Department of Applied Mathematics



Newsletter 2017-2018

University of Colorado Boulder



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APPLIED MATHEMATICS FACULTY

Department Chair: Keith Julien, Professor Associate Department Chair: Anne Dougherty, Senior Instructor Graduate Committee Chair: Mark Hoefer, Associate Professor

Mark Ablowitz, Professor Gregory Beylkin, Professor James H. Curry, Professor Vanja Dukic, Professor Bengt Fornberg, Professor Keith Julien, Professor Congming Li, Professor James Meiss, Professor Harvey Segur, Professor Daniel Appelö, Associate Professor David Bortz, Associate Professor Jem Corcoran, Associate Professor Mark Hoefer, Associate Professor Manuel Lladser, Associate Professor Juan G. Restrepo, Associate Professor Eric Vance, Associate Professor Stephen Becker, Assistant Professor Ian Grooms, Assistant Professor Yu-Jui Huang, Assistant Professor Zachary Kilpatrick, Assistant Professor William Kleiber, Assistant Professor Jerrold Bebernes, Professor Emeritus Bob Easton, Professor Emeritus Tom Mantueffel, Professor Emeritus Steve McCormick, Professor Emeritus Anne Dougherty, Senior Instructor Adam Norris, Senior Instructor Sujeet Bhat, Instructor

Murray Cox, Instructor Danielle Lyles, Instructor Maribeth Oscamou, Instructor, Student Support Specialist Eric Thaler, Instructor Brian Zaharatos, Instuctor Silva Chang, Instructor, Math Placement Advisor Rachel Tutmaher, Lecturer, Help Room Coordinator Justin Cole, Instructor, Research Associate Ezio Iacocca, Instructor, Research Associate Lucas Monzon, Instructor, Research Associate Susan Hallowell, Lecturer Jonathan Kish, Lecturer Daniel "Seneca" Lindsey, Lecturer Sandy Williams, Lecturer Nicholas Featherstone, Lecturer, Research Associate Benjamin Miquel, Lecturer, Research Associate Igor Rumanov, Lecturer, Research Associate John Ruge, Research Associate Ben Southworth, Research Associate Annick Pouquet, Adjunct Faculty

APPLIED MATHEMATICS STAFF

Ellie Bowers, Student Assistant Ian Cunningham, Office Coordinator, Undergraduate Program Assistant Mary Fentress, Program Manager Desiree Holtz, Accounting Tech Ashley Hopko, Student Writer

Dominique Ingoglia, IT Manager Alexus Longo, Student Writer, Newsletter Editor Emily O'Connor, Graduate Student Coordinator



WARM WELCOMES

Daniel Appelö Ezio Iacocca Dominique Ingoglia Maribeth Oscamou Farhad Pourkamali-Anaraki John Ruge Ben Southworth

FOND FAREWELLS Yolanda Hagar-Slichter Per-Gunnar Martinson Jacob Tafoya

VISITING SCHOLARS

Zhigang Wu, College of Science, Donghua University, China
Pipi Hu, Yuan Center for Applied Mathematics, Tsinghua University,
China
Oleksii Beznosov, Department of Mathematics and Statistics,
University of New Mexico
Shane Keating, School of Mathematics and Statistics, University of

New South Wales, Sydney, Australia

Luciano Ponzellini, National University of Rosario, Argentina

Summer 2017 & Spring 2018

GRADUATES

Department of Applied Mathematics



Spring 2018 Outstanding Graduate Award Winners

OUTSTANDING GRADUATE FOR RESEARCH

Maximilian Ruth, AMEN BS/MS + EPEN BS

OUTSTANDING GRADUATES FOR ACADEMIC ACHIEVEMENT

Gregory Benton, AMEN BS/MS Ian Char, AMEN BS/MS + CSEN BS Ansel Rothstein-Dowden, ASEN BS/MS + AMEN BS Evan Sidrow, AMEN BS/MS







Joseph Benzaken

Propagation and Control of Geometric Variation in Engineering Structural Design and Analysis Dissertation Advisor: John Evans, Ph. D., Aerospace

Hillary Fairbanks

Low-Rank, Multi-Fidelity Methods for Uncertainty Quantification of High-Dimensional Systems Dissertation Advisor: Alireza Doostan, Ph. D., Aerospace

