2019
2020

Applied Mathematics Newsletter

University of Colorado, Boulder

Summer
2020

Be Boulder.
Applied Mathematics

Table of Contents

Department Faculty

Department Chair: Keith Julien
Associate Department Chair: Anne Dougherty
Graduate Committee Chair: Mark Hoefer

PROFESSORS:
Mark Ablowitz
Gregory Beylkin
James Curry
Vanja Dukic
Bengt Fornberg
Keith Julien
James Meiss
François Meyer
Harvey Segur

ASSOCIATE PROFESSORS:
Daniel Appelö
David Bortz
Jem Corcoran
Mark Hoefer
William Kleiber
Manuel Lladser
Juan Restrepo
Eric Vance

ASSISTANT PROFESSORS:
Stephen Becker
Adrianna Gillman
Ian Grooms
Yu-Jui Huang
Zachary Kilpatrick
Maziar Raissi
Nancy Rodriguez

ADJUNCT PROFESSORS:
Lev Ostrovsky

PROFESSOR EMERITUS:
Jerrold Bebernes
Bob Easton
Congming Li
Tom Manteuffel
Steve McCormick

SENIOR INSTRUCTORS:
Anne Dougherty
Adam Norris
Brian Zaharatos

INSTRUCTORS:
Sujeet Bhat
Silva Chang
Justin Cole
Tahra Eissa
Jonathan Kish
Osita Onyejekwe
Maribeth Oscamou
Igor Rumanov
Patrick Sprenger
Eric Thaler

LECTURERS:
Daniel (Seneca) Lindsey
Danielle Lyles
Colin West
Stephen Molinari

RESEARCH ASSOCIATES:
Justin Cole
Nathan Duignan
Tahra Eissa
Nick Featherstone
Brad Hindman
Lucas Monzon
Igor Rumanov
Ben Southworth

Affiliated Faculty

Alireza Doostan - Aerospace Engineering
John Evans - Aerospace Engineering
Mahmoud I. Hussein - Aerospace Engineering
Lakshmi Kantha - Aerospace Engineering
Tomoko Matsuo - Aerospace Engineering
Daniel Scheeres - Aerospace Engineering

J. Michael Shull - Astrophysical & Planetary Sciences

Jeffrey B Weiss - Atmospheric and Oceanic Sciences

Baylor Fox-Kemper - Earth, Environmental, and Planetary Sciences; Brown University

Christine Hryena - Chemical & Biological Engineering
Dhinaker Kompala - Chemical & Biological Engineering

Rex Skodje - Chemistry

Elizabeth Bradley - Computer Science
Jed Brown - Computer Science
Xiao-Chuan Cai - Computer Science
Aaron Clauset - Computer Science
Rafael Frongillo - Computer Science
Elizabeth Jessup - Computer Science
Daniel Larremore - Computer Science
Sriram Sankaranarayanan - Computer Science
Henry Tufo - Computer Science

Natasha Flyer - Department of Applied Mathematics

Carlos Martins-Filho - Economics

Samuel Flaxman - Ecology and Evolutionary Biology

Mahesh Varanasi - Computer and Energy Engineering, Electrical

Ute Herzfeld - CIRES, Electrical, Computer and Energy Engineering
Emiliano Dall'Anese - Electrical, Computer and Energy Engineering

John Crimaldi - Civil Engineering, Environment & Architecture Engineering
Harihar Rajaram - Civil Engineering, Environment & Architecture Engineering
Franck Vernery - Civil Engineering, Environment & Architecture Engineering

Dave Frits - GATS Inc

Robert Anderson - Geological Sciences

Fatemah Pourahmadian - Geotechnical Engineering & Geomechanics

James Syvitski - Institute of Arctic and Alpine Research

Rodger Kram - Integrative Physiology

Ana Maria Rey - JILA
Juri Toomre - JILA

Stephan Sain - Jupiter Intelligence

Scot Elkington - Lab for Atmospheric and Space Physics

Fred Glover - Leeds School of Business
Manuel Laguna - Leeds School of Business
Nathalie Moyen - Leeds School of Business

Sean O'Rourke - Mathematics

Patrick Weidman - Mechanical Engineering

Aimé Fournier - Earth, Atmospheric and Planetary Science; Massachusetts Institute of Technology

Doug Nychka - National Center for Atmospheric Research
Annick Pouquet - National Center for Atmospheric Research

Joseph Werne - Northwest Research Associates

Meredith Betterton - Physics
Michael Calkins - Physics
John Cary - Physics
Thomas DeGrand - Physics
Mihály Horányi – Physics, Lab for Atmospheric and Space Physics
Scott Parker - Physics

Thomas Hauser - Research Computing

Hector Lomeli - Mathematics; University of Texas - Austin

Department Staff

Ian Cunningham - Office Coordinator, Undergraduate Program Assistant

Mary Fentress - Program Manager

Laura Gooch - Graduate Program Assistant

Desiree Holtz - Accounting Tech

Dominique Ingoglia - IT Manager

Kyle Zhou - IT Assistant

Patrick Talley - Student Assistant

Blake Kleinhans - Student Assistant

Patrick McCreery - Student Writer, Newsletter Editor

Zohreh Haycock - Student Writer

Doctor of Philosophy Graduates

Dylan Abrahamsen, Ph. D. Applied Mathematics
Space-time evolution with radial basis functions and Hermite-Based finite difference methods

Dissertation Advisor:
Bengt Fornberg

Joshua A. Aurand, Ph. D. Applied Mathematics
Optimal Control of Epstein-Zin Utility on Random Time Horizons

Dissertation Advisor:
Yui-Jui Huang

Zhishen Huang, Ph. D. Applied Mathematics
Topics of Statistical Machine Learning

Dissertation Advisor:
Stephen Becker

Mitchell Krock, Ph. D. Applied Mathematics
Some Models for Large Spatial Data

Dissertation Advisor:
William Kleiber

Antony Pearson, Ph. D. Applied Mathematics
On Hidden Structures in Contaminated Symbolic Data

Dissertation Advisor:
Manuel Lladser

Jacqueline Wentz, Ph. D. Applied Mathematics
Spatial-temporal effects of diffusion in complex biochemical networks

