# Department of Applied Mathematics

## Annual Report 2013

Colorado
University of Colorado at Boulder ™

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# Department of Applied Mathematics

University of Colorado at Boulder

## Vision

The vision of the Department of Applied Mathematics at the University of Colorado is to be an internationally leading department in Applied Mathematics in research and education.

## Mission

The Department of Applied Mathematics at the University of Colorado strives to provide excellent teaching, research, and service to the university community and to the world in the application of mathematics to other disciplines.

## Objectives

The Department of Applied Mathematics has four primary objectives:

- *To teach our students well;*
- *To seek out and develop new, interesting applications of mathematics in other disciplines;*
- *To provide each student with a rich educational experience;*
- *To create new mathematics.*

We interpret this to mean:

- *Provide undergraduate and graduate students with a high quality education and training in applied mathematics and prepare them for careers in government, industry, laboratories, and the academic professions;*
- *Offer and monitor degree programs leading to BS, MS and PhD degrees in Applied Mathematics;*
- *Nourish and maintain a professional environment in which excellence in teaching, learning, scholarship, and creativity are of central importance;*
- *Assure teaching and research expertise in a number of key areas of applied mathematics including the methodology of applied mathematics, computational mathematics and algorithms, industrial applications, applied probability, and statistics.*

## Cover Art

Each year, the Department of Applied Mathematics at the University of Colorado at Boulder creates a t-shirt that illustrates aspects of current research in the department. This year's design was created by affiliated faculty member Natasha Flyer of the National Center for Atmospheric Research (NCAR).

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# Department of Applied Mathematics 2013 Annual Report Overview

**Dr. Mark J. Ablowitz**
Department Chair

**Dr. Anne Dougherty**
Associate Chair

# Department of Applied Mathematics 2013 Annual Report
# Departmental Activities

## Undergraduate Education

Undergraduate education in the Department of Applied Mathematics provides students with broad-based preparation for the challenges and opportunities of today and tomorrow. Through courses, projects, research and other educational activities, the Department provides unique experiences to our majors and minors.
The Department also has a large teaching commitment since most undergraduate engineering majors are required to take four courses in applied mathematics.

Anne Dougherty continued to serve the department as Chair of Undergraduate Studies. The Undergraduate Committee consisted of Jem Corcoran, Anne Dougherty, William Kleiber, and Adam Norris. Applied Mathematics faculty and graduate students taught nearly 16,000 credit hours of courses to over 4,500 students in 2013. See p. 34 for a detailed list of the courses taught.

Applied Mathematics had 171 undergraduate Applied Mathematics majors for the full AY 2013-2014.
42 students received their baccalaureate degrees this year. (See p. 06 for a list of our graduates.) Our minor program, attracting students from other majors who are interested in more in-depth training in applied mathematics, had 117 students declared in 2013, and more are taking at least some of the upper division courses towards the minor.

## Graduate Education

Per-Gunnar Martinsson served as the department's Graduate Committee Chair. 12 new graduate students entered the department in 2013, all of them PhD candidates.

The role of the graduate program is to give students in-depth training in applied mathematics and to provide the skills necessary for success in industry, government laboratories, and academia. Different departments around the country use different definitions of "applied mathematics." In this department, the areas of mathematical expertise are: scientific computation, physical applied mathematics, dynamical systems, analysis, statistics/probability, and mathematical biology. In addition, the Department maintains an active program of affiliated faculty. These are faculty members in other departments with an interest in applying mathematics within their own disciplines. A graduate student in Applied Mathematics can pursue a doctorate in Applied Mathematics with an affiliated faculty member as the thesis advisor, along with an Applied Mathematics co-advisor. A basic goal of this department is to seek out and develop new areas of application for mathematics and our affiliated faculty members play a crucial role in that process.

The department offers four formal interdisciplinary programs, three at the MS level.

- A **Combined MA/MS with the Molecular, Cellular, and Developmental Biology Department (MCDB)**. The combined MA/MS is a three-year interdisciplinary program designed to produce students trained both in applied mathematics and in molecular biology. A student who completes this program can begin a career in the biological sciences with a very desirable combination of skills, or can continue on to a PhD either in APPM or in MCDB.

- An **MS with a Computational Science and Engineering Track**. This track is designed for a student in a participating department in science or engineering, with a strong interest in scientific computation and mathematical analysis. Under this plan, the student obtains an MS in APPM on the way to a PhD in the other department. Six other departments now participate in this program.

- **Teacher-Licensure Option**. An APPM graduate student can fulfill the outside-sequence requirement in the School of Education. By also meeting the requirements of that School, a student can obtain both an MS in applied mathematics and a license to teach mathematics in a secondary school (i.e., in middle through high school). More information about the graduate program is available at http://amath.colorado.edu/programs/grad.html

The **IQ Biology** program offers a mix of core classes, research projects and professional development experiences. These are all designed to help you work collaboratively across disciplines to solve problems. Other departments participating in IQ Biology include Chemistry & Biochemistry; Ecology and Evolutionary Biology; Molecular, Cellular and Developmental Biology; Computer Science; and Mechanical Engineering.

# Department of Applied Mathematics 2013 Annual Report
# Graduating Students

*Bachelor's Degrees*

## August 2013

Tracy Babb • Randall Callahan • Armeen Taeb • Kiran Thurimella
Amanda Yip

## December 2013

Anthony Barbarino • Alan Bromwell • Marshall Cornelius • Logan Howe
Andrew Pearce • Nicholas Truesdale • Steven Van Buskirk • Shelby Yenzer
Shanon Yeung

## May 2013

Jada Ballentine • Christina Bonfanti • Matthew Cullen • Jonathan Jaggers
Cameron Knauer • Shaelli Lawlor • Victoria Li • Nicole Look
Caitlin Lowe • Eric Massey • James O'Brien • Ethan Oehring
Brita Schneiders • Taylor Self • Steven Taylor • Kyle Wolma

*Master's Degrees*

## August 2013

Tommaso Buvoli (BS/MS)
Dai Tran
Ryan Young

## December 2013

Dylan Klein (BS/MS)

## May 2013

Jordan Martel
David Nieves
Jerome Perkins (BS/MS)
Ashley Same
Andrew Schauf
Paul VaughanMiller

*Doctoral Degrees*

## August 2013

Theodore Galanthay
Jonah Reeger
Adrean Webb

## December 2013

Tobias Jones
Anthony Rasca

## May 2013

Douglas Baldwin
Adam Fox
Ryan Lewis
Brock Mosovsky
Jonah Reeger
Sebastian Skardal
Dane Taylor
John Villavert

# Department of Applied Mathematics 2013 Annual Report
# Faculty, Instructors, Research Associates, Visitors, and Staff

## Core Faculty, Instructors, and Research Associates

**Mark J. Ablowitz** – Department Chair; Professor; College of Arts and Sciences Professor of Distinction; PhD, Massachusetts Institute of Technology. *Partial Differential Equations, Solitons, Nonlinear Waves.*

**Douglas Baldwin** –Research Associate; PhD, University of Colorado Boulder

**Jerrold Bebernes** – Professor Emeritus; PhD, University of Nebraska. *Differential Equations, Reaction Diffusion Systems, Combustion Theory, Analysis.*

**Gregory Beylkin** – Professor; PhD, New York University. *Computational Methods, Wavelets, Geophysical Inverse Scattering.*

**Sujeet Bhat** – Instructor; PhD, University of Florida. *Partial Differential Equations, Numerical Analysis, Graph Theory.*

**David Bortz** – Assistant Professor; Ph.D, North Carolina State University. *Biological Systems.*

**Marian Brezina** – Research Associate; PhD, University of Colorado at Denver..

**Samuel Butler** –Post-Doctoral Research Associate; PhD, University of Sydney

**Michael Calkins** - Research Associate; PhD, University of California Los Angeles.

**Jem Corcoran** – Associate Professor; PhD, Colorado State University. *Applied Stochastic Processes, Perfect Simulation, Statistical Physics.*

**Murray Cox** – Instructor; PhD, Texas A&M University.

**Ryan Croke** – Instructor; PhD, Colorado State University. *Nonlinear Phenomena*

**James H. Curry** – Professor; J. R. Woodhull Logicon Teaching Professor of Applied Mathematics; PhD, University of California at Berkeley. *Dynamical Systems, Numerical Methods, Nonlinear Equations.*

**Anne Dougherty** – Associate Department Chair; Chair of Undergraduate Studies: Senior Instructor; PhD, University of Wisconsin, Madison. *Applied Probability, Stochastic Processes.*

**Vanja Dukic** – Associate Professor; PhD, Brown University. *Biostatistics.*

**Robert Easton** – Professor Emeritus; PhD, University of Wisconsin. *Dynamical Systems, Hamiltonian Mechanics.*

**Bengt Fornberg** – Professor; PhD, Uppsala University, Sweden. *Numerical Analysis, Computations of Wave Phenomena.*

**Yolanda Hagar** –Research Associate/Instructor; PhD, University of California Davis

**Keith Julien** – Chair of Graduate Studies; Associate Professor; PhD, Cambridge University, United Kingdom. *Mathematical and Computational Fluid Dynamics, Dynamical Systems Theory.*

**Christian Ketelsen** – Instructor; PhD, University of Colorado Boulder. *Computational Mathematics*

**William Kleiber** – Assistant Professor; PhD, University of Washingont Seattle. *Multivariate Process Modeling, Stochastic Modeling of Physical Systems.*

**Congming Li** – Professor; PhD, New York University. *Elliptic Partial Differential Equations.*

**Manuel Lladser** – Assistant Professor; PhD, Ohio State University. *Probability Theory.*

**Yiping Ma** – Research Associate/Instructor; PhD, University of California Berkeley. *Nonlinear Phenomena, Physical Applied Mathematics.*

