

Matthew Parno | Curriculum Vitæ

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Education

Massachusetts Institute of Technology

Ph.D. Computational Science and Engineering, minor in Hydrology 2011–2014
Thesis title: "Transport maps for accelerated Bayesian computation."

Massachusetts Institute of Technology

S.M. Computation for Design and Optimization 2009–2011

Clarkson University

B.S. Electrical Engineering, minor in Computational Science 2005–2009

Clarkson University

B.S. Applied Mathematics and Statistics 2005–2009

Experience Summary

Software Development.....

MIT Uncertainty Quantification library (MUQ)

Founder and lead developer 2012–Present
<https://bitbucket.org/mituq/muq>

Research Projects and Assistanceships.....

Transport maps for accelerated MCMC and near real-time Bayesian computation Cambridge, MA
Massachusetts Institute of Technology 2010–Present

Development of a multiscale decomposition for large-scale Bayesian inference Cambridge, MA
Massachusetts Institute of Technology 2009–2013

Ensemble Kalman Filter for large-scale Bayesian inference in hydrology Albuquerque, NM
Sandia National Laboratories Summer 2010

Particle swarm optimization with surrogate functions Potsdam, NY
Clarkson University 2005–2009

Real-time RADAR signal processing with GPUs Fort Collins, CO
Colorado State University Summer 2008

Inverse problems and model averaging in hydrology. Livermore, CA
Sandia National Laboratories Summer 2007

Volunteer Experience.....

National Park Service – Kenai Fjords National Park Seward, AK
Mathematical assistance and manual labor Summer 2013

- Assisted in glacier mass balance and time-lapse photography field work.
- Provided guidance in regression and model averaging for net mass balance calculations on Exit glacier.

St. Lawrence-Adirondack Chapter of the Antique Automobile Club of America Madrid, NY
Measurement and CAD support Spring 2009

- Measured all details of a historic gas station in Madrid, NY
- Used CAD (Autodesk Inventor) to document building details and develop plans for future reconstruction (see <http://www.slpowermuseum.com/buildings/gasstation/> for the results)

Fellowships and Awards

- DOE Office of Science Graduate Fellowship (DOE SCGF)**
Awarded to support basic research in scientific computing. 2010
- Clarkson University's Levinus Clarkson Award**
Presented to top two students in graduating class, as decided by a faculty vote. 2009

Publications

- Book Chapters**.....
- Transport Maps for Conditional and Marginal Simulation**
Y. Marzouk, M. Parno, and A. Spantini 2015
Handbook of Uncertainty Quantification. R. Ghanem, D. Higdon, and H. Owhadi (Eds.), Springer.

Refereed Journal Articles.....

- A strategy for multiscale Bayesian inference using transport maps.**
M. Parno, T. Moselhy, and Y. Marzouk 2015
Submitted to the SIAM Journal on Uncertainty Quantification (JUQ).
- Transport map accelerated Markov chain Monte Carlo**
M. Parno and Y. Marzouk 2014
Submitted to the Journal of the American Statistical Association (JASA),
- A Decision Making Framework with MODFLOW-FMP2 via Optimization: Determining Trade-offs in Crop Selection**
K.R. Fowler, E.W. Jenkins, C. Ostrove, J.C. Chrispell, M.W. Farthing, and M. Parno 2014
Environmental Modelling & Software, Volume 69, July 2015, Pages 280-291.
- Applicability of Surrogates to Improve Efficiency of Particle Swarm Optimization**
M.D. Parno, T. Hemker and K.R. Fowler 2012
Engineering Optimization, Volume 44, Issue 5
- Derivative-free optimization via evolutionary algorithms guiding local search (EAGLS) for MINLP**
J.D. Griffin, K.R. Fowler, G.A. Gray, T. Hemker, and M.D. Parno 2011
Pacific Journal of Optimization, Volume 7, Number 3

Theses.....

- Transport Maps for Accelerated Bayesian Computation.**
Matthew Parno 2014
MIT Computational Science and Engineering Ph.D. thesis
- A Multiscale Framework for Bayesian Inference in Elliptic Problems.**
Matthew Parno 2011
MIT Computation for Design and Optimization master's degree thesis
- Particle Swarm Optimization with Surrogate Functions**
Matthew Parno 2009
Clarkson University undergraduate honor's program thesis

Technical Reports.....

- Bayesian data assimilation for stochastic multiscale models of transport in porous media.**
J. Ray, S. Lefantzi, K. Klise, L. Salazar, SA McKenna, B. van Bloemen Waanders, MD Parno, YM Marzouk 2011
Sandia National Laboratories Technical Report, SAND Report SAND2011-6811
- A Framework for Particle Swarm Optimization with Surrogate Functions.**
M.D. Parno, T. Hemker and K.R. Fowler 2009
TU-Darmstadt Technical Report, TUD-CS-2009-0319

Grants

Proposed.....