Dissertation Advisor:
David Bortz

Ashton Wiens, Ph. D. Applied Mathematics
Using Gaussian processes for registration and nonstationarity emulation

Dissertation Advisor:
William Kleiber

Wenqi Zhang, Ph. D. Applied Mathematics
Statistical Approaches to Assess High Frequency Variability of Solar Irradiance

Dissertation Advisor:
William Kleiber

2020 Graduates

Master of Science

Liam Madden
Amanda Mason
Thomas Jerald McMorrow
Nicholas Varberg

Professional Master of Science

Li-Yin Young

Master of Science and Bachelor of Science

Scott Baker •
Aidan Bohenick
Chloe Bruce †
Joseph Kelly Geisz †
Joshuah Jacobson •
Jiafan Qian †
William Shand ‡

Bachelor of Science: Applied Mathematics

Arturo Freydig Avila
Connor Barker
Samuel Bateman
Guilherme Camilotti Schulz
Feifan Chen
Dana Chernysheva ‡
Valliappan Chidambaram ‡
Ellen Considine ‡•
Thomas Costello
George Curtis
Jared Dempewolf
Jeremy Donhowe
Isabelle Echelman
Sarah Fisher
Lindsay Gettel *
Riley Hadjis ‡•
Camilla Hallin •
Margaret Hearn
XuSong Ho
Rebecca Hoffmann
Dorn Holland
Yifeng Huang
Emily Jordan
Liu Liu
Zhe Liu
Stevan Maksimovic
Alexandrea Marinelli
Gregory Miller †•
Wenrui Mu
Conrad Newfield ‡
Elise Niedringhaus ‡•
Kaitlyn Olson
Travis Peccorini
Caleb Penner ‡•
Yuting Zhou
Nikhil Rajaram •
Rachael Robinson *
Peter Rosenthal
Suyog Soti •
David Stearns *•
Ruitong Sun
Lauren Tafoya
Hui Min Tang
Brian Teklits
Olivia Treitman
Aparajithan Venkateswaran ‡•
Sousheel Vunnam •
Emily Webb •
Allyson Wheaton †•
Rui Zhan
Shida Zhang ‡
Vladimir Zhdanov ‡•

Bachelor of Arts: Statistics and Data Science

William Brickowski

Key:
• Engineering Honors
‡ Summa Cum Laude
† Magna Cum Laude
* Cum Laude

Graduate Awards

Outstanding Graduate of the College

Ellen Cosidine
Applied Mathematics, Bachelor of Science
Statistics and Data Science, Minor
Economics, Minor
Geography, Minor

Outstanding Graduates for Academic Achievement with the highest undergraduate GPA of graduating students in Engineering

Aparajithan Venkateswaran
Applied Mathematics, Bachelor of Science
Computer Science, Bachelor of Science

Vladimir Zhadanov
Applied Mathematics, Bachelor of Science
Computer Science, Bachelor of Science

CU Maurice Davies Award from Colorado and Wyoming American Statistical Association Chapter

Chloe Bruce
Applied Mathematics, Master and Bachelor of Science
Computer Science, Minor

Welcome to the Department!

Professor François Meyer

If you would like to learn more about Dr. Meyer, check out his Profile in Applied Math.

This year, the Department welcomed Professor François Meyer to the Applied Mathematics faculty!
Dr. Meyer's work is "sitting at the intersection of applied probability, graph theory, and some flavor of fast computation." Professor Meyer states that the most compelling part of his work, is helping students and fostering them to succeed in the growing sophistication of applied mathematics needed to analyze massive and complex datasets.

Meyer is enthusiastic about joining the department, saying that "it has been a long time since I've seen this passion at the undergrad level." He's excited to be working in the department because of the great faculty, stating: "I've been interacting with the faculty for many, many years; several APPM faculty members have had very profound impacts on my career."

Assistant Professor Adrianna Gillman

If you would like to learn more about Dr. Gillman, check out her Profile in Applied Math.

This year, the Department also welcomed Assistant Professor Adrianna Gillman to the Applied Mathematics faculty!
Professor Gillman's work "lies in the intersection of numerical PDEs and numerical linear algebra. What [she tries] to do is design algorithms that allow people to model things they couldn't model otherwise or allow them to do simulations on a desktop computer that they would normally ship out to a supercomputer."

On the topic of teaching classes, Dr. Gillman noted:
"I like teaching classes like numerical analysis, and teaching calculus can be fun. I try to bring the applications in so that you can see where things are being used."

Dr. Gillman recieved her PhD here in the Applied Math Department, and is excited to be returning to the Department, saying that "The environment in the department is very unique; it's very open, and as a grad student, I feel very well supported, and as a faculty member, I feel like all of my colleges appreciate my contributions."

Letter from the Department Chair, Professor Keith Julien

I would like to first extend a heartfelt thank you to our community of faculty, staff, students and alumni. Over my five years as the Chair of Applied Mathematics (APPM) the past year has been singularly unique. The impact of the COVID-19 pandemic combined with national unrest around racial justice posed, and will continue to pose, substantial challenges as we all transition into a new way a life. I would like to express gratitude for the resilience you have shown and for openness and capacity to embrace change. Your dedication and vision make the work involved extremely rewarding. Heretofore the departments mission in sustaining excellence in research and education marches on. During academic year 2019-2020 the department delivered over 22,000 student credit hours demonstrating our broad footprint in STEM'S education. APPM also succeeded in securing a new high of $5 million dollars of research funds from our national grant giving agencies. This is translating into high-quality research being performed by faculty and students.

APPM's undergraduate student body remains vibrant with continued growth. A significant part of this growth has occurred through our new Bachelor of Arts offering in Statistics and Data Science. The program is currently entering its third year of existence and is outpacing original projections. This year APPM graduated fifty-four (54) undergraduate majors and seven (7) Bachelor of Science/Master of Science students. Impressively, despite the challenging environment, approximately two-thirds of these students have either entered the professional workforce as applied mathematicians or continued onto graduate school. Many of the remaining talented graduates are simply taking well-deserved personal time before moving forward with their career decisions.