**Thomas Manteuffel** – Professor; PhD, University of Illinois, Urbana. *Computational Math, Numerical Linear Algebra, Iterative Mathematics, Numerical Solution of Partial Differential Equations, Parallel Computation, Computational Fluid Dynamics.*

**Philippe Marti** –Research Associate; PhD, Eidgenössische Technische Hochschule Zürich

**Per-Gunnar Martinsson** – Assistant Professor; PhD, University of Texas at Austin. *Numerical Analysis, Modeling of Heterogeneous Media, Computational Biochemistry.*

**Stephen McCormick** – Professor; PhD, University of Southern California. *Computational Math, Numerical Partial Differential Equations, Multigrid Methods, Parallel Computation, Computational Fluids, Tomography, Electromagnetics, Biomathematics.*

**James D. Meiss** – Professor; PhD, University of California at Berkeley. *Dynamical Systems, Hamiltonian Mechanics, Plasma Physics.*

**Lucas Monzon** – Postdoctoral Associate; PhD, Yale University.

**J. Adam Norris** – Instructor; PhD, University of Colorado at Boulder. *Phase Change Kinetics, Perturbation Methods, Numerical Methods.*

**Juan Restrepo** – Assistant Professor; PhD, Northeastern University. *Analysis of dynamical processes on complex networks*

**John Ruge** – Research Associate; PhD, Colorado State University.

**Harvey Segur** – Professor; PhD, University of California at Berkeley. *Nonlinear Waves, Fluid Dynamics, Asymptotic Methods.*

**Sarthok Sircar** –Research Associate; PhD, University of South Carolina

**John Williamson** – Professor Emeritus; PhD, University of Minnesota. *Statistical Methods in Genetics, Applied Probability, Mathematical Statistics.*

# Affiliated Faculty

**Steve C. Arendt** – Colorado Research Associates

**Meredith Betterton** – Physics

**Elizabeth Bradley** – Computer Science

**Richard Byrd** – Computer Science

**Xiao-Chuan Cai** – Computer Science

**John Cary** – Physics

**John Crimaldi** - Computser Science

**Senarath P. de Alwis** – Physics

**Thomas DeGrand** – Physics

**Alireza Doostan** – Aerospace Engineering

**Garland Durham** – College of Business

**Scot Elkington** – Laboratory for Atmospheric and Space Physics (LASP)

**Samuel Flaxman** - Ecology and Evolutionary Biology

**Natasha Flyer** – Institute for Mathematics Applied to Geosciences

**Baylor Fox-Kemper** – Cooperative Institute for Research in Environmental Sciences (CIRES)

**Fred Glover** – College of Business

**Debra S. Goldberg** – Computer Science

**Martin Goldman** – Physics

**Vijay K. Gupta** – Civil, Environmental, and Architectural Engineering

**Ute C. Herzfeld** – Institute of Arctic and Alpine Research (INSTAAR)

**Christine M. Hrenya** – Chemical and Biological Engineering

**Shannon Hughes** – Electrical, Computer, and Energy Engineering

**Elizabeth Jessup** – Computer Science

**Laskshmi Kantha** – Aerospace Engineering

**David R. Kassoy** – Mechanical Engineering

**Dhinaker Kompala** – Chemical and Biological Engineering

**Manuel Laguna** – College of Business

**Michael Lightner** – Electrical Engineering;

**Oliver McBryan** – Computer Science

**Francois Meyer** – Electrical and Computer Engineering

**Nathalie Moyen -** Finance

**Doug Nychka** – Geophysical Statistics Project, National Center for Atmospheric Research (NCAR)

**Lev Ostrovsky** – National Oceanic and Atmospheric Administration (NOAA)

**K. C. Park** – Aerospace Engineering

**Scott Parker** – Physics

**Annick Poquet** – National Center for Atmospheric Research (NCAR)

**Harihar Rajaram** – Civil, Environmental, and Architectural Engineering

**Steven Sain** – Institute for Mathematics Applied to Geosciences

**Robert Sani** – Chemical Engineering

**Daniel Scheeres** – Aerospace Engineering

**J. Michael Shull** – Astrophysical and Planetary Sciences (APS)

**Rex Skodje** – Chemistry

**James Syvitski** – Institute for Arctic and Alpine Research (INSTAAR)

**Juri Toomre** – Astrophysical and Planetary Sciences (APS)

**Henry Tufo** – Computer Science

**Patrick Weidman** – Mechanical Engineering

**Jeffrey B. Weiss** – Astrophysical and Planetary Sciences (APS), Atmospheric and Oceanic Sciences.

**Joseph Werne** – Colorado Research Associates

## Department Staff

**Vicky Nelson** – Interim Director of Operations

**Mary Fentress** – Director of Operations

**Matthew Clifford** – Graduate Program Assistants
**Catriona Alcock**

**Beth Klein** - Accounting Technicians
**Anna Gonzales**

**Ian Cunningham** - Office Coordinator and Undergraduate Program Assistant

**Amit Gupta/Eric Jackson** - Part-Time IT Support

## Changes in Personnel

Applied Mathematics welcomed Mary Fentress as our new Director of Operations in 2013, as well as new Graduate Coordinator Catriona 'Trina' Alcock, and new Accounting Technician Anna Gonzales.

Professor Steve McCormick retired on Dec 31, 2013. The vote to give him Professor Emeritus status is scheduled for early 2014.

# Department of Applied Mathematics 2013 Annual Report
# Departmental Seminars and Colloquia

## Tuesdays - Computational Math Seminar

*The Computational Mathematics seminar series was held on Tuesday mornings during the academic year at 10:00 am, in the Grandview Conference Room. Steve McCormick chaired and organized the seminars in the spring semester, and Tom Manteuffel chaired and organized in the fall.*

| | | |
|---|---|---|
| 02/12/2013 | **Luis Chacón**, Los Alamos National Laboratory | *Fully implicit, energy- and charge-conserving particle-in-cell algorithms for kinetic simulation of plasmas* |
| 04/30/2013 | **Tobias Jones**, Department of Applied Mathematics, University of Colorado Boulder | *Algebraic Multigrid for Parallel Computing, Systems, and Graphs... oh my!* |
| 04/30/2013 | **Christopher Leibs**, Department of Applied Mathematics, University of Colorado Boulder | *Multigrid Preconditioning Methods for an Implicit Jacobian-Free Newton-Krylov Two-Fluid Kinetic Plasma Solver* |
| 07/25/2013 | **Michael Brutz** and **Phil Lenzini**, Department of Applied Mathematics, University of Colorado at Boulder | *High Dimensional Data and Music Genre Classification* |
| 09/10/2013 | **Geoff Sanders**, Center for Applied Scientific Computing, Lawrence Livermore National Laboratory | *Maximum Principles for Graph Eigenvectors* |
| 09/17/2013 | **Tom Manteuffel**, Department of Applied Mathematics, University of Colorado Boulder | *Hybrid FOSLS/FOSLL** |
| 10/01/2013 | **John Ruge**, Department of Applied Mathematics, University of Colorado Boulder | *AMG Tutorial* |
| 10/08/2013 | **Marian Brezina**, Department of Applied Mathematics, University of Colorado Boulder | *Smoothed Aggregation* |
| 10/15/2013 | **Brad Martin**, Department of Applied Mathematics, University of Colorado Boulder | *Seismic Wave Simulation with Radial Basis Function-Derived Finite Differences (RBF-FD)* |
| 10/22/2013 | **Christopher Leibs**, Department of Applied Mathematics, University of Colorado Boulder | *Casting a Two-Fluid Darwin Plasma Model in a FOSLS/FOSLL* Framework* |
| 10/29/2013 | **Mike Sprague**, National Renewable Energy Lab (NREL) | *Coupling meso-scale and micro-scale fluid dynamics codes for wind-energy computing: A two-dimensional study* |
| 11/12/2013 | **Peter Graf**, National Renewable Energy Lab (NREL) | *Modelling Batteries* |

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|---|---|---|
| 11/19/2013 | **David Appelhans**, Department of Applied Mathematics, University of Colorado Boulder | *Range Decomposition with Adaptive Mesh Refinement for Peta and Exascale Computing* |

## Tuesdays - Nonlinear Waves Seminar

*The Nonlinear Waves seminar series was held on Tuesday afternoons at 4:00 pm, in ECOT 226. Mark Ablowitz chaired and organized the seminar series.*

| | | |
|---|---|---|
| 07/31/2013 | **Masataka Kanki**, Graduate School of Mathematical Sciences, University of Tokyo | *Integrability of discrete equations over finite fields* |
| 09/10/2013 | **Igor Rumanov**, Department of Applied Mathematics, University of Colorado Boulder | *Classical Integrability, Quantum Integrability, and Dyson beta ensembles of random matrices* |
| 09/24/2013 | **Virgil Pierce**, Department of Mathematics, University of Texas - Pan American | *Continuum Limits of the Toda Lattice for Map Enumeration* |
| 10/08/2013 | **Samuel Butler**, Department of Applied Mathematics, University of Colorado Boulder | *Nonlinear dynamics of surface plasmons* |
| 10/15/2013 | **Yi-Ping Ma**, Department of Applied Mathematics, University of Colorado Boulder | *Localized patterns in driven dissipative systems* |
| 10/22/2013 | **Thomas Ivey**, Department of Mathematics, University of Colorado Boulder | *Bäcklund Transformations for Equations of Sine-Gordon Type* |
| 10/29/2013 | **Douglas Baldwin**, Department of Applied Mathematics, University of Colorado Boulder | *Dispersive shock waves and shallow ocean-wave line-soliton interactions* |