Delyan Kalchev

Dual Least-Squares Finite Element Methods for Hyperbolic Problems Dissertation Advisor: Thomas Manteuffel, Ph. D., Applied Mathematics

John Nardini

Partial Differential Equation Models of Collective Migration During Wound Healing Dissertation Advisor: David Bortz, Ph. D., Applied Mathematics

Meredith Plumley

Investigations of Asymptotic Models for Convection-Driven Flows in Astrophysical and Geophysical Fluids Dissertation Advisor: Keith Julien, Ph. D., Applied Mathematics

Jay Stotsky

Computational and Mathematical Studies of the Biomechanics of Biofilms Dissertation Advisor: David Bortz, Ph. D., Applied Mathematics

Peter Wills

Studies in the Analysis of Stochastic Processes Dissertation Advisor: Francois Meyer, Ph. D., Electrical Engineering



Master of Science Sabina Altus Joshua Aurand Lewis Baker Joseph Benzaken David Gunderman Erik Johnson Mitchell Krock

Taisa Kushner Junfei Lei Alan Medinger Joy Mueller Patrick Sprenger Ashton Wiens

Master & Bachelor of Science



Greogry Benton Ian Guo-fan Char Amy Chen Felix Jimenez Denis Kazakov

Jonathan Wilder Lavington Maximilian Ruth **Evan Jeffery Sidrow** Justin Elling Cribbs Tyse Nicole Woytarowicz



Ali AlNasser **Dalton Anderson Royce Brosseau** Kylee Budai Jacob Burgess Edward Decrescenzo Nicole Anne Dobson

Bachelor of Science

Zoe Farmer Lauren Gregg Seth Hovestol Lee Huynh Joseph Johnston **Elizabeth Kane** David Levin Alexander Lien Qi Pei Gerardo Pulido

Ansel Rothstein-Dowden Shane Sarnac Jay Saunders Yongbo Shu **Clayton Skinner** Kevin Sun Dimitri Sergeevich Tarasov Robert James Tyrrell-Ead Kirk Van Arkel Alexander Winoker

Letter from Department Chair

Keith Julien—Chair for the Department of Applied Mathematics

(APPM) Applied Mathematics at CU Boulder continues to be a vibrant unit with many moving parts and new initiatives. The past year was a tremendously busy time for all. APPM is a healthy and dynamic unit that fulfills all of its missions with excellence and dedication. The APPM Department strives to uphold the feelings of camaraderie and healthy departmental climate found by the academic review process (ARPAC) evaluations conducted during AY16-17.

A significant event in the unit's history was approval by the CU Board of Regents for its second undergraduate degree, a BA in Statistics and Data Science to be offered in the College of Arts and Sciences.

The Regents stated, "The bachelors in statistics and data science is intended to produce alumni who will have a STEM-based understanding of statistics and its applications. The degree, which will be offered by the Department of Applied Mathematics in the College of Arts and Sciences, will prepare students for a wide range of careers in engineering, economics, data science, public health, epidemiology, insurance, forestry, psychology, social justice and human rights, and more. "No other university in the state offers an undergraduate degree program in statistics and data science, so this degree will increase the ability of CU Boulder to attract high-quality resident and nonresident students and enable the Boulder campus to place its alumni in highly desirable positions at top companies, national labs and graduate programs."

The new BA will officially begin in Fall 2018 and will be the culmination of a decade long effort in recruiting a critical mass of faculty of excellence capable of delivering a high-quality education to our students. Many thanks to Professor Vanja Dukic, Associate Chair Anne Dougherty and the statistics steering committee for their dedicated effort in bringing this venture to fruition.

The APPM undergraduates have had several notable accomplishments. As in years past, our students did exceptionally well in the international Mathematical Contest in Modeling (MCM). This 4-day contest has continued to grow, with 20,602 three-person teams competing from around the world. APPM had 15 teams with one team awarded Outstanding, five teams awarded Meritorious, and three teams awarded Honorable Mention. The Outstanding team also received the Mathematical Association of America and Society for Industrial and Applied Mathematics awards. Maximilian Ruth was awarded the College of Engineering's Outstanding Graduate in Research award. Finally, Gregory Benton, Ian Char, Ansel Rothstein, and Evan Sidrow received the College of Engineering's Academic Achievement award, for the highest undergraduate GPA amongst the graduating students.

