AMATH

UNIVERSITY OF WASHINGTON

AUTUMN 2011

Sunset, George Washington and the Olympics from Red Square

Note from the Chair

This Fall was an exciting time in AMATH as we successfully launched the new MS in Computational Finance and Risk Management. This is the first new graduate program launched in the department since its inception more than 25 years ago. It is also the second online program now supported by the department, the first being our online MS in Applied Mathematics which started in 2007. A tremendous amount of work went into building the program into an intellectually rich, cutting-edge, applications oriented degree capable of servicing a wide range of students and professionals. The department is especially indebted to Profs. Doug Martin (Statistics) and Eric Zivot (Economics) for their enthusiasm and tireless work in helping get the program off the ground. These key partnerships and alliances with other UW departments are a hallmark feature of AMATH's interdisciplinary activities with the broader University community. The development also marks our intellectual foray into the financial sciences and engineering, a field rich in statistics, dynamics, data analysis, and stochastics. We look forward to developing a vibrant and exceptional program over the years to come. I invite you to investigate the program. I'm sure you will enjoy seeing the breadth of mathematics represented in the program. And as faculty and students, we continue to take great pride in continuing to build the reputation and excellence of the AMATH program. Further, we continue to develop effective long-term strategies that are sustainable and yet allow AMATH to pursue the ambitious goal of maintaining one of the top applied mathematics institutions in the country. If you are interested in helping the department and find yourself in a position to contribute to the educational mission and vision of the department please visit the departmental webpage (*www.amath.washington.edu/giving/*).

Best regards,

J. Nathan Kutz, Professor and Chair

Contents

APPLIED MATHEMATICS
UNIVERSITY of WASHINGTON

Masters in Computational Finance and Risk Management

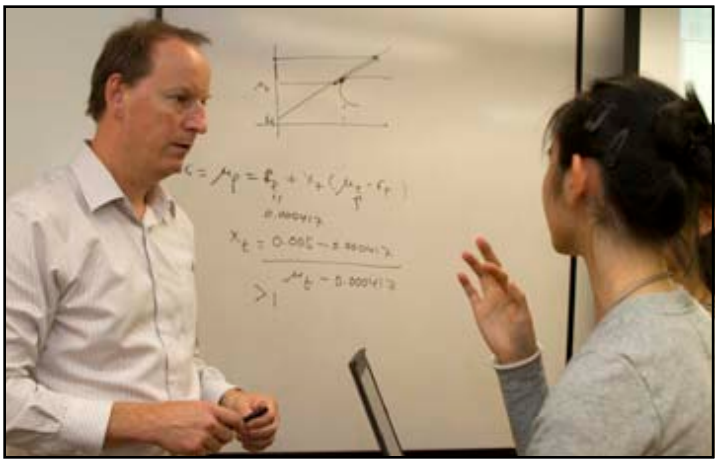
The demand in the United States for MS Degree programs in Quantitative Finance (under the names Computational Finance, Financial Engineering and Mathematical Finance) is substantial and has grown dramatically since 2004: There are now 44 such programs in the U.S., up from around 20 in 2004. Indeed, The need for highly-trained professionals who have an emphasis on the risk management portion of finance is of exceptional importance given the economic collapse of 2008.

As such, the Department of Applied Mathematics proposed the development of a new program in this area: the ***M.S. Degree in Computational Finance and Risk Management (CFRM)***. The degree is a professional M.S. degree program designed to address the demand in the financial services industry for advanced quantitative computational finance knowledge and next generation risk management skills. Individuals who understand how to manage assets to enhance investment returns while controlling risk are required throughout the world of financial services, as are individuals who understand modern risk management methods. The emerging profession of financial risk management underscores the growing importance of the latter skill set (see for example www.garp.org). For students with strong mathematical and quantitative skills, Computational Finance and Risk Management builds exciting new career paths and broadens opportunities.

The primary goals of the program are to:

- Deliver the highest quality M.S. degree education to current and future quantitative finance industry professionals that will enable them to be more effective in their work and able to rapidly advance in their chosen career path.
- Offer a curriculum whose course offerings educate students in best computational finance and risk management practices, including new cutting edge methods that have the potential to reduce investment risk and deliver higher risk-adjusted returns.
- The degree can be pursued in either classroom or online formats, full-time or part-time. There is no difference between the classroom and online options in the content delivered and the diploma awarded.
- Provide live online delivery and video capture of lectures and interactive class sessions using a best-of-breed approach that continually leverages advances in online delivery technology.