## Thursdays - Complex Systems/Dynamics Seminar

*The Complex Systems/Dynamics seminar series was held on Thursday afternoons during the academic year at 2:00 PM, in the Applied Mathematics Conference Room. Jim Meiss and Juan Restrepo co-chaired this series.*

| | | |
|---|---|---|
| 02/07/2013 | **Christine Hrenya**, Department of Chemical and Biological Engineering, University of Colorado Boulder | *Instabilities in Flows of Solid Particles* |
| 02/14/2013 | **Jim Meiss**, Department of Applied Mathematics, University of Colorado Boulder | *Robust Invariant Tori, Multidimensional Farey Trees, and Algebraic Irrationals* |
| 02/28/2013 | **Daniel Larremore**, Harvard School of Public Health | *Critical dynamics in balanced excitable networks: neuronal avalanches, dynamic range, and ceaseless activity.* |

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|---|---|---|
| 03/07/2013 | **Gregory Robinson**, Department of Applied Mathematics, University of Colorado Boulder | *Nonlinear chemical amplifiers and the search for animals' light-dependent magnetic compass sensor* |
| 03/14/2013 | **Robert Maier**, Department of Mathematics, University of Arizona | *How to integrate integrable three-species Lotka-Volterra systems* |
| 03/21/2013 | **Sears Merritt**, Department of Computer Science, University of Colorado Boulder | *Detecting friendship within dynamic online interaction networks* |
| 04/04/2013 | **Aaron Clauset,** Department of Computer Science, University of Colorado Boulder | *How large should whales be?* |
| 04/18/2013 | **Jeffrey Weiss**, Department of Atmospheric and Oceanic Sciences, University of Colorado Boulder | *Nonequilibrium Fluctuations and Climate Variability* |
| 04/25/2013 | **Amrik Sen**, Department of Applied Mathematics, University of Colorado Boulder | *A weak-wave turbulence theory for fluid flows in the limit of rapid rotation* |
| 05/02/2013 | **Patrick Shipman**, Department of Mathematics, Colorado State University | *Patterns and Oscillations: Minitornadoes and Liesegang Rings in Vapor-to-Particle Reaction Systems* |
| 09/05/2013 | **Mike Soltys**, Crimaldi Lab, Department of Civil, Architectural, and Environmental Engineering, University of Colorado Boulder | *The Effect of Structured Stirring and Mixing on Scalar Covariance of Initially Distant Scalars* |
| 09/19/2013 | **Christine Hrenya**, Department of Chemical and Biological Engineering, University of Colorado Boulder | *Dynamics of Wetted-particle Collisions* |
| 09/26/2013 | **Keith Julien**, Department of Applied Mathematics, University of Colorado Boulder | *Three-dimensional Quasi-Geostrophic Convection in the Rotating Cylindrical Annulus with Steeply Sloping Endwalls* |
| 10/03/2013 | **Ryan James**, Department of Computer Science, University of Colorado Boulder | *Chaos Forgets and Remembers: Measuring Information Creation, Destruction, and Storage* |
| 10/10/2013 | **Sarthok Sircar**, Department of Applied Mathematics, University of Colorado Boulder | *Multi-scale modeling in particulate suspensions and biofluids* |
| 10/17/2013 | **Juan Restrepo**, Department of Applied Mathematics, University of Colorado Boulder | *Stabilization of incoherence in the disordered Hamiltonian Mean Field model* |
| 10/24/2013 | **Anthony Rasca**, Department of Applied Mathematics, University of Colorado Boulder | *Modeling Solar Wind Mass-Loading Due to Dust in the Solar Corona* |
| 11/07/2013 | **Bob Dewar**, Plasma Research Laboratory, Australian National University, Canberra, Australia | Variational constructions of almost-invariant tori for 1 ½-D Hamiltonian systems |
| 11/19/2013 | **Hector Lomelli**, Department of Mathematics, University of Texas at Austin | Equivariant symmetries in Poncelet maps |

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|---|---|---|
| 12/05/2016 | **Ruth Martin**, Department of Applied Mathematics, University of Colorado Boulder | Kinetics of the alkali-silica reaction in concrete. |
| 12/12/2016 | **Peter Hamlington**, Department of Mechanical Engineering, University of Colorado Boulder | Vorticity dynamics in variable density flows |

## Fridays - Applied Mathematics Colloquium

*The Applied Mathematics Colloquium series was held on Friday afternoons during the academic year at 3:00 pm, with refreshments preceding at 2:30 pm outside the Applied Mathematics conference room. Juan Restrepo chaired and organized the Colloquium Series in Spring, with Jem Corcoran assuming the committee chair position in Fall.*

| | | |
|---|---|---|
| 01/18/2013 | **Juri Toomre**, Joint Institute for Laboratory Astrophysics, University of Colorado Boulder | Touching the inside of a convecting star and its magnetic dynamo |
| 01/25/2013 | **Anna Gilbert**, Department of Mathematics, University of Michigan | What's the frequency, Kenneth?: A survey of Fourier sampling algorithms |
| 02/01/2013 | **Franck Vernerey**; Department of Civil, Architectural, and Environmental Engineering; University of Colorado Boulder | Mathematical Model Of The Coupled Mechanisms Of Cell Adhesion, Contraction And Spreading |
| 02/08/2013 | **Mihaly Horanyi**, Laboratory for Atmospheric and Space Physics, University of Colorado Boulder | The Lunar Surface: A Dusty Plasma Laboratory |
| 02/15/2013 | **Maria Schonbek**; Department of Mathematics; University of California, Santa Cruz | Questions on Liquid Crystals |
| 02/22/2013 | **Phil Armitage,** Joint Institute for Laboratory Astrophysics, University of Colorado Boulder | Dynamical mysteries of extrasolar planetary systems |
| 03/01/2013 | **David Noone**, Cooperative Institute for Research in Environmental Sciences, University of Colorado Boulder | Estimating the hidden history of water in clouds and the subtropical atmosphere |
| 03/07/2013 | **H.T. Banks**, Center for Quantitative Sciences in Biomedicine, North Carolina State University | Mathematical and Statistical Modeling of Human Lymphocyte Proliferation Using CFSE Data |
| 03/15/2013 | **Alberto Bressan**, Department of Mathematics, University of Colorado at Boulder | Optima and equilibria for traffic flow on a network of roads. |

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|---|---|---|
| 03/22/2013 | **Max Gunzburger**, Department of Scientific Computing, Florida State University | A nonlocal vector calculus and nonlocal models for diffusion and mechanics |
| 04/05/2013 | **Greg Forest**, Carolina Center for Interdisciplinary Applied Mathematics, University of North Carolina at Chapel Hill | The Virtual Lung Project at UNC |
| 04/12/2013 | **Mahesh Varanasi**; Department of Electrical, Computer, and Energy Engineering; University of Colorado Boulder | On Information Transmission |
| 04/19/2013 | **Margaret Cheney**, Department of Mathematics, Colorado State University | Introduction to Radar Imaging |
| 04/26/2013 | **Stefan Llewellyn Smith**; Department of Mechanical and Aerospace Engineering; University of California, San Diego | Hollow Vortices |
| 09/06/2013 | **Jon Collins**, Department of Applied Mathematics and Statistics, Colorado School of Mines | Parabolic equation solutions for range-dependent seismo-acoustic propagation scenarios |
| 09/20/2013 | **Jim Keener**, Distinguished Professor of Mathematics, University of Utah | The dynamics of fibrin gel formation |
| 09/27/2013 | **Martin Tingley**, Department of Statistics, Penn State University | Changes in the mean and extremes of surface temperatures, from centennial to daily timescales |
| 10/04/2013 | **Patrick Shipman**, Department of Mathematics, Colorado State University | Self-Assembled Nanoscale Patterns Produced by Ion Bombardment of Binary Compounds |
| 10/11/2013 | **James Sethian**; Department of Mathematics; University of California, Berkeley | Tracking Multiphase Physics: Geometry, Foams, and Thin Films |
| 10/18/2013 | **Paul Martin**, Department of Applied Mathematics and Statistics, Colorado School of Mines | N masses on a string |
| 10/25/2013 | **Maria D'Orsogna**, Department of Mathematics, California State University at Northridge | Stochastic Nucleation and Clustering in Biology |
| 11/01/2013 | **Lev Ostrovsky**, Zel Energies/NOAA Environmental Research Laboratory | Dynamics of bubbles and particles under the action of acoustic radiation force |
| 11/15/2013 | **Andrzej Herczynski**, Department of Physics, Boston College | Pollockian Mechanics: Painting with Viscous Jets |
| 12/06/2013 | **Dan Cooley**, Department of Statistics, Colorado State University | Tales of Tail Dependence |

## Other Applied Math Talks

*Applied Mathematics often offers special talks that do not fall within the normal seminar schedule. There are many reasons for this, but all are as important as any of our regularly scheduled seminars.*

## Tenure Track Faculty Search

*The Department of Applied Mathematics sought two new tenure track faculty in Fall 2013. As always, candidates were asked to provide a talk focusing on their primary research interests.*

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|---|---|---|
| 11/05/2013 | **Mark Hoefer**, Department of Mathematics, North Carolina State University | Modulated Wavetrains in Dispersive Hydrodynamics |
| 11/07/2013 | **Michael Calkins**, Department of Applied Mathematics, University of Colorado Boulder | Reduced Models and Fast Algorithms: A Synergistic Approach for Modeling Geophysical and Astrophysical Fluid Turbulence |
| 11/12/2013 | **Katie Newhall**, Courant Institute of Mathematical Sciences, New York University | Dynamics of Ferromagnets: Averaging Methods, Bifurcation Diagrams, and Thermal Noise Effects |
| 11/14/2013 | **Stephen Becker**, Thomas J Watson Research Center, Yorktown Heights, NY | Information extraction via optimization |
| 11/14/2013 | **Lin Lin**, Lawrence Berkeley National Laboratory, Berkeley, CA | Fast algorithms for electronic structure analysis |

***Special Statistics Seminar***

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|---|---|---|
| 12/13/2013 | **Brad Carlin**, Division of Biostatistics, University of Minnesota | Success Stories in Bayesian Adaptive Methods for Drug and Device Clinical Trials |