- An Extensible Software Framework for Large-Scale Bayesian Inversion** NSF SI2
NSF Software Infrastructure for Sustained Innovation SI2 June 2015

Teaching

IMA Short Course: Introduction to Uncertainty Quantification

Institute for Mathematics and its Applications, University of Minnesota

Minneapolis, MN

Summer 2015

- I gave applications lectures where we walked through forward and inverse UQ problems.
- Extensive use of interactive MUQ tutorials with remote IPython servers to “get our hands dirty”.

Completed Teaching Certificate Program

Massachusetts Institute of Technology

Cambridge, MA

Summer 2014

Numerical Methods for Stochastic Modeling and Inference

Grader – Massachusetts Institute of Technology

Cambridge, MA

Spring 2014

Differential Equations

Recitation teaching assistant – Clarkson University

Potsdam, NY

Fall 2008

Outreach.....

Mathcounts Coach

Norwood-Norfolk Middle School

Norwood, NY

2006-2009

IMPETUS Program

Clarkson University

St. Lawrence County, NY

2006-2009

(Integrated Mathematics and Physics for Entry into Undergraduate STEM)

Presentations

Invited Talks.....

Accelerated Bayesian Inference with Transport Maps

Matthew Parno, Youssef Marzouk, Tiangang Cui, and Kody Law

SIAM Computational Science and Engineering

Salt Lake City, UT, Mar. 2015

Exploiting Geometry in MCMC Using Optimal Transport Theory.

Matthew Parno and Youssef Marzouk

SIAM Uncertainty Quantification – Recording available [from SIAM \(click here\)](#)

Savannah, GA, Apr. 2014

Multiscale Methods for Large-Scale Bayesian Inversion.

Matthew Parno and Youssef Marzouk

SIAM Computational Science and Engineering

Boston, MA, Mar. 2013

Post-Inference Design Applied to Largescale PDE Systems.

Matthew Parno and Youssef Marzouk

INFORMS Computing Society

Sante Fe, NM, Jan. 2013

Post-inference Optimization in a Multi-scale Bayesian Setting.

Matthew Parno and Youssef Marzouk

SIAM Optimization

Darmstadt, Germany, May 2011

Multiscale Methods for Statistical Inference in Elliptic Problems.

Matthew Parno and Youssef Marzouk

SIAM Computational Science and Engineering

Reno, NV, Feb. 2011

Efficient Multiscale Bayesian Inference and iterative nonlinear conditioning.

Matthew Parno and Youssef Marzouk

Clarkson University

Potsdam, NY, Dec. 2010

Multi-Scale Bayesian Uncertainty Quantification and Inversion.

Matthew Parno and Youssef Marzouk

Clarkson University

Potsdam, NY, Nov. 2009

Surrogate Optimization Techniques for Mixed-Integer Nonlinear Problems.

Matthew Parno, Kathleen Fowler, and Thomas Hemker

SIAM Optimization

Boston, MA, May 2008

Contributed Talks.....

Multiscale Robust Optimization.

Matthew Parno and Youssef Marzouk
CMWR

Champaign, IL, June 2012

A framework for multiscale inference with applications in Elliptic problems.

Matthew Parno and Youssef Marzouk
SIAM Uncertainty Quantification

Raleigh, NC, April 2012

Analysis of the Ensemble Kalman Filter in Porous Media Inference.

Matthew Parno, Bart van Bloemen Waanders, Sean McKenna, Youssef Marzouk, and Jaideep Ray
SIAM Annual Meeting

Pittsburgh, PA, July 2010

Point Ranking for Asynchronous Parallel Optimization.

M. Parno, I. Akrotirianakis, K. Fowler, G. Gray, J. Griffin, and T. Hemker
Copper Mountain Conference on Iterative Methods

Copper, CO, Feb. 2010

The Use of Surrogate Functions for Hybrid MINLP Particle Swarm Optimization.

Matthew Parno, Kathleen Fowler, and Thomas Hemker
SIAM Computational Science and Engineering

Miami, FL, Feb. 2009

A Framework for Particle Swarm Optimization with Surrogate Functions.

Matthew Parno, Kathleen Fowler, and Thomas Hemker
Copper Mountain Conference on Iterative Methods

Copper, CO, Feb. 2008

Plume Containment with Particle Swarm Optimization.

Matthew Parno and Kathleen Fowler
SIAM Computational Science and Engineering

Costa Mesa, CA, Feb. 2007

Posters.....

