technology, engineering and mathematics (STEM) disciplines.

RELEVANT SKILLS

Languages & Software: C, C++, FORTRAN 95+, MATLAB, Minitab, R, Maple, L^AT_EX. Parallel programming using OpenMPI, and OpenMP.

CURRENT MEMBERSHIPS

Society for Industrial and Applied Mathematics (SIAM)
Sigma Pi Sigma (ΣΠΣ) - National Physics Honor Society

TEACHING EXPERIENCE

Courses Taught at Indiana University Bloomington

Graduate Courses

BIOL-Z 620 Biostatistics
Semesters Taught: Fall 2014

STAT-S 440/640 Multivariate Data Analysis
Semesters Taught: Fall 2013

STAT-S 681 Design of Experiments
Semesters Taught: Spring 2014, Fall 2015

STAT-S 681 Uncertainty Quantification
Semesters Taught: Spring 2015

STAT-S 781 Parameter Estimation & Inverse Problems
Semesters Taught: Fall 2013

Undergraduate Courses

STAT-S 301 Business Statistics
Semesters Taught: Spring 2015

STAT-S 303 Applied Statistics for the Life Sciences
Semesters Taught: Spring 2014, Summer I 2014, Fall 2014, Summer I 2015, Fall 2015
(2 Sections)

Courses Taught at Colorado School of Mines

Math 323 Probability & Statistics For Engineers
Semesters Taught: Fall 2012 (2 Sections) Spring 2013 (2 Sections)

Courses Taught at Adams State College

Math 104 Finite Mathematics
Semesters Taught: Fall 2008 (2 Sections), Spring 2009 (2 Sections)

Math 106 College Algebra
Semesters Taught: Fall 2008 (2 Sections), Spring 2009

Math 107 Trigonometry
Semesters Taught: Spring 2009

Courses Taught at New Mexico Tech

MATH 103 Pre-Calculus (formerly listed as College Algebra with identical content)
Semesters Taught: Summer 2004, Fall 2004 (2 Sections), Fall 2005 (2 Sections), Spring 2006 (2 Sections), Fall 2006

MATH 104 Trigonometry
Semesters Taught: Spring 2005 (2 Sections)

MATH 131L Calculus & Analytic Geometry Laboratory I
Semesters Taught: Fall 2001 (2 Sections), Spring 2004 (2 Sections)

MATH 254L Introduction to Applied Linear Algebra Laboratory
Semesters Taught: Fall 2006 (2 Sections)

PHYS 121L General Physics Laboratory I
Semesters Taught: Spring 2002 (2 Sections)

PHYS 122L General Physics Laboratory II
Semesters Taught: Fall 2002 (2 Sections), Spring 2003 (2 Sections)