Robert Baraldi — Curriculum Vitae

Contact Information

University of Washington
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Research Focus

I am interested in inverse problems, optimization, and uncertainty quantification. Currently, I am working in seismic inversion, using PDE-constrained optimization and data interpolation techniques to image magma under Mt. St Helens. In the past, I have worked on parameter estimation/uncertainty quantification for disease models and machine learning techniques in genomics.

Graduate Education

University of Washington, Seattle: Department of Applied Mathematics, PhD program
September 2016-Present

- PhD Advisor - Aleksandr Aravkin

Honors:

- AMATH Boeing Fellowship/Top Scholar Award - Winter and Spring Quarters 2017
- National Science Foundation Graduate Research Fellowship - 2017 (declined)
- Department of Energy Computation Science Graduate Fellowship - 2017 (accepted)

Current Research - Seismic Inversion:

- Combining full waveform inversion with non-smooth, non-convex low-rank approximation techniques to image magma under Mt St. Helens (joint with Ken Creager, UW)
- Developing stochastic optimization techniques for inverse problems, in particular full waveform inversion.
- Using unsupervised learning techniques on locality-sensitive hashing techniques (joint with Gustavo Guzman, ISB).
- Efficiently combining PDE-constrained optimization techniques to solve jointly solve problems in parameter estimation and inversion (joint with Daniel Shapero, E-Sciences Institute)
- Combining implicit sampling techniques with reduced order models for uncertainty quantification (joint with Matthew Zahr, LBNL).

Undergraduate Education (if you want to know)

North Carolina State University: Mathematics-BS, Statistics (Minor); August 2012 –May 2016

- Research Advisor - Harvey Thomas Banks
- Academic Advisor - Alina Duca

Honors:

- Mathematics Honors Program at NC State University
- University Honors Program at NC State University
- Goodnight Scholarship (2012)
- SECU Foundation Scholarship (2012)
- Business and Finance Scholarship (2013)
- Dean's List (all semesters)

Undergraduate Academic Experience

Biomathematics Research, North Carolina State University Center for Research in Scientific Computation, Raleigh, NC: May 2013 – May 2016

- Developed models of Hepatitis C and HIV with the Undergraduate Bio-math program
- Analyzed parameter subset selection and its effect on uncertainty quantification in a circadian rhythm model
- Identified methods of spotting parameter dependency and identifiability in models with multiple parameterizations
- Used image analysis and machine learning in counting different object classes in pictures
- Used statistical techniques to determine an appropriate algae growth model for coupling with a discrete, Leslie matrix model for Daphnia growth
- Developed a method of parameter estimation using unidentified aggregate data in individual-based models
- Mentor: Dr. Harvey Thomas Banks (htbanks@ncsu.edu)

Cold Spring Harbor Laboratory Undergraduate Research Program, Cold Spring Harbor, NY: June - August 2015

- Investigated the properties of long, inter-genic, non-coding RNA co-expression data using machine learning techniques
- Developed code that uses network data to predict gene function through network propagation
- Mentor: Jesse Gillis (JGillis@cshl.edu)

Work Experience

Summer Student Worker, Pharmacometrics Unit at Pfizer's Research and Development site, Cambridge, Massachusetts: June 2016 – August 2016

- Developed and implemented a model of lipoprotein metabolism in humans
- Synthesized existing information to conduct test of DGAT2 inhibition with model
- Mentor: Dr. Satyaprakash Nayak (satyaprakash.nayak@pfizer.com)

Summer Student Worker, Systems Modeling Group of the Cardiovascular and Metabolic Diseases (CVMeT) Unit at Pfizer's Research and Development site, Cambridge, Massachusetts: May 2014 – August 2014

- Used and updated existing models to simulate the compartmental flow of different types of cholesterol under various treatment regimens
- Mentor: Dr. Cynthia J Musante (Cynthia.J.Musante@pfizer.com)

Teaching

- **Teaching Assistant,** University of Washington: MATH 126 Calculus III: Fall Quarter 2016.
- **Mathematics Tutor**, North Carolina State University: MA 141 Calculus I, MA 241 Calculus II. January 2013 – May 2013

Software

Part of the UW Applied Modeling and Optimization Github page: https://github.com/UW-AMO. Experienced in MATLAB, Python, R, Julia, Linux/Unix systems. Mildly aware of Java, C++, Fortran.

Publications

1. HT Banks, R Baraldi, K Cross, KB Flores, C McChesney, L Poag, E Thorpe (2015) Uncertainty quantification in modeling HIV viral mechanics. Mathematical Biosciences and Engineering 12(5): 937-964. http://aimsciences.org/journals/displayArticlesnew.jsp?paperID=11300

2. H.T. Banks, R. Baraldi, K. Flores. (2015) Optimal Design for Minimizing Uncertainty in Dynamic Equilibrium Systems. Eurasian Journal of Mathematical and Computer Applications 3, 20-43 http://www.ncsu.edu/crsc/reports/ftp/pdf/crsc-tr15-03.pdf

3. K Adoteye, HT Banks, R Baraldi, KB Flores, J Nardini, WC Thompson. (2015) Correlation of Parameter Estimators for Models Admitting Multiple Parametrizations. International Journal of Pure and Applied Mathematics 105(3): 497-522 http://www.ijpam.eu/contents/2015-105-3/16/16.pdf

4. HT Banks, R Baraldi, KB Flores, M Stemkovski. (2016) Validation of a Mathematical Model for Green Algae (*Raphidocelis subcapitata*) Growth and Implications for a Coupled DynamicalSystem with *Daphnia Magna*. Applied Sciences 6(5): 155 http://www.mdpi.com/2076-3417/6/5/155/htm

5. HT Banks, R Baraldi, J Catenacci, N Myers. (2016) Parameter Estimation Using Unidentified Individual Data in Individual Based Models. Mathematical Modeling of Natural Phenomena, 11(6):103–121https://www.ncsu.edu/crsc/reports/ftp/pdf/crsc-tr16-04.pdf

Conference Proceedings

1. R Baraldi, K Cross, C McChesney, L Poag, E Thorpe, KB Flores, HT Banks (2014) Uncertainty quantification for a model of HIV-1 patient response to antiretroviral therapy interruptions. Proceedings of the 2014 American Control Conference, 2753-2758 http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6858714&isnumber=6858556

Technical Reports

1. R. Baraldi, K. Cross, C. McChesney, L. Poag, E. Thorpe, K. Flores, and H.T. Banks (2013) Mathematical Modeling of HCV Viral Kinetics. CRSC Technical report CRSC-TR13-07, Raleigh, NC. http://www.ncsu.edu/crsc/reports/ftp/pdf/crsc-tr13-07.pdf

2. R. Baraldi, J. Nardini, E. Thorpe, and H.T. Banks (2014) The Effects of Parameterization on Inverse Problems, CRSC Technical report CRSC-TR14-07, Raleigh, NC. http://www.ncsu.edu/crsc/reports/ftp/pdf/crsc-tr14-07.pdf

Conference Presentations

1. “Systems Modeling and Data Assimilation in Drug Development”, SIAM Annual Life Sciences Conference, Boston, MA, July 11-15, 2016.