This year APPM graduated eight (8) PhD's from a student body that has held steady with approximately 90 students. However, the makeup of this body has seen a significant shift with an increase in the number of female graduates to an approximately 35% representation. Many of our female colleagues are receiving campus recognition and national accolades for their academic achievements. Our graduate colleagues are extremely active both academically and civically. Most pertinently, the Department is very proud to note that in recent 2018-2020 US News and World Reports of Applied Mathematics Graduate Programs, APPM was ranked 14th in the nation. This correlates well with the decadal findings of the National Research Council. APPM seeks to not only sustain these recent national rankings but improve upon them. APPM continued to see growth in its faculty during AY19-20.

"I would like to express gratitude for the resilience you have shown and for openness and capacity to embrace change."
-Department Chair

Letter from the Department Chair

The faculty welcomed four new members critical to the departmental mission: Full Professor, Dr. François Meyer; Assistant Professors, Dr. Adrianna Gillman and Dr. Maziar Raissi; and Instructor, Dr. Osita Onyejekwe. Dr. Meyer's research resides at the intersection of applied probability, graph theory, and some flavor of fast computation. He spent many influential years as a courtesy faculty member collaborating with APPM faculty and mentoring many of its graduate students. APPM is very fortunate that Dr. Meyer made the decision to become a full-fledged faculty member. Dr. Gillman joined the department from Rice University. Dr. Gillman is a computational mathematician specializing in designing state-of-the art fast algorithms for solving integral differential equations. Dr. Raissi joined the unit at the beginning of the spring semester after completing a postdoctoral research fellowship at Brown University followed by stint as research scientist at NVIDIA. Dr. Raissi is a data scientist specializing in modeling applications utilizing machine learning and deep learning techniques. Dr. Onyejekwe joins APPM's rank of talented instructors specially dedicated to its undergraduate teaching mission. With regret, APPM had to bid farewell to Associate Professor Daniel Appelö. APPM congratulates Daniel on his recent marriage and notes that he has been a fantastic colleague, we wish him well in his new faculty position at Michigan State University.

Staff changes also accompanied the faculty growth. Ms. Laura Gooch joined APPM team of talented staff as the Graduate Student Coordinator. Ms. Gooch (Laura) has been instrumental in upgrading the efficiency and organization of APPM's graduate program. She has been a strong advocate for our graduate students.
I hope that you get a sense of the department from the content of this newsletter. However, I would like to part by noting that APPM is continually striving to produce and sustain a culturally rich community. We are thankful to our Association of Women in Mathematics for their efforts in enriching our community experiences, both professional and social, and our Business Advisory committee for their positive and critical feedback on the department's education mission. We are also thankful to our community for their gifts and donations that are impactful to the lives of our students. I would like to give a special mention to the Rudy Horne Diversity Fund that partially supports graduate students from under-represented groups. This fund in its second year has now exceeded $50K in gifts. It is APPM's hope to vastly expand this fund to provide full support to a graduate student's entire five-year tenure through the program. Rudy Horne was an extremely gregarious, larger-than-life character who was APPM's first African-American Ph.D. (Class of 2001). Rudy went on to be a professor at the BC Morehouse College, a historically black college. Most notably Rudy was the Mathematics Consultant on the blockbuster movie Hidden Figures that center around the story of Katherine Johnson, a research mathematician who had an impact on NASA's early space program.

An Academic Year in Review: News and Events

Titles link to the original article on the Applied Mathematics Website

Associate Professor David Bortz: Graduate Mentor Award Winner

Last summer, Associate Professor David Bortz was awarded the Outstanding Faculty Mentor Award in recognition for his graduate mentoring work here in the Department of Applied Mathematics. Joining the Applied Mathematics (APPM) Department in 2006, Dr. Bortz has since "demonstrated an outstanding commitment to our graduate students ... He has also significantly contributed to the quality of our graduate program since his arrival and this makes him a perfect candidate for this award" (APPM Award Committee).

In Dr. Bortz's time here at APPM, he has been a very busy mentor, graduating six doctoral students, one master student, and will be in the midst of advising six doctoral students in the fall. The APPM Award Committee stated that, over the last five years, Dr. Bortz's "PhD students produce an average of four papers each, with a total of 15 published papers where students are first authors (with three more under review). Every doctoral student that Dr. Bortz has graduated is either in a permanent position (AFRL, AF Academy, Matlab) or postdoctoral program (Minnesota, SAMSI, MBI) across the nation.

"His exemplary mentoring style, which focuses equally on developing intellectual excellence and fostering community, turned me from a timid student into a confident scholar, equipping me to flourish on the world stage."
- Dr. Stephen Kissler

John Nardini (another former doctoral student), said: "I came to each research meeting knowing that he had thoroughly read through my research update and would provide a thoughtful perspective on how to approach current and future problems. His constant guidance ... led me to publish three research articles in top tier [applied math] journals as a graduate student."

Associate Professor Eric Vance: ASA Statistical Consulting Section's Outstanding Mentorship Award

In July, Associate Professor Eric Vance received the American Statistical Association's (ASA) Statistical Consulting Section's Outstanding Mentorship Award. ASA explained that Eric is "being recognized for his incredible dedication to mentoring others particularly in the area of statistical consulting. He has mentored students in the Laboratory for Interdisciplinary Statistical Analysis (LISA) so that they gain skills that are essential for consulting and collaboration." Elaborating on this, Dr. Vance said that "LISA and I are being recognized for one of our primary missions, which is to train the next generation of statisticians in the practical aspects of statistics and data science."

When asked about his mentoring, Associate Professor Vance elucidated, saying that "one aspect of my mentoring is that it's not just students here at CU that I mentor, but I also mentor other statisticians in developing countries through the LISA 2020 program. LISA 2020 is our program to create a network of statistical collaboration laboratories, like LISA. These other labs are in places like Africa, India, and Brazil. There are directors of new stat labs, and I am a mentor to them in helping them create the stat lab and making it become stable and productive."