***APPM Special Seminar***

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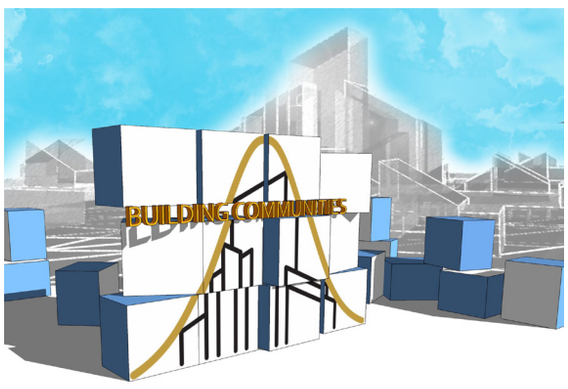
|---|---|---|
| 11/19/2013 | **Braxton Osting**; Department of Mathematics; University of California, Los Angeles | Extremal Eigenvalue Problems in Optics, Geometry, and Data Analysis |

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# Department of Applied Mathematics 2013 Annual Report
# Student Organizations

## Undergraduate Organizations

The University of Colorado at Boulder undergraduate chapter of the Society for Industrial and Applied Mathematics (SIAM) was founded to promote interactions between Applied Mathematics students and faculty. Society functions include technical presentations by students, faculty, and industry speakers, field trips and student/faculty social events –all designed to introduce undergraduates to the widespread use of applied mathematics in engineering and the sciences. All interested students, from any major, are encouraged to participate in SIAM-sponsored events. Sujeet Bhat served as the faculty advisor for the Undergraduate Chapter in 2013.

**9th Annual Front Range Applied Mathematics Student Conference**
Saturday, March 2nd, 2013
Location: The University of Colorado at Denver

This conference allowed student representatives from universities across the Front Range to meet and share research in the field of applied mathematics. Students had 25 minute slots in which to present their research and answer any questions for the audience. The Plenary Speaker for the 2013 FRAM conference was **Loren Cobb** of the University of Colorado Denver. He spoke on the topic of *The Mathematics of Society and Its Dysfunctions*

## Graduate Organizations

The graduate student chapter of SIAM at the University of Colorado at Boulder is a low-pressure, informal setting for discussing and learning about applied mathematics. The graduate student chapter holds regular meetings every other Thursday throughout the academic year. Faculty are not allowed at these meetings and the atmosphere is very low-key so that students can feel free to ask questions that they may not otherwise address to faculty members. Most recently, activities have included participating in the annual Front Range Applied Mathematics Student Conference, monthly seminars on student research, presentations from mathematicians now working in industry, and math movie/game nights. ... served as the Faculty Advisor for the Graduate Chapter in 2013. ... served as chapter president, and ... as chapter vice-president.

# Department of Applied Mathematics 2013 Annual Report
# Faculty Research

## Department-wide Grants

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## Individual Research Grants

Several new grants were received by APPM faculty in 2013. Department faculty were Principal Investigator, or Co-Principal Investigator, on over several million dollars in grant funding in 2013. APPM faculty remain strong researchers and work closely with both government and private industry.

### Mark J. Ablowitz

***Principal Investigator on Grants Received:***

*Air Force Office of Scientific Research (AFOSR), Program in Physical Mathematics, "***Nonlinear wave propagation***", 2012-2013*

*National Science Foundation-Division of Mathematical Sciences (NSF-DMS), "***Nonlinear wave motion***", 2009-2016*

***Co-Principal Investigator on Grants Received:***

*NSF-Division of Chemistry, "***SOLAR Collaborative: Photonic Enhancement of Organic Photovoltaics to Enable Higher Efficiencies and Exotic Mechanisms***", 2011-2014*

### Gregory Beylkin

***Principal Investigator on Grants Received:***

*Department of Energy (DOE)/UT-Battelle/Oak Ridge National Laboratory (ORNL), "***Multiresolution Adaptive Numerical Evaluation and Scientific Simulation***", 2005-2013*

*NSF, "***Nonlinear Approximations for Inverse Problems***", 2010-2013*

*AFOSR Small Business Technology Transfer program (STTR) Phase II, Omitron, "***Innovative Earth Gravity Reformulation and Numerical Integration for Responsive Space Situational Awareness (SSA)***", 2011-2013*

*NSF, "***Novel Algorithms for Separated Representations in Functional Form for the Adaptive Solution of Quantum Chemistry Problems and Other Applications***", 2013-2016*

## Gregory Beylkin

***Co-Principal Investigator on Grants Received:***

*AFOSR/Numerica, "***Uncertainty Computation and Propagation***", 2011-2013*

*NSF, "***Reduction Approach to Stochastic PDEs: Forward Uncertainty Propagation and Stochastic Homogenization***", 2012-2015*

## David M. Bortz

***Principal Investigator on Grants Received:***

*NSF, "***Microbial Flocculation Dynamics***"*

***Co-Princial Investigator on Grants Received:***

*National Institutes of Health (NIH), "***Biomechanics of Bloodstream Infections***", PI: J. G. Younger, Co-PI: M. J. Solomon*

*NSF, "***Collaborative Research: Type II: Flow-induced fragmentation mechanisms in bacterial biofilms by hierarchical modeling of polymeric, interfacial and viscoelastic interactions***"*

## Anne M. Dougherty

***Co-Principal Investigator on Grants Received:***

*CU-Boulder Outreach Committee, "***Colorado Math Circle***", **Co-PIs:** Silva Chang, Congming Li*

## Vanja Dukic

***Co-Principal Investigator on Grants Received:***

*NIH, "***Modeling the spread of MRSA in the Community***", 2010-2014*

*NSF, "***CNH: Cooking up clean air: Scaled-up quality and health impacts of clean cook stoves in Ghana***", PI: Christine Wiedinmyer, 2012-2015*

*Army Research Office (ARO), "***Meeting Support: The 36th Conference on Stochastic Processes and their Applications***", 2012-2013*

*NSF, "***Meeting Support: The 36th Conference on Stochastic Processes and their Applications***", 2012-2013*

*National Security Agency (NSA), "***Meeting Support: The 36th Conference on Stochastic Processes and their Applications***", 2012-2013*

*NSF, "***Collaborative Research: Scaling up epizootic dynamics: Linking individual infection to spatial spread of a disease using Bayesian hierarchical approaches***"*

*Environment Protection Agency (EPA), "***Scaled-up models for air quality and health impact of cook stoves***"*

## Bengt Fornberg

***Principal Investigator on Grants Received:***

*NSF-DMS, "***Radial Basis Functions***", 2009-2013*

*Shell International Exploration and Production, Inc., "***Radial Basis Functions (RBF) for wave propagation changing the media***", 2012-2014*

## Keith Julien

***Principal Investigator on Grants Received:***

*NSF-Focused Research Groups (FRG), "***Collaborative Research: Models of Balanced Multiscale Ocean Physics for Simulation and Parameterization***"*

*NSF-Cooperative Studies of the Earth's Deep Interior (CSE-DI), "***Collaborative Research: Next Generation Modeling of Core Turbulence via Combined Laboratory, Numerical, and Theoretical Model***"*

*NSF-Computational and Data-Enabled Science and Engineering (CDS&E), "***Collaborative Research: Formation, properties and evolution of protoplanetary vortices: Multiscale investigations of baroclinic instability***"*

*NSF-Earth Sciences (EAR), "***Next Generation Modeling of the Geodymano: Development of the First Multi-Scale Dynamo Model***"*

***Co-Principal Investigator on Grants Received:***

*National Aeronautics and Space Administration (NASA), "***Langmuir Circulations; Observing and Modeling on Global Scales***", PI: Fox Kemper, 2009-2012*

*NSF- Collaboration in Mathematical Geosciences (CMG), "***Collaborative Research: Multiscale Modeling between Langmuir Turbulence and Submesoscale Variability in the Oceanic Mixed Layer***", 2009-2013*

## Congming Li

***Principal Investigator on Grants Received:***

*NSF-DMS, "Collaborative Proposal: The Role of Convection on Dynamic Stability of 3D Incompressible Navier-Stokes Equations"*

***Co-Principal Investigator on Grants Received:***

*NSF-EAR, "CMG Research: Multiscale Nonlinear Domain Decomposition Method for Modeling the Impact of Climate Change on Groundwater Resources", 2009-2012*

## Manuel B. Lladser

***Principal Investigator on Grants Received:***

*NSF, "***AMC-SS: Markovian Embeddings for the Analysis and Computation of Patterns in non-Markovian Random Sequences***", 2008-2013*

***Co-Principal Investigator on Grants Received:***

*NSF, "***IGERT: Interdisciplinary Quantitative Biology Program***", PI: T. Cech, 2012-2017*

*NSA, "***The 36th Conference on Stochastic Processes and their Applications***", PI: B. Rider, 2013*

*NSF, "***The 36th Conference on Stochastic Processes and their Applications***", PI: J. Englander, 2013*

*W. M. Keck Foundation, "***The Earth Microbiome Project***", PI: R. Knight, 2013-2014*

## Thomas A. Manteuffel

***Principal Investigator on Grants Received:***

*DOE***, "First-order system least-squares (FOSLS) for nonlinear systems arising from DOE Applications",** *2010-2014*

*NSF***, "Collaborative Research: Least-Squares Finite Element Methods for Data Assimilation in Large-Scale Simulations",** *2013-2016*

## Per-Gunnar Martinsson

***Principal Investigator on Grants Received:***

*NSF-DMS, "CAREER: Fast Direct Solvers for Differential and Integral Equations", 2009-2014*

*Defense Advanced Research Projects Agency (DARPA), "Randomized methods for linear algebra and data analysis"*

***Co-Principal Investigator on Grants Received:***

*NSF-DMS, "CDI-Type I: Geometrical Image Processing with Fast Randomized Algorightms", 2009-2014*

*NSF-DMS, "Scalable and accurate direct solvers for integral equations on surfaces"*

## James Meiss

***Principal Investigator on Grants Received:***

*NSF-DMS, "Structure, Transport, and Chaos in Volume-Preserving Dynamics", 2012-2017*

***Co-Principal Investigator on Grants Received:***

*NSF, "Conference: Dynamic Days 2013", PI: J. Restrepo*

*Office of Naval Research (ONR), "Conference: Dynamic Days US 2013", PI: J. Restrepo*

## Juan Restrepo

***Principal Investigator on Grants Received:***

*NSF, "Conference: Dynamic Days 2013"*

*Office of Naval Research (ONR), "Conference: Dynamic Days US 2013"*

*ARO, "Dynamic Days 2013"*

## Harvey Segur

***Principal Investigator on Grants Received:***

*NSF-DMS, "***Collaborative Research: Nonlinear Water Waves***", 2011-2014*

## Publications

Research dollars alone do not measure the quality of an academic body's faculty - the dictum of "Publish or Perish" still holds. Applied Math faculty have published dozens of articles 2013. We cite the peer reviewed materials published below.