I would like to take this parting opportunity to thank faculty, staff, alumni and friends for their continued engagement, contributions and dedication in advancing the Department of Applied Mathematics.

CU Faculty Win Grant to Further Understanding of Wound Healing

By: Ashley Hopko

When it comes to the healing process of wounds, there is an important lack of understanding about how cells collectively migrate to the site of an injury. David Bortz and Vanja Dukic in Applied Math and Xuedong Liu in Biochemistry and their postdoc and graduate students set out on a mission to learn more about this fundamental biological process. In support of this endeavor, they were recently awarded a \$1,510,000 grant. This four-year grant comes from a joint program between the NSF Division of Mathematical Sciences and the National Institute of General Medical Sciences (a part of the NIH).

"The overall goal of this project is to use model selection to choose the mechanistic spatial models which best describe cell migration/wound healing experiments." -Bortz "The overall goal of this project is to use model selection to choose the mechanistic spatial models which best describe cell migration/ wound healing experiments," said Bortz. The broader applications of their research includes potential for medical advancement around chronic wounds and even possibly new techniques for tissue engineering. One of the main obstacles to developing effective models of cell migration is that there are a large number of possible biological explanations. Accordingly, along with the biological investigation, this grant

is also funding research into developing a methodology for selecting the best spatial (i.e., partial differential equation-based) model for cell migration. The principle is that the biology encoded by the best model is most likely to describe the actual biological mechanism.

By the end of the project, 4 years down the line, the team hopes to both learn more about what causes wounds to heal and have a robust mathematical approach for selecting accurate spatial models.

Professors Bortz and Dukic are both faculty in the Department of Applied Mathematics, while Professor Liu is a faculty member in the Department of Chemistry and Biochemistry. Bortz is a mathematical biologist and the principal investigator on this grant, Liu is a biochemist, and Dukic is a computational statistician. "I originally met Xuedong Liu at a BioFrontiers task force meeting in 2013 and we started talking about a possible collaboration." said Bortz. "It took us a while to figure out a question to ask which mathematical modeling could help answer, but once we did, it led to mentoring a grad student (John Nardini), a publication, and this grant." Bortz and Dukic will be developing the models and selection methodology and Liu will be designing and carrying out the validating experiments.

Lastly, the project also provides a training opportunity for the postdoc (Doug Chapnick) and the graduate students (John Nardini & Lewis Baker) supported by this funding.

Colorado Journal of Applied Mathematics Highlights Important Student Work

The Colorado Journal of

Applied Mathematics

By: Ashley Hopko

The Colorado Journal for Applied Mathematics is a student club at the University of Colorado which was founded by the members from the Society of Industrial and Applied Mathematics. The journal focuses on highlighting research and innovative projects within the university.

Will Shand is a sophomore at CU, studying applied math and computer science, who has a knack for communicating the findings of both scientific and mathematical research. As a founding member of

CJAM, he hopes that the journal will expand community outreach and

get students, staff, and faculty interested in new projects.

In the last few months, CJAM struck a partnership with the student podcast, Probably Novel, to team up in hopes of helping each other create engaging content. Probably Novel is a podcast aired through Radio 1190 which tells similar stories. Both groups hope a partnership means they can bring new perspectives and cover more ground.

CJAM is always accepting submissions of new material. Both undergraduate and graduate students are encouraged to submit any work or research they've been doing both independently and under faculty guidance. They also accept submissions of originally written articles or essays in STEM fields. Submissions can be sent to appm_urj@colorado.edu and more information can be found on their website. "We are just now starting to publish, and people are really excited," said Shand. He said that one of his

favorite submissions that the

journal revived was a hypothetical research essay about life on mars.

> In the next few months, the journal staff is optimistic about the club's growth.

They're working on creating more of a connection with the community and have started reaching out to more students at CU. They've done this through presentations to professors and creating marketing materials to hang in the hallway. "We've been interested in publishing shorter articles about topics people are interested in and that aren't lengthy. We've been trying to find ways to make it more accessible and easy to read," said Shand.

CJAM released its first edition on March 13, 2018.



Q: How long have you been with cQuant.io?

A: I've been with cQuant.io full-time since August 2017, but I did a fair bit of moonlighting before that to help get the business to the point where I could really feel confident jumping in with both feet.

Q: What did you learn at CU which is most applicable to your job now?