Given AMATH's extensive experience in online education, the degree was proposed to have both an online and resident matriculated graduate student components. This was a highly appealing aspect of the program as it catered well to working professionals in the finance industry. Thus pursuing the degree did not require that a person quit their job in order to pursue the degree. Rather, working professionals from across the country and world could engage in graduate studies on a part-time or full-time basis as their jobs and position in life permitted. The degree program has been developed in partnership with other relevant campus departments as appropriate, including in particular the Departments of Statistics and Economics. Additionally, the CFRM program capitalizes on existing industry experts in the greater Seattle area.



Origins of the Program

The proposed program is the logical next step based on the existence and success of two existing Computational Finance Certificate programs on the UW Seattle campus. These programs were co-developed by Profs. Doug Martin and Eric Zivot in 2004 and have continued to serve the larger PhD community on the UW campus. The current CFRM program greatly extends the scope and purpose of the program while maintaing a strong applications perspective.

Professor Eric Zivot teaches one of the inaugural CFRM investment courses in the Summer Quarter 2011.

Doug Martin

Professor Doug Martin is Professor of Statistics, Adjunct Professor of Applied Mathematics, Adjunct Professor of Finance, and Director of Computational Finance at the University of Washington. He is also a former Chairman of the Department of Statistics and one of its co-founders. Martin was a consultant in the Mathematics and Statistics Research Center at Bell Laboratories from 1973 to 1983. In 1987 he founded Statistical Sciences to commercialize the S language for data analysis and statistical modelling in the form of S-PLUS. Subsequently he was a co-founder and Chairman of FinAnalytica, Inc., developer of the Cognity portfolio construction and risk management system, and served as CEO from 2006 to 2008. Martin has authored numerous publications on time series and robust statistical methods, and is co-author of two books: Modern Portfolio Optimization (2005), and Robust Statistics: Theory and Methods (2006). His research is on applications of modern statistical methods in finance and investment. As Director, Doug has been tireless in his efforts to build a world-class computational finance program. The successful launch of the program is a credit to his efforts and broad-minded thinking. AMATH is extremely pleased to have him on-board with us as a colleague.

Director

Doug Martin

Professor of Statistics
Adjunct Professor of AMATH

B.S. Princeton
M.S. Washington
Ph.D. Princeton

Co-Director

Eric Zivot

Robert Richards Chair
Professor of Economics
Adjunct Professor of AMATH

B.S. UC Berkeley
Ph.D. Yale

Eric Zivot

Eric Zivot is the Robert Richards Chaired Professor in the Economics Department, Adjunct Professor of Statistics, Adjunct Professor of Finance, and Adjunct Professor of Applied Mathematics. He regularly teaches courses on econometric theory, financial econometrics and time series econometrics, and is the recipient of the Henry T. Buechel Award for Outstanding Teaching. He was an associate editor of the Journal of Business and Economic Statistics. He is also co-author of Modeling Financial Time Series with S-PLUS and co-developer of S+FinMetrics, and has consulted on the use of S-PLUS and R in the finance industry. He has published in the leading econometrics journals, including Econometrica, Econometric Theory, the Journal of Business and Economic Statistics, Journal of Econometrics, and the Review of Economics and Statistics, and in empirical finance journals including the Journal of Empirical Finance, the Journal of Financial Markets, and the Journal of International Money and Finance. Along with Doug, Eric has been instrumental in developing the intellectual atmosphere for computational finance on the University of Washington campus.