### Mark J. Ablowitz

***M.J. Ablowitz, C.W. Curtis, Y. Zhu***, "Localized nonlinear edge states in honeycomb lattices", *Physical Review A*, **vol: 88**

***M.J. Ablowitz, D.E. Baldwin***, "Dispersive shock wave interactions and asymptotics", *Physical Review E: Statistical, Nonlinear, and Soft Matter Physics*, **vol: 87**

***M.J. Ablowitz, Z.H. Musslimani***, "Integrable nonlocal nonlinear Schrödinger equation", *Physical Review Letters*, **vol: 110**

***M.J. Ablowitz, C.W. Curtis***, "Conservation laws and non-decaying solutions for the Benney-Luke Equation", *Proceedings of the Royal Society of London. Series A. Mathematical, Physical, and Engineering Sciences*, **vol: 469**

***M.J. Ablowtiz, S.D. Nixon, T.P. Horikis, D.J. Frantzeskakis***, "Dark solitions of the power-energy saturation model: application to mode-locked lasers", *Journal of Physics A Mathematical and Theoretical*, **vol: 46**

***M.J. Ablowitz, D.E. Baldwin***, "Interactions and asymptotics of dispersive shock waves- Korteweg-de Vries equation", *Physics Letters A*, **vol: 377**, pg. 555-559

***M.J. Ablowitz, Y. Zhu***, "Unified Orbital Description of the Envelope Dynamics in Two-Dimensional Simple Periodic Lattices", *Studies in Applied Mathematics*, **vol: 13**, pg. 41-71

***M.J. Ablowitz, Y. Zhu***, "Nonlinear wave packets in deformed honeycomb lattices", *SIAM Journal of Applied Mathematics*, **vol: 87**, pg. 1959-1979

***M.J. Ablowitz, Y. Zhu***, "Nonlinear Dynamics of Bloch wave packets in honeycomb lattices", *Spontaneous Symmetry Breaking, Self-Trapping, and Josephson Oscillations in Nonlinear Systems*, pg. 1-26

***M.J. Ablowitz, D.E. Baldwin***, "Nonlinear Ocean-Wave Interactions on Flat Beaches", *SIAM News*, **vol: 46**

### Gregory Beylkin

***G. Beylkin, A. Damle, T. Haut, L. Monzon***, "Near optimal rational approximations of large data sets", *Applied and Computational Harmonic Analysis*, **vol: 35**, pg. 251-263

***G. Beylkin, L. Monzon, M. Reynolds***, "Rational approximations for tomographic reconstructions", *Inverse Problems*, **vol: 29**

***G. Beylkin, L. Monzon, M. Reynolds***, "On generalized Gaussian quadratures for bandlimited exponentials", *Applied and Computational Harmonic Analysis. Time-Frequency and Time-Scale Analysis, Wavelets, Numerical Algorithms, and Applications*, **vol: 34**, pg. 352-365

***G. Beylkin, T. Haut, L. Monzon***, "Solving Burgers' equation using optimal rational approximations", *Applied and Computational Harmonic Analysis. Time-Frequency and Time-Scale Analysis, Wavelets, Numerical Algorithms, and Applications*, **vol: 34**, pg. 83-95

***G. Beylkin, R.D. Lewis, and L. Monzon***, "Fast and accurate propagation of coherent light", *Proceedings of the Royal Society A*, **vol: 469**

***G. Beylkin, T.S. Haut***, "Nonlinear approximations for electronic structure calculations", *Proceedings of the Royal Society A*, **vol: 469**

## David M. Bortz

***D.M. Bortz, S. Sicar, "***Impact of flow on ligand-mediated bacterial flocculation", *Mathematical Biosciences*, **vol: 245**, pg. 314-321

***D.M. Bortz, M. Ganesan, D.W. Newton, D. Pyne, A.E. Satorius, M.J. Solomon, J. Szafranski, J.G. Younger, "***Complement c5a generation by staphylococcal biofilms***",*** *Shock*, **vol: 39**, pg. 336-342

***D.M. Bortz, E.C. Conrad, Y.Y. Hsu, J.G. Younger, "***Spatiotemporal dynamics of complement C5a production within bacterial extracellular polymeric substance***",*** *Journal of Innate Immunity*, **vol: 5,** pg. 114-123

***D. Bortz, E. Conrad, A. Satorius, P. Sharma, J. Younger,*** "The Host Response to Line Sepsis: Experimental and Computational Analysis of Complement Activation against Coagulase-Negative Staphylococcal Biofilms"***,*** *Annals of Emergency Medicine*, **vol: 62**

## Murray Cox

***M. Cox,*** "The teaching implications of gender inequality"***,*** *Journal of Adventist Education*, **vol: 75,** pg. 19-24

## Vanja Dukic

***V. Dukic, G. Dwyer, B.D. Elderd,*** "Population-level differences in disease transmission: A Bayseian analysis of multiple smallpox epidemics"***,*** *Epidemics*, **vol: 5,** pg. 146-156

***V.M. Dukic, N. Maric,*** "Minimum correlation in construction of multivariate distributions"***,*** *Physical Review E*, **vol: 87**

***R.S. Daum, M.Z. David, V.M. Dukic, D.S. Lauderdale, J. Wilder,*** "Epidemics of community-associated methicillin-resistant Staphylococcus aureus in the United States: a meta-analysis"***,*** *PLOS ONE,* **vol: 8**

***V. Dukic, Y. Zhang,*** "Predicting multivariate insurance loss payments under the Bayesian copula framework"***,*** *Journal of Risk and Insurance*, **vol: 80,** pg. 891-919

***V. Dukic, A. Merrick, V. Sumo,*** "This Won't hurt a Bit: Academic research reveals eight ways to improve public health", *Magazine of The University of Chicago Booth School of Business: Capital Ideas*

***V. Dukic,*** "Cooking up clean air in Africa"***,*** *National Science Foundation Discoveries*

## Bengt Fornberg

***B. Fornberg, F.G. Meyer, N.D. Monnig,*** "Inverting Non-Linear Dimensionality Reduction with Scale-Free Radial Basis Interpolation"**,** *Applied Computational Harmonic Analysis*, **vol: 1**

***B. Fornberg, C. Raphaël Davis*****,** "A spectrally accurate numerical implementation of the Fokas transform method for Helmholtz-type PDEs"**,** *Complex Variables and Elliptic Equations*, pg. 1-14

***B. Fornberg, J.A. Reeger*****,** "Painlevé IV with both parameters zero: a numerical study"**,** *Studies in Applied Mathematics*, **vol: 130,** pg. 108-133

***B. Fornberg, A. Heryudono, E. Larsson, E. Lehto*****,** "Stable Computation of Differentiation Matrices and Scattered Node Stencils Based on Gaussian Radial Basis Functions"**,** *SIAM Journal on Scientific Computing*, **vol: 35**

***B. Fornberg, E. Lehto, C. Powell*****,** "Stable calculation of Gaussian-based RBF-FD stencils"**,** *Computers and Mathematics with Applications. An International Journal,* **vol: 65,** pg. 627-637

## Keith Julien

***M.A. Calkins, K. Julien, P. Marti,*** "Three-dimensional quasi-geostrophic convection in the rotating cylindrical annulus with steeply sloping end walls"***,*** *Journal of Fluid Mechanics*, **vol: 732,** pg. 214-244

***G. Chini, K. Julien, Z. Malecha,*** "Multiscale Algorithm for Simulating Spatially-Extended Langmuir Circulation Dynamics"***,*** *Journal of Computational Physics*

***K. Julien, P. Weidman,*** "Spin-down of a rotating air hockey disk"***,*** *Bulletin of the American Physical Society, 58th Fall Meeting*

***K. Julien, D. Nieves, A. Rubio,*** "Statistical classification of flow morphology in rapidly rotating Rayleigh-Bernard convection: A numerical and experimental synthesis"***,*** *Bulletin of the American Physical Society, 58th Fall Meeting*

***G. Chini, K. Julien, Z. Malecha,*** "The Craik-Leibovich Vortex Force as a Skin Effect"***,*** *Bulletin of the American Physical Society, 58th Fall Meeting*

***G. Chini, K, Julien, Z. Zhang,*** "Numerical Simulations of the Reduced Craik—Leibovich Equations in Spatially-Extended Domains"***,*** *Bulletin of the American Physical Society, 58th Fall Meeting*

***B. Fox-Kemper, S. Haney, K. Julien,*** "Modifications to Symmetric and Baroclinic Instabilities in the Presence of Surface Gravity Waves"***,*** *Bulletin of the American Physical Society, 58th Fall Meeting*