A: One of the most valuable lessons I took from graduate school was how to dissect complicated problems into more tractable components, and how to write solid computational software that builds the component solutions back up into a working solution to the original problem.

Q: What is the most rewarding part of your job?

A: The most rewarding part of my job is to be able to watch the company grow through the efforts of our close-knit team. We're a small company still very much in "startup mode", which means our priorities are constantly shifting and our work is never done. When we put effort into APPM Alumni, Brock Mosovsky, Co- Founds Energy Analytics Company By: Ashley Hopko

About Brock Mosovsky

Brock Mosovsky is Co-Founder and Director of Operations and Analytics at cQuant.io, a leading software-as-aservice provider of energy-focused advanced quantitative analytics. He has over a decade of analytical modeling experience with a focus on risk management, financial engineering, market analysis, and model validation for the energy industry. Brock has worked with the country's largest electric utilities and independent power producers to help improve operational and budget certainty amid volatile financial energy markets, and has validated financial models for more than 100 gigawatts of generation capacity. He holds a Ph.D. in Applied Mathematics from the University of Colorado, Boulder, a B.S./M.A. in Mathematics from Villanova University, and was awarded a U.S. Fulbright Scholarship for study in the Netherlands.

something, we typically need that effort to yield immediate results. This makes the feedback loop between hard work and tangible reward a pretty short cycle. It's always fulfilling to hear praise from our clients about how our analytical platform is helping them be more efficient and more effective.

Q: What is the most challenging part of your job, how do you overcome challenges?

A: The most challenging part of my job is knowing where to focus my energy on any given day. Since cQuant is growing, and since our team is currently small, on any given day I could be hammering away on code for a new model, leading technical demos for business development, writing blog posts and thought leadership articles, or managing our team of analytical developers. There's so much to do that I never get to a point where all items on my to-do list are checked off, and it can be tough to prioritize them all. It's too much for anyone to take on individually, so I try to rely on my excellent core team to help me make the tough decisions on where to spend my time so that it has the most impact. Priorities seem to become clearer as long as we're all keeping open channels of communication with each other.

Q: How is cQuant.io a leader in innovation and tech development?

A: cQuant.io provides a web-based energy analytics platform that enables our clients to access sophisticated analytic models at a fraction of the cost of traditional enterprise software. Our subscription-based platform runs in the cloud, which reduces overall costs compared to on-site software deployments. We're able to pass that cost savings on to our customers, providing cost-effective, top-tier energy analytics to many who could not afford it in the past.

Q: How did you end up at the company?

A: I helped to co-found cQuant.io after working at an energy analytics company in town that took a very different approach to providing analytical software. Their product was a more traditional enterprise-level offering, and typically came with high price tags and prolonged deployment projects. It wasn't uncommon to see clients spend over a million dollars after all was said and done. My business partner, David Leevan, approached me with an idea he had to reduce costs and provide the same level of analytical capability as the enterprise software vendors at a cost that knocked a zero (or two!) off the price tag. From there, we started working hard to make cQuant.io a reality, and we haven't looked back since!

Q: What other things were you involved in during your time at CU?

A: I've always loved the outdoors and, in addition to the Department of Applied Math at CU, the mountains were a primary draw for me to move to Colorado. While I was at CU I started rock climbing as much as I could, which is how I met some of my closest friends and my wonderful wife, Lot. I also snowboarded, played ultimate frisbee, and always jumped at the chance to play weekend lawn sports over a few beers.

Q: What are some trends in the industry students should be aware of?

A: Wow, that's a loaded question when you're talking energy! There is so much going on right now in the energy industry, that it's actually not hyperbole to use the word "revolution". The explosion in renewable energy coming onto the grid, the electrification of our country's vehicle fleet, the emergence of cost-effective grid-scale energy storage, the continued deregulation of energy markets, and the beginning of programs to price carbon and other harmful emissions are just a few of the current trends. There's also an extremely

important trend spanning virtually all industries toward the increased use of data and sophisticated mathematical modeling to inform business decision making. In the past, many pivotal business decisions were based on the experience and intuition of business leaders. Now, businesses that don't properly embrace the power of data analytics to propel them forward are likely not to survive. It's hard to think of a better degree than applied math for today's world, so I would encourage CU's students to leverage their obvious advantage in today's job market to the absolute fullest.