Associate Professor Eric Vance: 2019 Journal of Statistics Education's Best Paper Award Winner

In April, Associate Professor Eric Vance was informed that his collaborative paper, The Attitude, Structure, Content, Communication, and Relationship (ASCCR) Frame for Learning Essential Collaboration Skills, was selected as the Journal of Statistics Education's best paper published in 2019. Dr. Vance collaborated with Heather Smith of Cal Poly, who is a lecturer in their Department of Statistics.

Interdisciplinatry communication skills are critical to have for any data scientist or applied statistician, which is why Dr. Vance and Heather Smith collaboratively "developed a framework covering five essential components of statistical collaboration: Attitude, Structure, Content, Communication, and Relationship," which is called the ASCCR Frame. This paper shows "how this framework can be applied specifically to statisticians and data scientists to improve their collaboration skills and their interdisciplinary impact … the ASCCR Frame can help organize and stimulate research and teaching in interdisciplinary collaboration and call on individuals and organizations to begin generating evidence regarding its effectiveness" (Vance & Smith, 2019).

The full statement from the JSE selection committee reads:
"On behalf of the selection committee, it is my pleasure to inform you that your paper, "The ASCCR Frame for Learning Essential Collaboration Skills" has been selected by a committee as the best paper published in the Journal of Statistics Education for 2019! Thank you so much for your excellent contribution to the statistics education literature."

2019 Rudy Horne Memorial Fellowship

In October, Seunghyun Kim, a first-year PhD student in the Applied Mathematics (APPM) Department was awarded the Rudy Horne Memorial Fellowship award!

Through this Fellowship, the Department seeks to increase the diversity of the Department's student body and faculty, to maximize the educational benefits of diversity, and to increase the number of professors who can and will use diversity as a resource for enriching the education of all students. The fellowship is given in memory of late Dr. Rudy Horne, who was the first African American to graduate in the Department. The APPM Graduate Committee elaborated, saying that "Rudy Horne overcame many obstacles to pursue his dream of teaching and doing research in Applied Mathematics."

In a personal statement, Seung explained that "a few years ago, I had a medical complication which led to bleeding in my brain. During my undergraduate years, I underwent a few brain surgeries which continue to impact me to this day. Despite the consequent medical limitation, I have tried to continue to learn mathematics through courses and research."

Seung expressed her excitement to continue to learn mathematics at this fabulous institution, and she is extremely grateful for the wonderful support from the community here. As a Rudy Lee Horne Memorial Fellowship recipient, Seung hopes to contribute to the diversity of students desiring to pursue higher education, and be a beneficial addition to the community of Applied Mathematics.

Rudy Horne

"It is in [Dr. Horne's] spirit of dedication and perseverance that the Graduate Committee recognizes and values Seunghyun Kim's effort to pursue graduate studies here in Boulder. Her presence in the Department brings a unique perspective, which benefits the Department immensely."

- APPM Graduate Committee

Associate Professor Mark Hoefer: College Scholar Award Winner

In February, Associate Professor Mark Hoefer recieved the College Scholar Award from the College of Arts and Sciences. Along with the recognition, Dr. Hoefer will also receive a year-long sabbatical at full salary during which he will spend the first six months at the Isaac Newton Institute in Cambridge, England engaging in his research on nonlinear wave phenomena.

At the Isaac Newton Institute, Dr. Hoefer will be participating in and helping to organize a six-month residential research program titled "Dispersive Hydrodynamics: Mathematics, Simulations, and Experiments with Applications in Nonlinear Waves." There will be participants from all over the world: 25 to 30 people in residence, sharing offices, giving seminars and collaborating on research problems in the area of dispersive hydrodynamics. Applied mathematics students that Dr. Hoefer is working with will also spend time at the institute. Dr. Hoefer acknowledged that "this extended program demonstrates the growing interest in this field of physical applied mathematics."

Dr. Hoefer expressed gratitude for receiving this award: "I feel honored and grateful to have been acknowledged by the department and the college in this way. It gives me a special opportunity to really engage in that research in a way that otherwise I wouldn't be able to."

Associate Professor Mark Hoefer: T. Brooke Benjamin Award Winner

In April, the Society for Industrial and Applied Mathematics (SIAM) awarded the Department's Dr. Mark Hoefer with the 2020 T. Brooke Benjamin Prize.

In a letter from the Department Chair, Dr. Keith Julien expressed that "The SIAM Activity Group on Nonlinear Waves and Coherent Structures (SIAG/NWCS) awards the T. Brooke Benjamin Prize every two years to one mid-career established researcher for recent outstanding work on a topic in nonlinear waves ... The candidate's work must contain a significant contribution to the field of nonlinear waves, broadly interpreted in the spirit of the SIAG/NWCS conferences."

The Department Chair continued on to provide the details of the announcement that Dr. Hoefer received:

"The selection committee wishes to recognize you for your 'significant contributions to the understanding of dispersive shock waves in hydrodynamics and other physical systems,' as evidenced in your paper, "Solitonic dispersive hydrodynamics: theory and observation," Physical Review Letters (2018)."

Silva Chang: Excellence in Leadership and Service Award Winner

In February, Instructor Silva Chang was given the Boulder Faculty Assembly (BFA) Excellence Award in Leadership and Service. According to the BFA, this Excellence Award is given for "professional activities other than teaching and research that are performed by faculty members as part of their University responsibilities or as community outreach."

The new CU Math Placement Process is an achievement that has been sorting students into their most qualified math class for a couple of years now, and its importance for the College of Engineering and is pivotal: "An appropriate first college math course will create the foundation that students need for their upper level courses. An inappropriate course may overwhelm students and cause them to rethink their choice of major." In order to give students the best chance at completing their degree, Instructor Chang created a new placement test by writing over 200 questions based on the Assessment Test that APPM students take the first week of class. A new placement algorithm that takes data from high school GPA and standardized test scores, along with the results of the exam, gives the most apt assessment of the student's math background. "Based on results since fall 2018, the new process is working well."