Neuroscience, Nonlinear Waves, and Dimensionality Reduction

by Eli Shlizerman

The goal of my research has been to develop a mathematical theory and framework for understanding the dynamics of nonlinear systems that arise in applications. My interests are primarily in dimension reduction techniques applied to high-dimensional systems of differential equations that model evolution of biological, physical or computational systems. It is an exciting time to work on the foundations of dimension reduction. The emergence of fast computational tools and the availability of enhanced experimental techniques introduce many opportunities for gathering observations of a system for which analytical study is untractable. Generic methodologies that guide these observations and comprise them into a broad understanding of the phenomena are in great need. In this respect, dimension reduction is an extremely imminent methodology. It utilizes computation and experimental data to reduce the high-dimensional system to a low-dimensional one that is amenable to analysis. Progress in such methodology immediately impacts a variety of systems that could not be approached beforehand. Further, currently such techniques revolutionize the classical research approach in applied and computational mathematics. So far I have succeeded to introduce such methodology in three different disciplines resulting with structural classification of solutions and novel insights regarding dynamics. The interdisciplinary character of my research exposed me to various models and systems. Generalization of the approaches resulted in novel tools for the study of these systems or systems of similar kind.

Two specific research agendas have focused on (i) applications in neuroscience and how "functionality" of a network of neurons can be extracted from a biophysical detailed model? Can it result with a successful reduction? Taking into account the individual dynamics and interactions between individuals I have developed a framework that describes the equations of a projection (AMEE) that expresses the functionality of a network. In the presence of an attractor, we show that the solutions of the AMEE shadow the activity of the network, composed from neurons governed by continuous conductance based equations and general interactions. For some neural systems experimental recording are available and further reductions can be obtained. Along with the availability of the anatomical structure of the network an open question that emerges is whether data and structural knowledge can lead to the understanding of the functionality of the system. A fascinating example for such neural system is the olfaction in insects. Experiments clearly indicate appearance of persistent and distinct patterns associated with distinct odors. We were able to utilize the experimental data to propose a reduction to a decision making model for which existence of stable fixed points is shown. The resulting conclusions from the reduction are regarding the dynamics of mixtures of odors and quantification of the key mechanisms responsible for the behavior (See Figure). (ii) The approach of finding the optimal global orthogonal basis for projection of nonlinear system onto it is appealing. The resulting reduced system can be studied using numerical continuation or analytic transformations to normal forms. Many issues remain unresolved such as: How to obtain the basis with the least knowledge of the system's solutions? What is the most efficient method to combine local modes into global? For specific solutions (for example periodic) can one justify closeness of the reduced and full systems? Approaching these questions, we studied low dimensionality of periodic gravity waves and constructed low dimensional models that reproduce their dynamics quantitatively and used for bifurcation study. Use of such models for efficient numerical tools and determination of stability of periodic waves is under current study.

Applied mathematics at UW has provided a rich intellectual environment where interdisciplinary bounds (especially with Profs. J. Nathan Kutz and Jeff Riffell) are easily crossed and neuroscience and AMATH are fully and seamlessly integrated.