Scant Evidence of Power Laws Found in Real-World Networks

By: Anna Broido & Aaron Clausset

A paper posted online last month has reignited a debate about one of the oldest, most startling claims in the modern era of network science: the proposition that the most complex networks in the real world — from the World Wide Web to interacting proteins in a cell — are "scale-free." Roughly speaking, that means a few of their nodes should have many more connections than others, following a mathematical formula called a power law, so that there's no one scale that characterizes the network.

Student Podcast Talks About Fascinating Findings in STEM Fields

By: Ashley Hopko

From 10 to 11 pm every Sunday night Greg Benton, Ian Char, and Jonathan Wilder Lavington, can be found live on the air. Their podcast, Probably Novel, is a new series on CU Boulder's Radio 1190. Every week, they explore a new area of STEM fields and bring their audience information that takes them out of the normal realm of academics by discussing outside-the-box topics and perspectives.

Lavington, Benton, and Char are all in their last year within the Applied Mathematics Department. They started the podcast earlier this semester, with the guidance of, Manuel Lladser. He plays the role of "producer" on the show. What started as just a fun idea, quickly turned into reality thanks to Jonathan Wilder Lavington's prior experience working for Radio 1190.

"It's kind of crazy because we had this idea and then Wilder was like 'oh, I'll set something up.' We literally went there and just started talking into a microphone. It's pretty wild," said Char.

So far, the guys have been inviting their peers onto the show to discuss their findings and research. Most of their listeners come from their inner friendship circles or are fellow classmates.

A struggle that they've faced is the air time for their show. Since they joined later in the semester, they were stuck with an unpopular timeslot. In the coming months, they hope to develop more of a structure for the show and develop themselves on campus. They've expressed gratitude for Lladser and claimed the coordination they have is thanks to him.

"We believe the show is a very refreshing and novel way to reach out to a broader community in Colorado, particularly in the Denver/Boulder area and to keep attracting high-quality undergrads to our program by exposing APPM's research strengths as well as how they relate to other departments in Campus," said Lladser.

One of their goals for the upcoming semesters is to expand outreach by hosting a larger variety of people. They've only had one woman on the show and guests have only talked about coding for the most part.

Before a show, the group likes to go into interviews blind to the details regarding the guest's research. Though this might be an unorthodox approach, the guys explain that this helps them to perceive what the audience might not understand ask good clarification questions. They usually let the guest decide the topic of the podcast and let the talk about what they're most passionate about.

Two of the most interesting stories, according to the guys, was when they had a guest on the show that discussed how to recreate microstructures of gecko hands to pull trash out of space and then the research suggested that there has never been a recorded case of Barn Swallows nesting on a non-man-made structure.

APPM Graduate Makes Great Strides in Boulder Tech Industry

By: Ashley Hopko

After his graduation from CU in 2015 in Applied Mathematics, student Zack Thoutt has made great strides in his professional career. As an Applied Math major with minors in Economics and Biochemistry, he had an impressive skillset that was quickly put to use by major startups in the tech industry.

He began his career, the summer before his senior year, at a company that focused on helping people trace their own genealogy. Originally called Mocavo, the company was eventually acquired by a similar company called Find My Past. For Mocavo he was a data scientist and worked on machine learning projects to expand site growth and user outreach. Now, he works as a full stacks developer to build analytics software at a company trying to rethink the auto industry. "My degree laid the foundation for me to expand my knowledge and learn all of these skills. It taught me the building blocks necessary to understand complex topics and how to learn quickly and efficiently." - Thoutt

"As a full-stack developer, I work across our entire technology stack. I help build our web apps, scrape websites, host our apps, design our interfaces, and train machine learning models to assist our ordering team. My degree laid the foundation for me to expand my knowledge and learn all of these skills," said Thoutt.

"The math that I studied influenced my decision to explore the artificial intelligence space." -Thoutt. Back in August of 2017, Zack Thoutt caught media attention for his attempt to create and predict the unfinished 6th novel of Game of Thrones using Artificial Intelligence. He became a full-stack software engineer after graduating from CU and tried writing with AI as a side project. "The math that I studied influenced my decision to explore the artificial intelligence space. Once you have a good understanding of linear algebra, probability, statistics, and calculus, you can pretty

much understand any artificial intelligence research paper if you have the patience to sit down and read it thoroughly," said Thoutt.