MUQ (MIT Uncertainty Quantification): Flexible Software for Connecting Algorithms and Applications

Matthew Parno, Andrew Davis, Patrick Conrad, and Youssef Marzouk
SIAM CSE 2015

Salt Lake City, UT, Mar. 2014

Transport maps for geometry-accelerated MCMC

Matthew Parno and Youssef Marzouk
ISBA World Meeting 2014

Cancun, Mexico, July 2014

Using multiscale structure and transport maps for high-dimensional inverse problems.

Matthew Parno, Youssef Marzouk, and Tarek Moselhy
MCMSki 2014

Chamonix, France, Jan. 2014

Differential geometric approaches for efficient Bayesian inference.

Matthew Parno and Youssef Marzouk
DOE SCGF Annual Meeting

Brookhaven National Lab, July 2012

A multiscale framework for Bayesian inference in Elliptic Problems.

Matthew Parno and Youssef Marzouk
DOE SCGF Annual Meeting

Oak Ridge National Lab, July 2011

Groundwater Plume Containment Using Particle Swarm Optimization.

Matthew Parno and Kathleen Fowler
DOE SCGF Annual Meeting

Potsdam, NY, Jan. 2007

Institutes and Affiliations

Department of Energy DiaMonD Center

A DOE center focused on multidisciplinary research driven by DOE scientific applications.
<http://dmd.mit.edu/>

2013-Present

Department of Energy QUEST Institute

A DOE SciDAC institute focused on uncertainty quantification in large-scale computations.
<http://www.quest-scidac.org/>

2012-Present

Professional Development

American Institute of Mathematics

Palo Alto, CA

AIM Workshop

May 2015

"Integrated analysis for agricultural management strategies."

- Workshop focused on combining simulation (OWHM-FMP) with advanced optimization and uncertainty quantification for sustainable agricultural management.
- Involved researchers from hydrology, optimization, and uncertainty quantification.

American Institute of Mathematics

San Jose, CA

AIM SQUARE (Structured Quartet Research Ensembles)

April 2013

"Mathematical modeling, simulation, and optimal design for agricultural water management"

- Small workshop focused on the application of derivative free optimization techniques for agricultural water management.
- Researchers in hydrology and optimization focused on sustainable crop rotations.
- Developed python framework to couple Modflow-FMP2 simulator with optimization tools in Dakota

American Institute of Mathematics

Palo Alto, CA

AIM SQUARE (Structured Quartet Research Ensembles)

February 2010

"Derivative-Free Hybrid Optimization Methods for Solving Simulation-Based Problems in Hydrology"

- Eight person focused workshop on combining evolution algorithms with local search methods for efficient optimization.
- The EAGLS (Evolutionary Algorithm Guiding Local Search) algorithm was a result of this workshop.

American Institute of Mathematics

Palo Alto, CA

AIM Workshop

October 2008

"Derivative-Free Hybrid Optimization Methods for Solving Simulation-Based Problems in Hydrology"

- This workshop brought together researchers from statistics, derivative free optimization, and hydrology.
- Focused on the application of hybrid optimization techniques in hydrology

Professional Service

Peer reviewer service.....

- Transactions on Mathematical Software (TOMS)
- SIAM Journal on Applied Mathematics
- Engineering Optimization
- Computers and Geosciences
- Pacific Journal of Optimization

Society, Club, and Team Memberships

Professional.....

- Society for Industrial and Applied Mathematics (SIAM)
- International Society for Bayesian Analysis (ISBA) 2014
- Tau Beta Pi
- INFORMS Computing Society (ICS) 2013

Other.....

- Clarkson University Alpine Ski Team 2005-2009
- Clarkson University Outing Club (CUOC) 2005-2009

Other skills

Operating systems.....

Expert in:: OSX, Linux (Ubuntu, Fedora, RedHat/CentOS) **Experience with::** Windows, Android, iOS

Software.....

Expert in:: Matlab, MS Office, KDevelop **Experience with::** Visio, Eclipse

Programming Languages	
Expert in: c++,c,Matlab,Python,Fortran 77/95,L ^A T _E X	Experienced with: Tikz, CUDA, Javascript, VHDL, VBA, bash, html
Computing libraries	
Expert: MPI, Boost, LAPACK/BLAS, Eigen, FFTW3, OpenMP, GTEST	Experienced with: Dakota, Trilinos, PETSC, Deal.II, LibMesh, QT, portaudio
Miscellaneous	
Expert:	Experienced with: Soldering,Oscilloscopes,Arduino
Outdoor skills	
Expert: Backcountry skiing, Kayaking, Rafting, Hiking	Experienced with: Climbing, Mountaineering, glacier travel

Other Jobs

- Whitewater River Guide at Blazing Adventures, Snowmass, CO (Summer 2006)
- Whitewater Raft Guide at Whitewater Challengers, North River, NY (Summer 2005)
- Sales Associate at REI, Roseville, MN (2004-2005)