Research Highlight

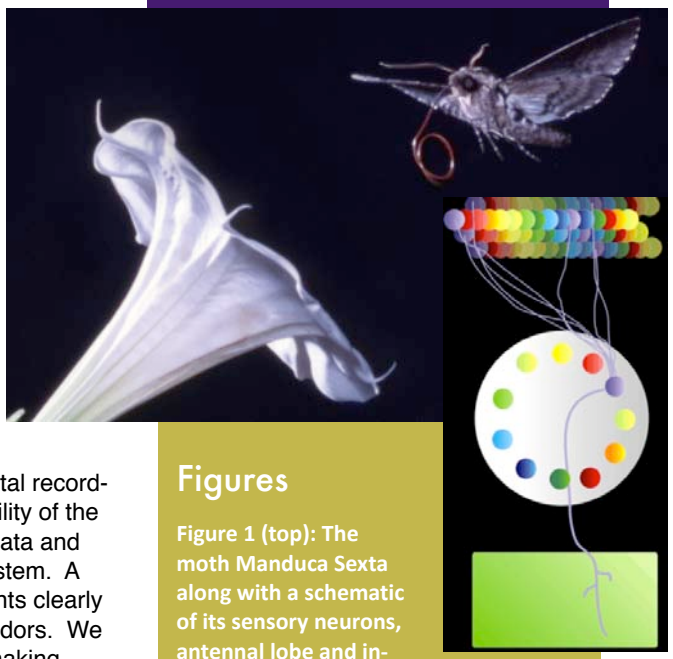
Eli Shlizerman

Acting Assistant Professor

B.S. 2001 Bar-Ilan
M.S. 2005 Weizmann
Ph.D. 2009 Weizmann

Advisor: Vered Rom-Kedar

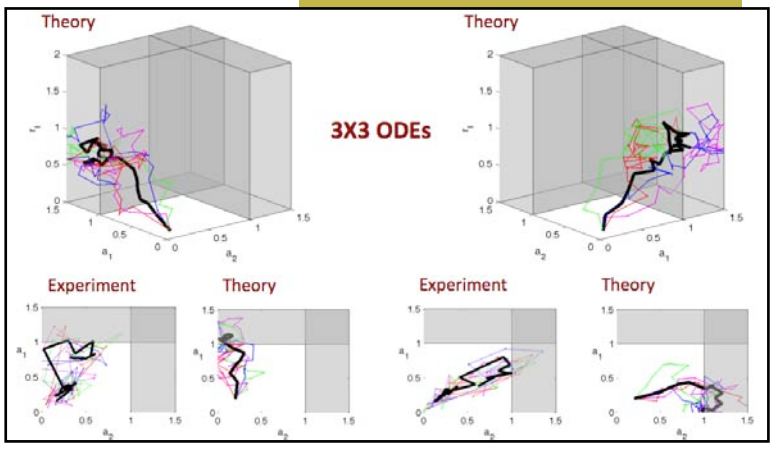
Thesis: *Instabilities in the forced nonlinear Schrodinger equation*



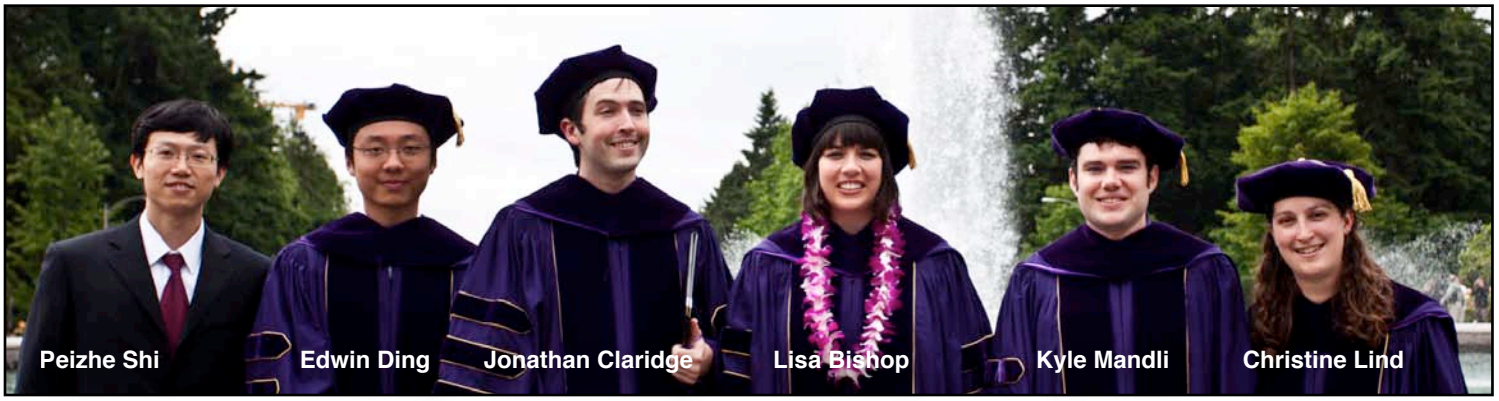
Figures

Figure 1 (top): The moth Manduca Sexta along with a schematic of its sensory neurons, antennal lobe and interconnection to the mushroom body (brain).

Figure 2 (bottom): Comparison of the reduced decision making dynamics with experiments from Jeff Riffell's (Biology) laboratory.