When he isn't working for startups or revolutionizing the future of AI and taking over the internet, he likes to embrace his passion for nature. As part of the alpine club during his undergraduate years at CU, he found his love for the outdoors early. He and his wife aim to take two hiking trips a year to get away from work and the stresses of everyday life. "When

I'm not traveling, hiking, or learning, I like to do yoga and spend time with my wife, border collie (Skutull!), and family who all live in the Boulder area. We are quite a crowd (over 30 people), but I can't imagine life without my close, wonderful family," said Thoutt.

Over the past years, his travels have brought him to exotic destinations like Iceland, New Zealand, and the Alps. He also blogs about upcoming technological trends and started an

adventure travel company with his wife, in hopes that others will share similar adventures. The company matches people to their ideal vacation through a set of specific algorithms and questions.

Out of his entire time at CU, he says that the most valuable part of his experience was the amazing people he met. "My degree laid the foundation for me to expand my knowledge and learn all of these skills. It taught me the building blocks necessary to understand complex topics and how to learn quickly and efficiently. "When I'm not traveling, hiking, or learning, I like to do yoga and spend time with my wife, border collie (Skutull!), and family..." -Thoutt

I also developed a lot of great relationships during my degree--some with fellow students and a few with grad students and professors. I think these relationships are what I value most from my degree because they have connected me to an amazing, talented group of people in the Boulder area who share my interests and are genuinely good people," said Thoutt.



APPM Takes on the Buffalo Bicycle Classic

By: Ashley Hopko

The Buffalo Bicycle Classic is an annual bicycle race and fundraising effort to help students in severe financial need achieve their goals of a higher education in the college of arts and sciences. Since 2003, the BBC has raised over 3 million dollars in scholarship money for in-state students.

On September 10th, 2017, APPM instructor, Brian Zaharatos, participated in the ride alongside other members of the APPM department including Daniel Appelo, a new associate professor, and students Lewis Baker, Ksenia Lepikhina, and Jacob Mink. For Zaharatos, this was a great excuse to get to know other members within his department.

The Buffalo Bicycle Classic race allows participants to pick from over 7 different routes, each varying in length and difficulty. Together, the team chose to complete the 70-mile-long race, which classifies as a middle-tier course difficulty. With almost 3,000 feet in elevation gain, the course brings participants along the Carter Lake Climb.

"It was a great way to get back into cycling. Until this summer, I wasn't riding very regularly over the past few years. The BCC changed that," said Zaharatos. He hopes to keep training throughout the winter so he can

ride up Mount Evans next summer.

After the race, CU Boulder hosted a party with food, drink, and live music to celebrate.

"If you are affiliated with APPM in some way, want to join our 'cycling team', and ride the BBC next year, please contact me at brian.zaharatos@colorad.edu," said Zaharatos. "Also, we'd like to wish team member Jacob Mink good luck as he tours Japan this fall on two wheels."

Zaharatos also expressed gratitude to the APPM Faculty for allowing them to represent the department. For anyone looking to participate or volunteer in next year's race, more information can be found at https://buffalobicycleclassic.com.



Q&A with Erin Ellefsen, a Recent Addition to the APPM PhD Program

About Erin Ellefsen

Erin graduated from Luther College in Decorah, Iowa with a degree in Mathematics. She worked on research projects in disease spread in populations with varied levels of vaccination and quantum modular forms while at Luther. At CU, she hopes to do research in the math bio area. She likes to run and hike in her free time, and hopes to get a job in academia after graduation.

Q: Why did you choose to attend graduate school?

A: My interest in applied math and the career paths available after graduate school compelled me to attend. I also felt like there was much more to learn after undergraduate, as I just scratched the surface of many subjects I was interested in and the research process.

Q: Has your first week met your expectations?

A: The newest thing in the first week was being a TA. I didn't know what to expect when it came to leading a recitation section,

so I didn't have expectations to be met! While I tutored and graded in undergrad, I have never lead anything like a recitation or written quizzes, so the preparation and execution is very different. I've enjoyed it so far and am excited to keep teaching.

Q: What surprised you about grad school so far?

A: One thing that was an excellent surprise was the immediate community and support from the people in my cohort. Already I have done a lot of work for classes with them and we have a community that I think will be awesome as I go forward in graduate school.

Q: What kind of things are you nervous about?