"[Ms. Chang's] outreach activities have the common goal of developing an appreciation and enthusiasm for mathematics among young students."
- Boulder Faculty Assembly

Along with these amazing achievements, Instructor Chang also teaches applied math courses, oversees core mastery tests, and analyzes data on student performance. This last job entails examining APPM course grades from previous years with the goal of improving student achievement. Her analysis in data incorporates student performance after they leave applied math, including graduation rates, and their performance in other engineering courses. All of Ms. Chang's work in data analysis aims at ensuring students understand and complete their math courses and are prepared for upper division classes.

Kumar Thurimella: Gates-Cambridge Scholarship Award Winner

In February, Applied Math (APPM) alumnus, Kumar Thurimella, received the Gates-Cambridge Scholarship. This prestigious award, given to 80 people out of 5,500 applicants worldwide, is presented to students with outstanding leadership and academic skills who wish to pursue a postgraduate degree from the University of Cambridge. This scholarship will support Thurimella in his goal to obtain a PhD in Biotechnology in three years.

"With the aid of this scholarship, I am able to solely focus on my research and conduct more risky science that could have a future impact in medicine," Thurimella said. "Within the Gates-Cambridge community there are experts in sociology, ethics, and law where together collaborative efforts can augment my skills to develop technology with the most benefit for society."

After graduating from CU Boulder in 2013 with an Applied Math degree, Thurimella worked as a software engineer at Uber in San Francisco. He then went to Cambridge, where he received his MPhil in Computational Biology. With the Gates-Cambridge Scholarship, he will return to Cambridge to start his PhD training. Thurimella will work alongside experts in statistics and biotechnology in the hopes of creating more thorough mathematical models of the digestive system for patients with gastrointestinal diseases.

Upon earning his PhD at Cambridge, Thurimella plans to come back to Colorado and resume his studies for a medical degree from University of Colorado Anschutz Medical Campus. Thurimella is the third Applied Math graduate to have received the Gates-Cambridge Scholarship and shares the honor with Stephen Kissler (2014) and Derek Driggs (2017). Anna Lieb received the Churchill Scholarship in 2010.

"Being able to enter the life sciences and develop software, build mathematical frameworks, and continually learn was something I developed in Applied Math ... Applied Math taught me to have the confidence of venturing into an unfamiliar space and to use logical and rigorous methodology to approach problems in that domain."

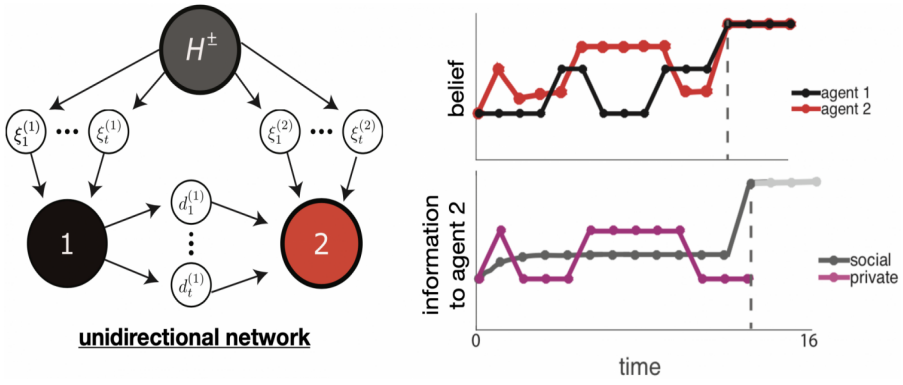
Assistant Professor Zachary Kilpatrick: Decision Making

In an article published in CU Boulder Today in March, Associate Professor Zachary Kilpatrick's work on decision making was highlighted in the context of electoral decision making. In the article, Dr. Kilpatrick's ongoing research project on how people make decisions, such as voting, is discussed to understand the way that people make decisions on which candidate to vote for, and why a person may choose one candidate over another.

The critical part of this project is the real world application of the topic. Dr. Kilpatrick discusses how people use their friends' opinions in their own decisions, and how those decisions may be biased. "You see friends that you trust are voting for this particular candidate in the primary, that may sway your belief in that direction … these biases really affect how opinions spread on networks. Such opinion propagation networks can be hijacked to rapidly spread disinformation." Understanding how disinformation spreads is critical to addressing a number of current problems in the media and social networks. Dr. Kilpatrick emphasized the importance of having a "good quantitative understanding of how bias can shape group opinion spread in networks," which is what Dr. Kilpatrick is working on doing.

We asked Dr. Kilpatrick about what a person should take away from his work. He responded by saying that "when you're considering how much to value your friends' or experts' or news sources' opinions, look at their history of decisions that they've made and usually that's a good guide to what their preexisting biases may already be … Briefly, just consider peoples' biases when you weigh their opinions in making your own decisions."

Dr. Kilpatrick explained that to motivate his work, he uses an example from the 1987 movie The Princess Bride: In The Princess Bride, Vizzini [shown] tries to use what he thinks Dread Pirate Roberts thinks to make the best decision about which cup is poisoned.



Left: graph of the flow of information in a two agent unidirectional network. Right: Each agent receives a sequence of pieces of evidence. Agent 1 then communicates their decision state (decided for H+, decided for H-, or undecided) to agent 2. Agent 2 then uses this information to update their belief.

Graduate Student Sabina Altus Awarded Fellowship

In April, Sabina Altus, one of our PhD Students in the Department, was awarded a summer dissertation fellowship by the Graduate School. In summer 2020, Sabina will be given funding to work on her thesis with her advisor, Associate Professor David Bortz in our department. Sabina described that the "fellowship is specifically awarded to PhD students during their last summer of graduate school as a final push towards finishing their dissertations and graduating."

In regards to the work she will be completing this summer, Sabina explained she will be completing a paper in the area of mathematical biology, which is the primary research focus of her advisor and an important component of the research CU's Applied Math Department does. Sabina uses partial differential equations to model growth dynamics in populations of cyanobacteria.

When asked what part of the work that she's most excited about, Sabina exclaimed: "I am excited to have my first first-author publication! This will be a huge milestone for me both personally and academically. Beyond that, I am just so grateful to have this time to work on my research without all of the other distractions and time requirements that I would normally have."