***M.A. Calkins, K. Hale, K.A. Julien, P. Marti, D. Nieves,*** "Compositional Convection in Planetary Interiors: Is There an "Ultimate" Regime?"***,*** **AGU Fall Meeting**

***J.M. Aurnou, M.A. Calkins, K.A, Julien, P. Marti,*** "An Efficient Sparse Approach for Core Flow Problems"***,*** **AGU Fall Meeting**

***G. Chini, K.A. Julien, Z. Malecha, Z. Zhang*** "Asymptotic Modeling of Non-Hydrostatic/Hydrostatic Dynamical Coupling in the Ocean Surface Boundary Layer"***,*** *SIAM Geosciences*

***K.A. Julien,*** "Asymptotic Approaches for Rotationally Constrained Flows"***,*** *SIAM Geosciences*

***J.M. Aurnou, M.A. Calkins, K.A. Julien, P. Marti,*** "Anelastic Models for Rotationally Constrained Convection"***,*** **AGU Meeting of the Americas**

***J.M. Aurnou, M.A. Calkins, K.A, Julien, P. Marti,*** "Asymptotically Reduced Models for Convection in Earth's Core"***,*** **Gordon Research Conference**

***M.A. Calkins, K.A. Julien, P. Marti,*** "Numerical Simulations of Three-dimensional Quasigeostrophic Convection in a Cylindrical Geometry"***,*** **AGU Meeting of the Americas**

***J.M. Aurnou, M.A. Calkins, K.A. Julien, P. Marti,*** "An Efficient Numerical Framework to Study Fluid Dynamics in Spherical and Cylindrical Geometries"***,*** *IPLEX, Connecting Theory to Experiments in GAFD*

***J.M. Aurnou, M.A. Calkins, K.A. Julien, P. Marti,*** "Asymptotically reduced models of rapidly rotating convection"***,*** *eGDR*

## Christian Ketelsen

***D. Kalchev, C. Ketelsen, P. Vassilevski,*** "Two-level adaptive multigrid for a sequence of problems with slowly varying random coefficients"***,*** *SIAM Journal of Scientific Computation*, **vol: 35,** pg. 1215-1234

## William Kleiber

***R.W. Katz, W. Kleiber, B. Rajagopalan,*** "Daily Minimum and Maximum Temperature Simulation over Complex Terrain"***,*** *Annals of Applied Statistics*, **vol: 7,** pg. 588-612

***M.G. Genton, W. Kleiber,*** "Spatially varying cross-correlation coefficients in the presence of nugget effects"***,*** *Biometrika*, **vol: 100, *pg. 213-200***

## William Kleiber

***D. Bingham, M.J. Heaton, W. Kleiber, C.S. Reese, S.R. Sain, M. Wiltberger,*** "Parameter Tuning for a Multi-Fidelity Dynamical Model of the Magnetosphere"**,** *Annals of Applied Statistics***, vol: 7,** pg. 1286-1310

## Congming Li

***W. Chen, C. Li,*** "Super polyharmonic property of solutions for PDE systems and its applications"**,** Communications of Pure and Applied Analysis**, vol: 12,** pg. 2497-2514

***Z. Chen, C. Li,*** "An extended discrete Hardy-Littlewood-Sobolev inequality"**,** *Discrete and Continuous Dynamical Systems***, vol: 34,** pg. 1951-1959

***C. Deng, C. Li,*** "Endpoint bilinear estimates and applications to the 2-dimensional Poisson-Nerst-Planck system"**,** *Nonlinearity***, vol: 26,** pg. 2993-3009

***W. Chen, Y. Fang, C. Li,*** "Super poly-harmonic property of solutions for Navier boundary problems on a half space"**,** *Journal of Functional Analysis***, vol: 265,** pg. 1522-1555

## Manuel B. Lladser

***S. Chestnut, M. Lladser*****,** "Approximation of sojourn-times via maximal couplings: motif frequency distributions"**,** *Journal of Mathematical Biology***, vol: 69,** pg. 147-182

***R. Knight, M. Lladser,*** "Mathematical approaches for describing microbial populations: practice and theory for extrapolation of rich environments"**,** *The Human Microbiota: How Microbial Communities Affect Health and Disease***,** Wiley-Blackwell Publishing

## Thomas A. Manteuffel

***J.H. Adler, M. Brezina, T.A. Manteuffel, S.F. McCormick, J.W. Ruge, L. Tang,*** "Island coalescence using parallel first-order system least-squares on incompressible, resistive magnetohydrodynamics"**,** *SIAM Journal of Scientific Computing***, vol: 35,** pg. 171-191

***K. Liu, T. Manteuffel, S. McCormick, J. Ruge, L. Tang,*** "Hybrid first-order system least squares finite element methods with application to Stokes equations"**,** *SIAM Journal of Numerical Analysis***, vol: 51,** pg. 2214-2237

***K. Liu, T. Manteuffel, S. McCormick, J. Ruge, L. Tang,*** "Hybrid First-Order System Least Squares with Applications to Stokes Equations"**,** *Proceedings of the Eleventh International Conference of Numerical Analysis and Applied Mathematics*

## Per-Gunnar Martinsson

***PG. Martinsson,*** "A direct solver for variable coefficient elliptic PDEs discretized via a composite spectral collocation method"**,** *Journal of Computational Physics***, vol: 242,** pg. 460-479

***A.H. Barnett, S. Hao, PG. Martinsson, P. Young,*** "High-order accurate methods for Nyström discretization of integral equations of smooth curves in the plane"**,** *Advances in Computational Mathematics***,** pg. 1-28

## James D. Meiss

***J.D. Meiss, B.A. Mosovsky, M.F. Speetjens,*** "Finite-time transport in volume-preserving flows"**,** *Physical Review Letters***, vol: 110**

***A.M. Fox, J.D. Meiss,*** "Greene's Criterion for the Break-up of Tori in Volume-Preserving Maps"**,** *Physica D***, vol: 243,** pg. 45-63

***J.D. Meiss,*** "Greene's Residue Method for the Break-up of Tori in Volume Preserving Maps"**,** *SIAM Dynamical Systems Conference*

## Juan G. Restrepo

***E.J. Fertig, J.G. Restrepo, D. Taylor,*** "Dynamics in hybrid complex systems of switches and oscillators"***, CHAOS,*** **vol: 23**

***J.G. Restrepo, P.S. Skardal, D. Taylor,*** "Complex macroscopic behavior in systems of phase oscillators with adaptive coupling"***,*** *Physica D: Nonlinear Phenomena*

***J.G. Restrepo, P.S. Skardal, J. Sun, D. Taylor,*** "Effects of degree-frequency correlations on network synchronization: Universality and full phase-locking"***, EPL,*** **vol: 101**

## Harvey Segur

***H. Segur,*** "The role of dissipation in the evolution of ocean swell"***, Journal of Geophysical Research: Oceans,*** **vol: 118,** pg. 5074-5091

## Invited Lectures and Meetings Attended

The department of Applied Mathematics is filled with dynamic instructors and active researchers. Presenting their results at other universities and at meetings of their peers demonstrates both of these traits. Sharing knowledge is vital to the scientific process - below we list the locations around the globe that our faculty have given and received shared knowledge.

### Mark J. Ablowitz

"SQuaRE: Nonlinear wave equations and integrable systems", ***American Institute of Mathematics***; Palo Alto, CA

"Nonlinear Waves from beaches to dispersive shock waves", ***South African Numerical and Applied Mathematics Symposium***; Stellenbosch, SA

"Two-dimensional water waves theory and ocean observations", ***Conference on two-dimensional solitons, water waves***; Edinberg, TX

"Two-dimensional water waves theory and ocean observvations", ***BIRS Workshop on Water Waves***; Banff, Canada

"Nonlinear Waves from beaches to dispersive shock waves", ***The 8th Symposium on Quantum Theory and Symmetries***; Mexico City, Mexico

"Deformations, Localized Edge States and Associated Pulse Dynamics in Nonlinear Optical Honeycomb Lattices", ***AFOSR Workshop: Nonlinear Optics***; Arlington, VA

### Anne M. Dougherty

"Using a Pre-Calculus Assessment Test to Understand Unintended Barriers to Calculus Success", ***SEI/STEM Meeting***; University of Colorado, Boulder

"Oral Assessments: Enabling More Students to Pursue STEM Majors", ***5th Annual National Colorado Learning Assistant Workshop***

### Vanja Dukic

"Highly Structured Stochastic Epidemic Processes", ***8th workshop on Bayesian Inference in Stochastic Processes***; Milan, Italy

"Tracking Fly Epidemics using Google Flu Trends and Particle Learning", ***Colloquium Speaker for the University of Toronto Department of Statistics***; Toronto, Canada

"Tracking Flu Epidemics using Google Flu Trends and Particle Learning", ***Colloquium Speaker for the University of Houston Department of Mathematics***; Houston, TX

### Bengt Fornberg

Colloquium; ***University of Stellenbosch***; Stellenbosch, SA

Colloquium; ***University of Oxford***; England

Colloquium; ***University of Bath***; England

***Society of Exploration Physicists annual meeting***; Houston, TX

## Keith Julien

"A Three-dimensional Model for Quasi-Geostrophic Convection in the Rotating Cylindrical Annulus with Steeply Sloping Endwalls", ***Geophysical Fluid Dynamics Summer School***, Woods Hole Oceanographic Institute

"Rotationally Constrained Flows. A Review of Qusi-Geostrophy and its Applications", ***Connecting Theory to Experiments in GAFD***; UCLA, Institute for Planets and Exoplanets

"Modeling and Simulation in Rotationally Constrained (Convective) Flows", ***Boundary Layer Workshop***; University of New Hampshire

## Christian Ketelsen

"An Introduction to Multilevel Monte Carlo Methods", ***University of Colorado at Boulder Computational Mathematics Seminar***; Boulder, CO

## William Kleiber

"Model Calibration Under Space-Time Misalignment", ***The International Environmetrics Society meeting***; Anchorage, AK