A: I'm worried about time and stress management as I know there will be times when I have a lot to do and/or am very stressed. I was able to do just fine in undergrad, but I don't know if it'll be different in grad school with the harder material or different workload.

Q: Why did you choose to attend grad school at CU?

A: I had three visits to different graduate programs, and not only did I feel like I fit in the best here, I also felt like I'd get a lot of support throughout my time here as I work toward my degree.

Q: How does the workload so far differ from your undergraduate experience?

A: The workload is much more concentrated on math than my undergraduate experience, as every semester in undergrad I took classes outside of the math department. Now, my energy is concentrated entirely on math, with time invested in prepping for recitation and leading recitation sections.

APPM Welcomes New Postdoctoral Research Associate

By: Ashley Hopko

Farhad Pourkamali Anaraki is a new face in the Applied Mathematics Department. After receiving both his M.S. degree in Electrical Engineering and Ph.D. at CU Boulder, he has recently accepted an opportunity to return to the University as a Postdoctoral Research Associate. He is excited to join the department because of their wonderful reputation when it comes to research and a high standard of academic excellence.

He is excited about the current semester because teaching gives him the opportunity to pass on knowledge to the new generation of scholars and scientists. "I view teaching, educating, and advising the new generation of engineers and scientists as core responsibilities of my academic career. Also, I am passionate about my research on analyzing massive high-dimensional sets that are ubiquitous in all modern domain applications. I consistently give talks in conferences, workshops, and colloquiums about my research," said Farhad Pourkamali Anaraki.

This semester, he will be teaching Calculus 1 for Engineers. Anaraki considers the ability to think mathematically a very valuable skill and he hopes to pass onto his students. He attributes this skill to students who tend to stay engaged with the course material.

When it comes to his own academic passions he likes to focus more on the statistical analysis of data. "My research revolves around identifying fundamental tradeoffs between memory, computational, and statistical efficiency in analyzing modern data sets with the goal of developing practical data analysis methods. I use various tools from computer science, applied mathematics, and statistics to provide mathematical guarantees on the quality of learning algorithms with limited resources, i.e., memory and time. The rigorous characterization of these tradeoffs is then used to design efficient methods that learn the underlying structure of modern data sets in the form of subspaces, clusters, and manifolds with variety of applications in scientific disciplines," said Anaraki.

Daniel Appelö Joins APPM Department as an Associate Professor

By: Ashley Hopko

Daniel Appelö was recently hired as associate professor in the Applied Mathematics department at the University of Colorado Boulder. Originally from Sweden, he was drawn to Colorado because of its natural beauty and culture. He also admired CU for its prestigious numerical analysis program.

He is excited to be joining the faculty in their mission of higher education and he feels like it is a great fit for him. Appelö was originally supposed to take a sabbatical this year,

"My core interest is high order accurate numerical methods that can be used for applications in science and engineering. However, I always get excited about problems where I feel that I can contribute by designing better computational methods enabling new problems to be solved or new science to be discovered." -Appelö but felt like he would have been missing out on the amazing opportunities that his current position offered.

This semester, he is teaching an introductory course in numerical analysis. Since CU is also known for high order methods and its impact on "national laboratory problems", he hopes to be interacting with this subject more in the future. "My core interest is high order accurate numerical methods that can be used for applications in science and engineering. However, I always get excited about problems where I feel that I can contribute by designing better computational methods enabling new problems to be solved or new science to be discovered. What makes it so fun to go to work every day is that in academia we have, in the words of Feynman, the opportunity to

experience 'the pleasure of finding things out'," he said.

He hopes that his future students will understand, that although classwork and focus on their major is important, it is also important to be a well-rounded individual. Appelö encourages students to attend other events sponsored by the apartment, like guest lectures and research seminars that might not be directly related to their field.

"I was fortunate in that my mentors were skilled researchers and teachers as well as 'whole human beings' capable of giving advice on a wide range of topics. Most of the graduates from APPM will end up as leaders and mentors, be it in a scientific field or elsewhere, and I therefore think it is important to have a skillset that covers more than the technical aspects of being a PhD in Applied Mathematics," said Appelö.