Sabina also highlighted the importance of her work for the CU chapter of the Association for Women in Math (AWM), where she was the president of the chapter:
"I'd be remiss not to acknowledge or give a shout out to women pursuing higher education or careers in math or STEM in general! Supporting and encouraging women to get involved and stick with STEM is something I am certainly very passionate about and I know I would not still be here without the support of other women in the department, plus my advisor has been wonderful in that regard."

"From the time we first organized and established our AWM chapter among graduate students, the department has been extremely supportive and has even made an effort to hire more female faculty. This has been such a positive change that I have been so happy to see and be a part of … Thank you to the department, particularly Dr. Bortz and Mark Hoefer, for their support, patience, and encouragement."

Kiera van der Sande: Sheryl R. Young Memorial Fellowship Recipient

In April, the Applied Math Department congratulated Applied Math graduate student Kiera van der Sande for being awarded the Sheryl R. Young Memorial Fellowship. This fellowship is given to a graduate student in the memory of Sheryl R. Young, who graduated with her Ph.D. in Psychology from CU in 1984. While at Carnegie Mellon University as an assistant professor, Dr. Young became internationally recognized and respected as a computer scientist and supporter of women's causes in STEM.

Kiera is working on internal ocean waves and is "interested in both analysis of the PDEs used to model these processes, as well as developing numerical tools for simulating them… [and is] excited to be working on this more over the summer."

Professor Keith Julien: Kirk Distinguished Fellowship Recipient

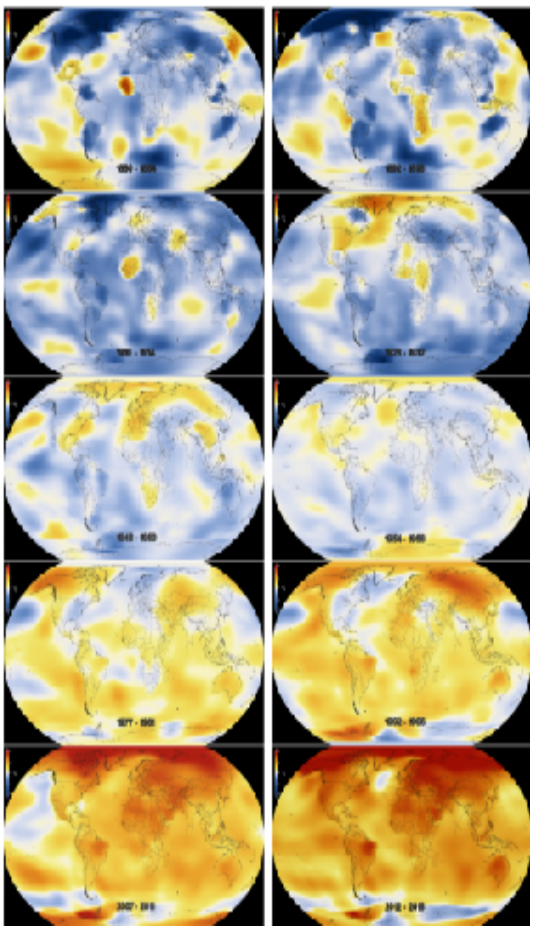
In February, Professor Keith Julien, the chair of the Department of Applied Mathematics, received the Kirk Distinguished Fellowship from the Isaac Newton Institute for Mathematical Sciences, Cambridge, England, UK. As part of the upcoming Fall program, Professor Julien will be a member of the program on Frontiers in Dynamo Theory: From the Earth to the Stars.

As of 2019, a generous £250,000 donation from the Turner-Kirk Charitable Trust has allowed the establishment of the Kirk Distinguished Visting Fellowships scheme. The fellowship provides funding for one senior mathematician selected from under-represented groups within higher mathematical research.

The Isaac Newton Institute of Mathematics is devoted to the advancement of mathematics "in the broadest sense." To achieve this, they employ strict criterion for program selection. According to their website, programs are selected by the extent to which the topic is "interdisciplinary, bringing together research workers with very different backgrounds and expertise." Since the institute opened in July 1992, 27 Fields Medalists, 9 Nobel Laureates, 23 Wolf Prize winners, and 12 Abel Prize winners have attended programs at the institute.

Dr. Osita Onyejekwe: Climate Change Study

This spring, Dr. Osita Onyejekwe had a paper published in Hydrology titled Climate Change Study via the Centennial Trend of Climate Factors. In this paper, Dr. Onyejekwe and his associate, Dr. Nezamoddin N. Kachouie of the Florida Institute of Technology, "utilized a novel approach to non-parametric analysis through the optimization of Signal to Noise Ratio (SNR) to clean up data obtained from NOAA (National Oceanic and Atmospheric Administration)." After cleaning up the data, Dr. Onyejekwe used MATLAB code that he wrote "to analyze and verify global weather pattern behaviors during the periods of 1880 to 2017. Certain climate factors observed included Land Temperature, Sea Surface Temperature, Temperature Over Land Plus Ocean, Carbon Dioxide concentration, and Northern Hemisphere Sea Ice Extent."