"Model Calibration via Space-Time Feature Matching", ***The European Meeting of Statisticians in Budapest***; Budapest, Hungary

"Equivalent Kriging for Large Datasets", ***Joint Statistical Meetings***; Montreal, Canada

"A framework for daily space-time stochastic weather simulation", ***World Statistics Congress***; Hong Kong, China

"Model Calibration Under Space-time Misalignment", ***University of Colorado Department of Economics Colloquium***; Boulder, Co

"Model Calibration via Deformation and Equivalent Kriging", ***University of Colorado Department of Civil, Environmental and Architectural Engineering water seminar series colloquium***; Boulder, Co

"Equivalent Kriging", ***University of Illinois Department of Statistics colloquium***; Urbana-Champaign, IL

"Nonstationary Space-time Stochastic Weather Simulation", ***SAMSI Workshop on Massive Datasets in Environment and Climate***; Boulder, CO

## Congming Li

Colloquium; ***JiangSu Normal University***; January

Colloquium; ***JiangSu Normal University***; March

Colloquium; ***Fudan University***

***Workshop on the Analysis of Partial Differential Equations***; Shanghai, China

***AMS Sectional Meeting, Special Session on Elliptic Systems***; Shanghai, China

***Workshop on the Analysis of Partial Differential Equations II***; Shanghai, China

***2nd Pacific Rim Mathematical Association Congress***; Shanghai, China

## Manuel Lladser

Computational Biology Colloquium; ***University of Southern California***

Probability and Statistics Seminars; ***University of Southern California***

Probability Seminar; ***University of San Diego***

School of Engineering Seminar; ***Universidad Adolfo Ibanez***; Chile

Smith Lab Group Presentation; ***University of Southern California***

Introduction to Research Seminar; ***University of Colorado Boulder***

## Per-Gunnar Martionsson

Matrix Computations Seminar; ***UC-Berkeley***

"High accuracy dimension reduction via randomized pre-conditioners", ***DARPA program review on computational mathematics***

"A Direct Solver for Variable Coefficient Elliptic PDEs", ***SIAM CSE Meeting***; Boston, MA

"Fast Direct Solvers for Integral Equations", ***SIAM Annual Meeting***; San Diego, CA

"A direct solver for variable coefficient elliptic PDEs", ***SIAM Annual Meeting***; San Diego, CA

"A direct solver with O(N) complexity for spectral multidomain method", ***SciCADE meeting***; Valladolid, Spain

## Juan Restrepo

"Effect of network structure on the propagation of avalanches in networks", ***Information, Instability and Fragility in Networks: Methods and Applications***; Boulder, CO

"Critically and Dynamic Range in Network Cascading Processes" ***University of Arizona Colloquium***

"Critically and Dynamic Range in Network Cascading Processes", ***Arkansas University Colloquium***

"Stabilization of incoherence in the disordered Hamiltonian Mean Field Model", ***Applied Dynamics Seminar***; College Park, MD

"Stabilization of incoherence in the disordered Hamiltonian Mean Field Model", ***Dynamics Seminar***; Boulder, CO

## Harvey Segur

"Tsunami", ***Penn State Math Department Colloquium***

"The nonlinear Schrodinger equation, dissipation and ocean swell", ***8th IMACS Conference on Nonlinear Evolution Equations and Wave Phenomena***

"The role of dissipation in the evolution of ocean swell", ***Workshop on Ocean Dynamics***

"Tsunami", ***NSF-CBMS Regional Conference on 'Solitons in two-dimensional water waves, with application to tsunami'***

"The nonlinear Schrodinger equation, dissipation and ocean swell", ***Banff International Research Station***

# Department of Applied Mathematics 2013 Annual Report
# Faculty Service

Service is the third pillar of faculty support for the University, alongside Teaching and Research. Activity in all three areas is required for tenure at the University of Colorado, and is expected of faculty even after achieving tenure. Service takes many forms, from membership on important governing committees, to educational outreach, to editing and reviewing scientific papers. Applied Mathematics faculty are active in all these areas and more.

## Mark J. Ablowitz

Chair of the Department of Applied Mathematics

Member of Chairs and Directors Advisory Council (CDAC), *Cambridge Texts in Applied Mathematics* Editorial Board, *Studies in Applied Mathematics* Editorial Board, *Dynamics of Partial Differential Equations* Editorial Board

Reviewer for Air Force and NSF grants, *Studies in Applied Mathematics*, *Physical Review*, *Optics Letter*s, *Proceedings of the Royal Society*, *Journal of Fluid Mechanics*, *Optics Communications*, *Cambridge University Press: Texts in Applied Math*

## Gregory Beylkin

Member of Spring 2013 Graduate Committee, Fall 2013 Executive Committee, Fall 2013 Search Committee, the *Applied and Computational Harmonic Analysis* Editorial Board, *Applied and Computational Harmonic Analysis* Editorial Board

Reviewed seven papers

## Sujeet Bhat

Member of the Fall 2013 Undergraduate Committee

Course Coordinator Spring 2013, APPM 1360; Fall 2013, APPM 1350

Faculty Advisor for Undergraduate Chapter of SIAM, Fall & Spring; ASPIRE Summer Freshman Math Program

## David M. Bortz

Member of APPM Graduate Committee, APPM Assistant Professor Hiring Committee, Partial Differential Equations Prelim Committee, IQ Bio Graduate Admissions Committee, *Mathematical Biosciences and Engineering* Editorial Board, *SIAM Undergraduate Research Online* Editorial Board

Affiliated with Renewable and Sustainable Energy Institute (RASEI)

Faculty Member of IQ Bio

Task Force Member of CU-BioFrontiers Admissions Committee

Reviewed four articles

## Jem Corcoran

Chair of Probability and Statistics Preliminary Examination Committee

Chair of Department Colloquium

Member of Involve Editorial Board

## Murray Cox

Department Liaison to Mathematical Association of America

## James H. Curry

Session Chair/Moderator of Ford Foundation Annual Program

Trustee of the University of Colorado Foundation

Program Director for the National Science Foundation Division of Mathematical Sciences

## Anne M. Dougherty

Associate Chair for the Department of Applied Mathematics

Chair of the Undergraduate Committee, Instructor Search Committee

Member of the Applied Math Program Administrator Search Committee, Pre-Engineering Program Coordinator Search Committee, Actuarial Studies and Quantitative Finance Certificate Program Committee, Director of Institutional Research Search Committee

Representative for the Department of Applied Mathematics to the Undergraduate Education Council, to the College of Engineering's Scholarship Committee

Transfer Credit Evaluator for the Department of Applied Mathematics

## Vanja Dukic

Member of the Program Council for International Society for Bayesian Analysis; APPM Graduate Admissions Committee; Probability and Statistics, Department of Mathematics Search Committee; APPM Executive Committee; APPM Buyout Committee; *STAT* Editorial Board; NSA Mathematical Sciences Program, Probability and Statistics Advisory Panel; NIH Data Safety Monitoring Board

Representative for ASC

Task Force member for BioFrontiers

Chair for the Budget Committee

Manuscript reviewer for three Journals

Reviewer for Oxford University Press

## Bengt Fornberg

Member of Numerics Prelim Committee, Executive Committee, Computational Mathematics Search Committee, Faculty Evaluation Committee, Post Tenure Review Committee, Boulder Faculty Assembly: Administrative Services and Technology Committee

Reviewed for NSF and AAAS

Refereed 25 articles

## Keith Julien

Member of the APPM Executive Committee

Chair of the School of Mathematical Science Ad hoc Committee, Faculty Search Committee on Nonlinear Mathematics, APPM Primary Unit Evaluation Committee

Member of the Arts & Sciences Tenure and Promotions Committee, *Nonlinearity* Editorial Board, 2014 Long Program Committee for the Institute of Pure and Applied Mathematics

Reviewer for NSF proposals and various journals

## Christian Ketelsen

Refereed articles for *SIAM Journal on Scientific Computing* and *Journal on Numerical Linear Algebra with Applications*

## William Kleiber

Session Chair for the World Statistics Congress

Referee for 13 journals

## Congming Li

Member of the Prelim Committee for Applied Mathematics, *Discrete and Continuous Dynamical Systems* Board of Editors

Organizer of the Workshop on the Analysis of Partial Differential Equations and for the AMS Sectional Meeting, Special Session on Elliptic System and Their Applications

## Manuel Lladser

Chair of the Probability and Statistics Prelim Committee

Member of the Local Organizing Committee for 2013 Conference on Stochastic Processes and their Applications, IQ Biology Mentoring Committee, BioFronteirs Task Force Committee

Reviewed for the *Journal of Discrete Algorithms*

## Tom Manteuffel

Member of the SIAM Publication Committee, SIAM Science Policy Committee, Bravarian Graduate School of Computational Engineering Advisory Board, Fundamental and Computational Sciences Directorate Advisory Board, APPM Tenure and Promotion Committee, ICSE Committee, Department Executive Committee, *Numerical Linear Algebra and Applications* Editorial Board, *SIAM Journal on Numerical Analysis* Editorial Board, *SIAM Journal of Scientific Computing* Editorial Board, 16th Copper Mountain Conference on Multigrid Methods Program Committee

Consultant for the Lawrence Livermore National Laboratory

Chair of the Assistant Professor Search Committee

Associate Editor for Electronic Transactions in Numerical Analysis

Reviewed proposals for DOE and NSF, as well as for three journals

Co-organizer of the Workshop on Algebraic Multigrid Methods

## Per-Gunnar Martinsson

Chair of the Applied Mathematics Graduate Committee

Member of the Executive Committee, NSF Panel evaluating CAREER awards in the Division of Mathematics Sciences

Associate Editor for *SIAM Journal of Scientific Computation*

Associate Editor for *Advances in Computational Mathematics*

Reviewed 15 manuscripts for various journals, and proposals for NSF

Chair of the Workshop on Computational Methods for Analyzing Large Graphs Organizing Committee