CU Applied Math Students Awarded Prestigious National Science Foundation Fellowships

By: Alexus Longo

The National Science Foundation (NSF) Graduate Research Fellowship Program (GRFP) aims to recognize outstanding graduate students in STEM fields by awarding each honoree \$34,000 a year for the next three years. This year, the NSF received 12,000 applications and only offered 2,000 awards. Two CU Applied Math



students, Ian Char and Maximilian Ruth, were among the select 2,000 students awarded. Ian Char works in the Lladser Lab and researches the design and analysis of optimal algorithms to find keywords in text. He hopes to eventually develop probabilistic techniques to characterize the frequency at which keywords occur in different bodies of



text. Char believes these findings could inform new methods of studying patterns in DNA.

Maximilian Ruth works in the Dispersive Hydrodynamics Lab and was additionally awarded the University of Colorado at Boulder's Outstanding Graduate for Research Award for his research on nonlinear dynamics in magnetic materials. He recently published a paper in Physical Review B about the instability of magnetic bion stripes. Ruth will be attending a PhD program for Applied Mathematics at Cornell University this coming fall.

The NSF also awarded Honorable Mention recognition to 1,459 individuals, one of which was

another CU Applied Math student, Gregory Benton. During graduation, Ian Char and Gregory Benton were also recognized as Outstanding Graduates for Academic Achievement.

CU Team Awarded Outstanding Designation in International Mathematical Contest in Modeling

By: Alexus Longo

This year, a record number of 20,602 teams from across the world competed in the 34th annual International Mathematical Contest in Modeling (MCM/ICM). From February 8th through February 12th (4 days), each team of 3 students selected a problem (A-F) and proceeded to research, create mathematical and numerical models, and write a report about their solution. CU Boulder's Department of Applied Mathematics, with additional support from the Engineering Honors Program, sent 15 teams from a wide array of majors including almost every engineering major sub-field. Applied Math faculty members, Anne Dougherty, Bengt Fornberg, and Manuel Lladser, organized and advised the teams.

The team of Marc Thomson, Derek Gorthy, and Christine Reilly, advised by Anne Dougherty, was awarded an Outstanding designation, the Mathematical Association of America (MAA) award, and the Society for Industrial and Applied Mathematics (SIAM) award for their work on Problem A. According to the MCM press release, Problem A required teams to "determine the maximum amount of hops a transmission could make before the signal dropped below a maximum usable frequency (MUF) over a calm ocean, turbulent ocean, and rugged terrain." The object receiving the high frequency (HF) radio transmissions was a ship moving on the ocean. Like light waves, radio waves are affected by reflection, refraction, diffraction, absorption, scattering, and polarization. HF radio waves can refract from charged particles in the atmosphere back to earth

over large distances. So the integrity of the radio transmissions in Problem A depended on surface and atmospheric conditions. Only 33 of the 20,602 total teams were given an Outstanding designation, placing this CU team's work on Problem A in the top 0.16%.

CU teams also received 5 Meritorious (placing them in the top 9-10%), 3 Honorable Mentions (top 35%), and 6 Successful Participant designations. Over the 34 years of the International Mathematical Contest in Modeling, CU teams have received more Outstanding designations and named awards than any other university in the world.

The Outstanding team is pictured from left to right: Anne Dougherty, Marc Thomson, Christina Reilly, Derek Gorthy, Bengt Fornberg (not pictured: Manual Lladser).



ACADEMIC YEAR 2017-2018

S T U D E N T A W A R D S

OUTSTANDING GRADUATES =

FOR RESEARCH

FOR ACADEMIC ACHIEVEMENT

Maximilian Ruth

Gregory Benton Ian Char Ansel Rothstein-Dowden Evan Sidrow

NATIONAL SCIENCE FOUNDATION — FELLOWSHIP HONORABLE MENTION

Maximilian Ruth Ian Char

Gregory Benton

MATHEMATICAL CONTEST IN MODELING

OUTSTANDING

Marc Thomson Derek Gorthy Christine Reilly

MAA & SIAM AWARDS

Marc Thomson Derek Gorthy Christine Reilly

MERITORIOUS

Tyler Schuessler Nelson Mitchell Ryan Ibarra Kylee Budai Anthony Tracy Scott Marin Vladimir Zhdanov Andrew Jeseritz Brendan Palmer Aparajithan Venkateswaran Johann Kailey-Steiner David Bloom Lucas Laird Willam Shand

HONORABLE MENTION

Kyle Kolanowski Sydney Levy Emma Simmerman Emily Zuetell Hannah Livingston

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