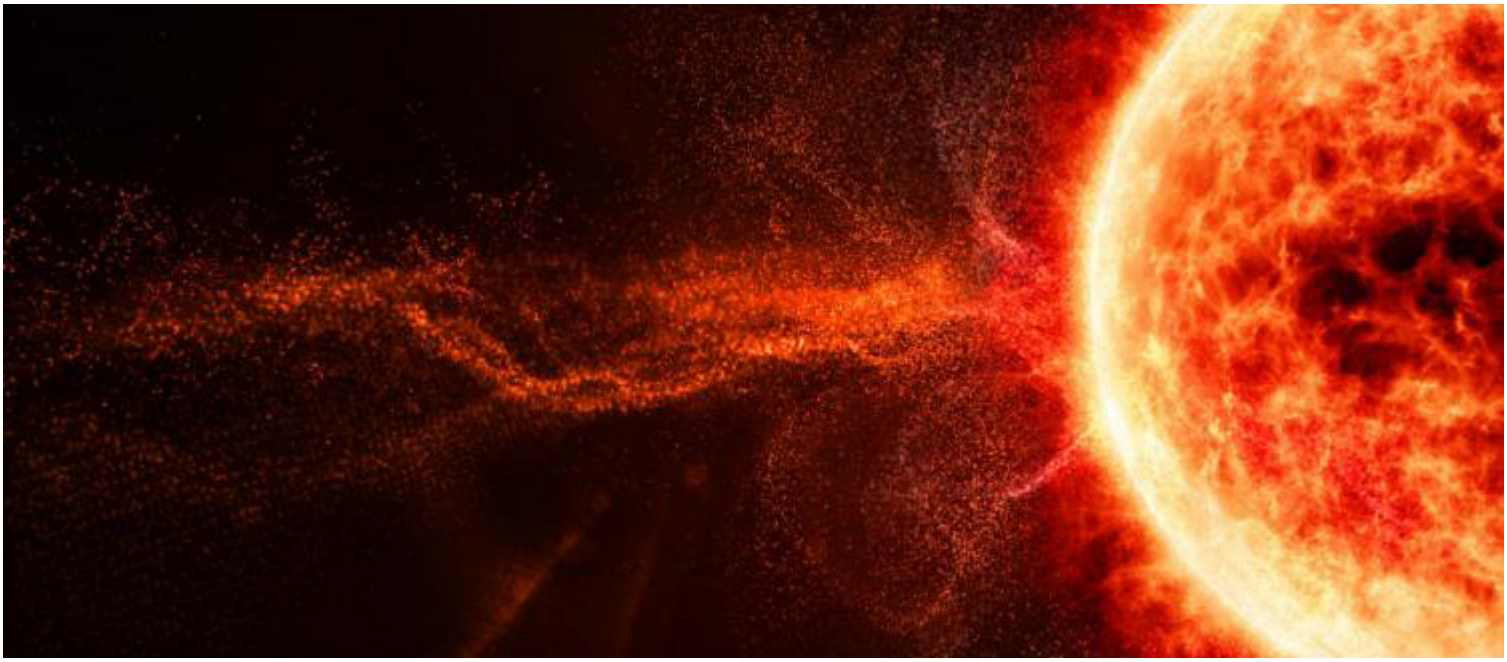
The figure on right shows one of the results of the analysis: "Global heat content between 1880 and 2017. The temperature anomalies are represented within a range from -2 degrees Celsius (dark blue) to +2 degrees Celsius (dark orange)."

As a result of this paper, Dr. Onyejekwe explained that climatologists will be better equipped to deal "with data denoising and feature extraction with the goal of being able to predict and prepare for drastic weather behaviors that are certain to impact this planet at any moment in time. It also helps scientists understand machine learning algorithms and how to apply them to climate data."

Now, Dr. Onyejekwe is focusing on Mauna Loa, Hawaii, and the extreme weather patterns that are observed there. With an Aerospace undergraduate, he is working on exploring the climate factors that impact the weather patterns seen in Mauna Loa.

Dr. Onyejekwe said that he "would like to thank NOAA/OAR/ESRL PSD, Boulder, Colorado for the extensive and informative data which made this project a success."

Professor James Meiss: Solar Flares



In May, Applied Mathematics Professor James Meiss had his interdisciplinary work on solar flares highlighted in a College of Engineering & Applied Science article.

Along with Thomas Berger, the director of the Space Weather Technology, Research and Education Center, Professor Meiss assisted Professor Elizabeth Bradley from the Computer Science Department in better understanding solar flares and how to predict their occurrences. Professor Meiss began working with Professor Bradley in 2000, co-advising an Applied Math PhD thesis, and "have been collaborating in this area for many years," Professor Meiss explained.

Professor Meiss elaborated on his role on the project:

Solar Flare"My part of the project is to provide mathematical background for computational topology: how does one compute "shape" from data … The basic idea is to use a notion of scale-dependent shape: each point in a data set, if you blur your eyes, becomes a ball. As the radii of the balls grow, the effective shape changes. For example, "holes" in the data are formed as neighboring balls begin to overlap and then later fill in as they merge. Holes that have long lifetimes are "persistent" and are viewed as being more important in characterizing the data … For this project, the data corresponds to a sequence of images of the magnetic field on the sun's surface."

To learn more about the project and those involved, read the original article. Image credit to the original article as well.

Associate Professor David Bortz: COVID Modeling

In March, an interdisciplinary team was assembled by the state of Colorado to develop a model to help inform policy decisions concerning the ongoing COVID-19 epidemic. Associate Professor David Bortz was among those invited to join because of his research in the mathematical modeling of biological systems. Dr. Bortz explained that, as the team was being assembled, there was a consensus that a mathematical biologist was needed for development and theoretical and computational analysis of the compartmental model.

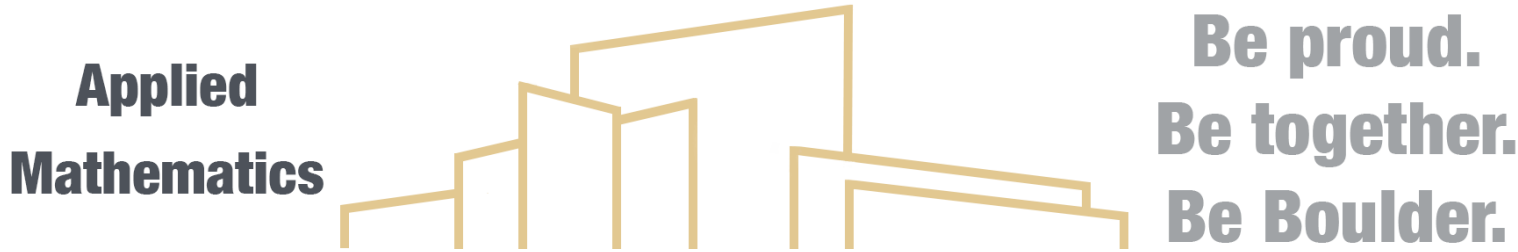
In helping to create the model, Dr. Bortz worked with the epidemiologists to ensure that the most accurate mathematical terms were being used to describe the transmission and recovery processes during an outbreak in a population. Additionally, Dr. Bortz developed the code to compute the basic reproductive number for the age-structured model, as well as to estimate the uncertainty around the overall case count projections. For additional information about the project, please see the Colorado School of Public Health's webpage on the COVID-19 modeling team.