## James Meiss

Member of the APPM Executive Committee, Assistant Professor Committee, Graduate Committee, Boulder Faculty Assembly, BFA Libraries Committee,

Affiliate Member of the Renewable and Sustainable Energy Institute

Editor for the Mappings Section of the ***Dynamical Systems Encyclopedia***

Editor for the ***Applied Mathematics Encyclopedia***

Reviewer for 20 journals and 12 proposals for NSF

## Adam Norris

Member of the APPM Undergraduate Committee, APPM Teaching Assistant Training Seminar, Instructor Search Committee, CU Administrative Services and Technology Committee, Arts and Sciences Council Grievance Committee, Parking and Transportation Services' Parking Management Advisory Committee, Boulder Campus Deputy Chief of Police Search Committee

Sampler for the College of Engineering

Representative for APPM at the College of Engineering New Student Day, and to Boulder Faculty Assembly

Panel Member for College of Engineering Academic Expectations and Success

## Juan Restrepo

Member of the *Chaos* Journal Advisory Board, PDE Preliminary Exam Committee, and Graduate Committee

Co-organized the Dynamics/Complex Systems Seminar

Chair of the Colloquium

Reviewer for *Physical Review E*, *Chaos*, *Physical Review Letters, Physica D*, *Europhysics Letters,* and a grant proposal for NSF

## Harvey Segur

Member of the New Faculty Member Hiring Committee

Reviewer for *Proceedings of the Royal Society* and *Communications in Computational Physics*

# Department of Applied Mathematics 2013 Annual Report
# Teaching Activities

## *Undergraduate Courses Taught by Department Personnel*

### *Spring Semester*

| | | |
|---|---|---|
| *APPM 1340* | *Jonathan Kish* | *Calculus 1A with Algebra* |
| *APPM 1345* | *Silva Chang*<br>*Antonio Rubio* | *Calculus 1B with Algebra* |
| *APPM 1350* | *Silva Chang*<br>*Antonio Rubio* | *Calculus I for Engineers* |
| *APPM 1360* | *Sujeet Bhat*<br>*Samuel Butler*<br>*Mimi Dai*<br>*John Villavert* | *Calculus II for Engineers* |
| *APPM 2350* | *Adam Norris*<br>*Sebastian Skardal* | *Calculus III for Engineers* |
| *APPM 2360* | *Douglas Baldwin*<br>*David Bortz*<br>*Mimi Dai*<br>*Theodore Galanthay*<br>*Kevin Manley* | *Introduction to Ordinary Differential Equations with Linear Algebra* |
| *APPM 2450* | *Graduate Students* | *Calculus III Lab* |
| *APPM 2460* | *Graduate Students* | *Differential Equations Lab* |
| *APPM 3050* | *Adam Norris* | *Scientific Computing in Matlab* |
| *APPM 3310* | *Juan Restrepo* | *Matrix Methods* |
| *APPM 3570* | *Sujeet Bhat*<br>*Will Kleiber* | *Applied Probability* |
| *APPM 4120* | *Sarah Streett* | *Introduction to Research* |
| *APPM 4360* | *Jim Meiss*<br>*Chris Curtis* | *Complex Variables* |
| *APPM 4390* | *David Bortz* | *Modeling in Mathematical Biology* |
| *APPM 4450* | *Anne Dougherty* | *Undergraduate Applied Analysis* |
| *APPM 4570* | *Vanja Dukic* | *Statistical Methods* |
| *APPM 4660* | *Bengt Fornberg* | *Intermediate Numerical Analysis 2* |
| *APPM 4720* | *Manuel Lladser*<br>*Vanjua Dukic* | *Tpc - Genomes: Stats-Comp.*<br>*Statistical Modeling* |
| *APPM 4950* | *Adam Norris* | *Seminar in APPM* |

## *Summer - Term C*

| | | |
|---|---|---|
| *APPM 1350* | *Brad Martin* | *Calculus I for Engineers* |
| *APPM 1360* | *Tony Wong* | *Calculus II for Engineers* |
| *APPM 2350* | *Christian Ketelsen*<br>*Mike Ostroski* | *Calculus III for Engineers* |
| *APPM 2360* | *Sarthok Sircar*<br>*Dane Taylor* | *Introduction to Ordinary Differential Equations with Linear Algebra* |
| *APPM 2450* | *Amanda Crawford* | *Calculus III Lab* |
| *APPM 2460* | *Amanda Crawford* | *Differential Equations Lab* |
| *APPM 3310* | *Sujeet Bhat* | *Matrix Methods* |
| *APPM 4650* | *Adam Norris* | *Intermediate Numerical Analysis 1* |

## *Fall Semester*

| | | |
|---|---|---|
| *APPM 1235* | *Murray Cox*<br>*Ann DeFranco*<br>*Kevin Manley*<br>*Mike Ostroski*<br>*Sandy Williams* | *Pre-Calculus for Engineers* |
| *APPM 1340* | *Silva Chang*<br>*Jonathan Kish* | *Calculus 1A with Algebra*<br>*Calculus 1A with Algebra* |
| *APPM 1350* | *Sujeet Bhat*<br>*Murray Cox*<br>*Ryan Croke*<br>*Christian Ketelsen* | *Calculus I for Engineers* |
| *APPM 1360* | *Silva Chang*<br>*Anne Dougherty*<br>*Vanja Dukic* | *Calculus II for Engineers* |
| *APPM 2350* | *Sam Butler*<br>*Ryan Croke*<br>*Adam Norris* | *Calculus III for Engineers* |
| *APPM 2360* | *David Bortz*<br>*Congming Li*<br>*Yiping Ma*<br>*Sarthok Sircar* | *Introduction to Ordinary Differential Equations with Linear Algebra* |
| *APPM 2450* | *Graduate Students* | *Calculus III Lab* |
| *APPM 2460* | *Graduate Students* | *Differential Equations Lab* |
| *APPM 3170* | *Sujeet Bhat* | *Discrete Applied Mathematics* |
| *APPM 3310* | *Doug Baldwin*<br>*Greg Beylkin* | *Matrix Methods* |
| *APPM 3350* | *Adam Norris* | *Adv. Engineering Calc.* |
| *APPM 3570* | *Anne Dougherty* | *Applied Probability* |

| | | |
|---|---|---|
| *APPM 4350* | *Harvey Segur* | *Methods in Applied Math I (Fourier Series)* |
| *APPM 4380* | *Bengt Fornberg* | *Modeling in APPM* |
| *APPM 4440* | *Jim Meiss* | *Undergraduate Applied Analysis* |
| *APPM 4520* | *Jem Corcoran* | *Introduction to Mathematical Statistics* |
| *APPM 4560* | *Jem Corcoran* | *Markov Processes* |
| *APPM 4650* | *Christian Ketelsen* | *Intermediate Numerical Analysis 1* |
| *APPM 4950* | *Adam Norris* | *Seminar in Applied Mathematics* |

## *Graduate Courses Taught by Department Personnel*

### *Spring Semester*

| | | |
|---|---|---|
| *APPM 5120* | *Sarah Streett* | *Operations Research* |
| *APPM 5360* | *Chris Curtis*<br>*Jim Meiss* | *Complex Variables* |
| *APPM 5390* | *David Bortz* | *Modeling in Mathematical Biology* |
| *APPM 5450* | *Per-Gunnar Martinsson* | *Applied Analysis 2* |
| *APPM 5480* | *Keith Julien* | *Approximation Methods* |
| *APPM 5570* | *Vanja Dukic* | *Statistical Methods* |
| *APPM 5610* | *Gregory Beylkin* | *Numerical Analysis 2* |
| *APPM 6640* | *Steve McCormick* | *Multigrid Methods* |
| *APPM 7400* | *Jem Corcoran*<br>*Dan Kaslovsky*<br>*Gunnar Martinsson*<br>*Doug Nychka* | *Probability and Measure Theory*<br>*High-Dimensional Data*<br>*Intro to Research*<br>*Spatial Statistics* |

### *Fall Semester*

| | | |
|---|---|---|
| *APPM 5350* | *Harvey Segur* | *Methods in Applied Math I (Fourier Series)* |
| *APPM 5380* | *Bengt Fornberg* | *Modeling in APPM* |
| *APPM 5440* | *Congming Li* | *Applied Analysis I* |
| *APPM 5470* | *Keith Julien* | *Methods of Applied Mathematics 3: PDEs* |
| *APPM 5520* | *Jem Corcoran* | *Introduction to Mathematical Statistics* |
| *APPM 5560* | *Jem Corcoran* | *Markov Processes* |
| *APPM 5600* | *Bengt Fornberg* | *Numerical Analysis I* |
| *APPM 7300* | *Mark Ablowitz* | *Nonlinear Waves with Integral Equations* |
| *APPM 7400-001* | *Sujeet Bhat* | *Seminar on Teaching Excellence* |

## *Courses Offered by the Department, Taught by Non-Departmental Personnel*

| | | | |
|---|---|---|---|
| *APPM 4520* | *Spring 2013* | *Janos Englander, Mathematics* | *Introduction to Mathematical Statistics* |
| *APPM 4540* | *Spring 2013* | *Sergei Kuznetsov, Mathematics* | *Introduction to Time Series* |
| *APPM 4570/5570* | *Spring 2013* | *Ray Littlejohn, Engineering Mgt* | *Statistical Methods* |
| *APPM 4580/5580* | *Spring 2013* | *Ray Littlejohn, Engineering Mgt.* | *Statistical Methods of Data* |
| *APPM 4650* | *Spring 2011* | *Alejandro Spina, Mathematics* | *Intermediate Numerical Analysis 1* |
| *APPM 4720* | *Spring 2011* | *Michael J. Stutzer, Finance* | *Math Finance 1* |

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