Graduation 2011



Doctor of Philosophy Recipients 2011

Lisa Bishop - The origin of noise-induced phenomena: a mathematical analysis of mesoscopic chemical and biochemical dynamics
Jonathan Claridge -Numerical methods and studies of parabolic problems, operating splitting, and adaptive mesh refinement
Joshua Goldwyn - Mathematical modeling of cochlear implants - from single neurons to psychoacoustics
Edwin Ding - Modeling high-energy temporal and spatial mode-locking
Christine Lind Cole - Mathematical models for molecular motors
Kyle Mandli - Finite volume methods for the multilayer shallow water equations with applications to storm surges
Peizhe Shi - The coupled process and its applications in cellular molecular biology

Master of Science Recipients 2011

Sunyoung Ahn
Noah Champagne
Kathleen Curtius
Carlos Garcia Jurado Suarez
Bethany Herwaldt
Alexander Sasha Malinsky
Aaron Maus
Edward Schasteen
Kina Tatchukova
Shuang Zhang
Wan Tai Au Yeung
Tiffany Chang
Heather Dillon
Michael Gargano
Andrew Hunter
Carrie Marshall
Julia Nalven
Windy Steinkuhler
Olga Trichtchenko
Jason Callaghan
Renyu Chen
Kevin Empson
Michael Gostintsev
Shaminoo Kapoor
Tyler Martin
Randal Oddi
James Smolka
Kai Wen
Steven Case
David Corwin
Logan Gantner
Aneesh Hariharan
Misha Kutzman
May Anne Mata
Benjamin Parker
Konrad Schroder
Tracie Witherspoon

Over 150 people participated in the graduate ceremony celebrating the conference of the PhD degree to 7 recipients and the Masters degree to 38 recipients. The event culminated in the graduation ceremony of the University of Washington at Husky Stadium. You can find more photos of the event online by following the "Alumni & Friends" link on the department's webpage: *www.amath.washington.edu*

News & Notes Applied Mathematics in the News

Rodney Wan Endowment Fellowship


Rodney Wan

Established in memory of Rodney Mason Wan, the purpose of this endowed fellowship is to help graduate students in applied mathematics and the mathematical sciences fund the cost of attending the University of Washington. This endowment was created in memory of Rodney Wan, brother of former AMATH faculty member Frederic Wan. Rodney passed away quietly on December 8, 2010 surrounded by the love of his family. Rodney was born in Los Angeles on April 1, 1948, and was the youngest of eight children of Wai Nam and Olga Wan. When Rodney was, one, he moved to Vietnam with his parents. He returned to the U.S. at age sixteen. Rodney's long career in the hospitality industry began at the University Tower Hotel (now the Deca Hotel) in Seattle which was under the same ownership as the 6th Avenue Motor Inn, Town Motor Inn, and the Riverside Hotel in Portland. Rodney worked at all four hotels and was their Food & Beverage Director before obtaining overseas assignments with the Sheraton group of hotels in Nigeria, Africa, Hong Kong, followed by Xian and Guilin in China. He later joined Marriott International, renovating and opening hotels in Guanzhou, Kunming, Beijing, Wuhan and Ningboa in China, rising to the rank of General Manager before his retirement in 2009. During his years in China, Rodney hosted many family members and their friends who visited him. He was a generous and giving person. His favorite pastime was playing poker with his brothers when he came home for holidays. Fred and Julia Wan, have established a significant endowment in honor of Rodney and the entire Wan family. AMATH is proud to honor the memory of Rodney and the Wan family.


Fred Wan

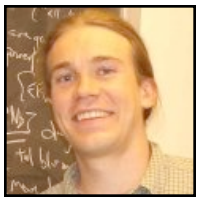
Mathday GK-12 Project

Three times this year, volunteer graduate students from the AMATH department will gather at Lockwood Elementary to run a full day Math & Science Fair for grades 3-6. Organized by SIAMUW, the student SIAM chapter, volunteers present engaging math problems from real world science applications. Some of the most popular activities have included: using lasers and similar triangles to measure the height of objects, doing unit conversions to calculate the amount of sugar in grocery store items, and a large scale experiment to measure the spread of disease using vinegar and cabbage juice. It's a great opportunity for graduate students to share their love of math with young students, and demonstrate real-world applications for the math they are learning in school. More details can be found on the Math Fair website, http://www.amath.washington.edu/~siamuw/math-fair.html.

News & Notes Applied Mathematics in the News

Faculty Awards

Professor Chris Bretherton was named Boeing Professor of Applied Mathematics and was awarded the prestigious Jule Charney Award from the American Meteorological Society, “For fundamental contributions to our understanding of atmospheric moist convection, particularly the discovery of mechanisms governing the transition from stratocumulus to shallow cumulus convection.” The Jule G. Charney Award is granted to individuals in recognition of highly significant research or development achievement in the atmospheric or hydrologic sciences. The award is in the form of a medallion.