This model has been critical for understanding the possible future trajectory of the COVID-19 crisis and the responses that are critical in slowing the spread of the virus. Dr. Bortz explained that "the decisions made by the Governor's Office and the Colorado Department of Public Health and the Environment have been strongly data-driven with a focus on understanding the model predictions about both the needed number of ventilators and the timing for the initiation and duration of the stay-at-home order."

Dr. Bortz highlighted that although a vaccine or antiviral drug is not ready, there are still actions that everyone can take in keeping themselves and those around them safe: "it is critical that everyone continue to follow the non-pharmaceutical mitigation strategies (hand washing, distancing, and wearing masks in public, etc.). That is the biggest 'knob' we have currently, and each of us can do something about it."

Congratulations and thank you for your work Dr. Bortz!

Remote Learning: The Challenges and Successes



The Spring 2020 semester was an unprecedented semester with many challenges, roadblocks, and unexpected turns that led to an equally fulfilling and successful semester after rising to the occasion given the COVID-19 pandemic. The Applied Mathematics Department underwent critical changes after the announcement from the Chancellor, which directed the University to shift to remote learning effective March 16, 2020 through the rest of the semester. Eventually, this was changed to be effective through the summer terms.

As the situation began to unfold, the Applied Math Department began to move quickly to keep continuity in classes for students, especially as their academic and personal situations changed. The Department's faculty, graduate and undergraduate students had their own important roles in helping move courses to a remote platform and take advantage of various technologies. The Graduate Committee Chair, Associate Professor Mark Hoefer, explained that his graduate class was smoothly transitioned thanks to the technology that he was already using in the course. Dr. Hoefer highlighted that his course had "been using online tools already this semester for homework submission and communication, so these modalities continue." This sentiment is true for most classes, as the online-based Canvas application that is also used during in-person semesters is a tool used across campus to submit homework, distribute announcements, assignments, class notes, and more. Canvas was important within the Department to stay involved with students and send updates about the class throughout the transition to remote learning.

Some classes, like Dr. Hoefer's were also aided by technology already used when classes were in-person. Dr. Hoefer explained: "For lectures, I was using an iPad projected onto a screen during class with a note taking app, and posting the iPad handwritten lecture notes as a PDF online. All I had to do was shift from being in class to sitting in front of my computer." A student in APPM also explained: "Amazingly, remote learning has been a good thing for me. I've started reading from textbooks a lot more and spending more of my free time doing schoolwork … I would say the quality of my education remained fairly consistent! Things felt different, but the quality was the same."

The shift was certainly not without its challenges, however. When taking away the in-person component of a class, it can be difficult to engage students, especially when remote learning hasn't been done before in this context. This issue of engaging students was an issue uniquely dealt with by different instructors. Splitting students into smaller discussion groups was one technique, using polling, similar to Clicker questions, was another way to keep students engaged.

Initial issues were eased by the leniency of deadlines of assignments to accommodate for the quickly changing direction from the University. The Department recognized that students may be moving away from Boulder, so part of the transition was to give leniency to students while still keeping courses continuous.

The pacing of courses was another challenge that Dr. Hoefer mentioned was present. While being online, it's more difficult to read the body language of students that is often critical feedback for the pacing of the course. Lecturing at a computer doesn't give the feedback necessary to understand where the students are at. When asked how the pace of the classes have changed as a result of remote learning, Dr. Hoefer noted that the "pace of class has slowed down, and rightly. We are in the midst of a historic pandemic and everyone is being impacted differently." In an effort to combat this, Dr. Hoefer asked his students to turn their computer cameras on during live lectures so that he could have input on the pacing of the course and see where students are at in their understanding of the material.

Instructing students to turn on their webcams is easier in a small class, but much more difficult to achieve in larger courses, such as the Calculus courses, which have 70 students in a lecture. Asking students to utilize their webcams if possible helped students feel more connected to those around them and create a more realistic lecture environment. Furthermore, encouraging students to continue participating in study groups/sessions on Zoom, or other video conferencing applications, aided the course instructors and the students in understanding where more attention in the course may be necessary.

Examination of undergraduate classes was also an issue, especially in the larger, lower division courses, which administer exams to hundreds of students on exam days. One Applied Math student explained that the department was very concerned with "maintaining original logistical plans" and tried to keep things consistent with how exams would have been proctored in-person. TAs were important in the exam proctoring in some classes. In the lower-division Differential Equations course Applied Math offers. For example, TAs set up Zoom rooms in which they could be present with students during exams just as they would have if they were in-person. To keep the exam as close to "normal" as the exam could be during the extraneous circumstances, students had their webcams on to feel more in-person, but also to deter students from cheating.

The situation the University and Department are in with regards to online learning are far from over, however, as more online learning is expected for the Fall semester after Fall Break. Dr. Hoefer explained:

"Anticipating more online teaching this Fall, Applied Math is using the summer to prepare and develop materials that will be helpful for instructors and TAs. In addition to the usual instructors and TAs for our summer course offerings, we are hiring graduate students in support roles to bring their perspective and expertise to preparing for Fall online courses. Not only does this help the Department as a whole but it also provides employment opportunities for the students."

Whether it be exam administration, remote teaching, graduation, or may other obstacles, the students have been able to take the changes in stride and succeed in the face of adversity, which is a lesson that cannot be taught in the classroom. The Department congratulates all students for getting through a tough semester and looks forward to returning to campus for the Fall semester in a safe and effective manner!

"I admire and am in awe of the students for persevering admist these changes."
- Associate Professor Mark Hoefer

WE INVITE YOU TO CONTRIBUTE TO OUR ANNUAL FUND DRIVE

We appreciate your contribution and note that donations are tax deductible.
Click link above or go to
https://www.colorado.edu/amath/donate

Department of Applied Mathematics
University of Colorado, Boulder
526 UCB
Boulder, Colorado 80309-0526