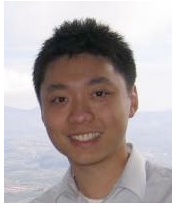
Assistant Professor Eric Shea-Brown was awarded an NSF CAREER award. Eric’s work focuses on understanding information processing by the brain. With its 100 billion highly nonlinear and stochastic neurons, this is a structure-function problem on an astonishing scale. To understand such complex neural systems, issues of noise, collective neuron behavior, and circuit-based memory must be understood and integrated across vast spatial scales, from molecules and cell membranes to circuits to entire neural populations. This is the second major junior research award received by Eric (He previously won a Wellcome-Burroughs). Congratulations Eric!

Adjunct Associate Professor Kristin Swanson was awarded a $4.6 million NIH grant for her work entitled "Patient-specific predictive modeling that integrates advanced cancer imaging." It is a multi-PI R01 between Kristin and Paul Kinahan (Radiology). The grant proposal integrates mathematical modeling of tumor proliferation and invasion with advanced cancer imaging methods. The goals of the project are twofold: 1) To impact current clinical challenges with treatment of gliomas, and 2) provide tools for the development of new therapies for these challenging cancers.

Adjunct Assistant Professor Archis Ghate was awarded an NSF CAREER award. His work focuses on mathematical models, theory, and algorithms for dynamic and stochastic optimization. His work combines elements of dynamic programming, control theory, game theory and applied probability to supplement his research in operations management and medical treatment planning.

Student Awards

Natasha (Alex) Cayco-Gajic (left) and ***Kathleen (Kit) Curtius (right)*** were awarded National Science Foundation graduate fellowship for three years of study in Applied Mathematics. Alex is a former Wan Fellowship holder (after Ruth Jung Chinn and Olga Jung Wan) for graduate studies in Applied Mathematics. She is currently working with Prof. Eric Shea-Brown on how information propagates in a simple model of a feedforward network of binary neurons. Kit is at the start of her second year and is engaged in cancer modeling with researchers from the Fred Hutchinson Cancer Research Center.



Edwin Ding was awarded runner up best speaker prize at Photonics West 2011. The award honors outstanding student contributions to one of the premier, international conferences in lasers and photonics (18,000 attendees). The award was presented for his talk on “Mode-locking pulse dynamics using multimode optical fibers.” The work was in collaboration with his advisor, Prof. J. Nathan Kutz, and experimentalists Simon LeFrancois and Frank Wise of Cornell University. Edwin has since taken a faculty position at Azusa Pacific University.

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APPLIED MATHEMATICS
UNIVERSITY of WASHINGTON

414 Guggenheim Hall
Box 352420
Seattle, WA 98195-2420

AMATH

Calendar of Events

The Boeing Distinguished Colloquium

Autumn Quarter

James Murray *(Princeton)*
October 6, 2011
Vignettes from a mathematician's odyssey in biology: from pilot ejection injuries to the benefits of cannibalism

Eliot Fried *(Washington)*
October 27, 2011
Some features and challenges of the Navier-Stokes-alpha-beta equation

Felix Otto *(Bonn)*
November 10, 2011
Pattern formation and partial differential equations

Winter Quarter

Marsha Berger *(Courant)*
January 5, 2012
Cut cell methods for flow in complicated geometry

Walter Strauss *(Brown)*
January 19, 2012
Steady rotational water waves

Gigliola Staffilani *(MIT)*
January 26, 2012
Dispersive equations: the deterministic versus the random approach

Spring Quarter

Lai-Sang Young (*Courant*)
April 12, 2012
Dynamics of neuronal networks modeling visual cortex

Larry Abbott *(Columbia)*
April 26, 2012
Harnessing neural network dynamics

Michael Shelley *(Courant)*
May 17, 2012
Active fluids

The Boeing Colloquia are on Thursday afternoons from 4-5 p.m. in Guggenheim 220; a reception follows. We would especially like to encourage our alumni in the greater Seattle area to participate in these exceptional events. It is a chance to see a great colloquium and catch up with the life of the department. We hope to see you here!