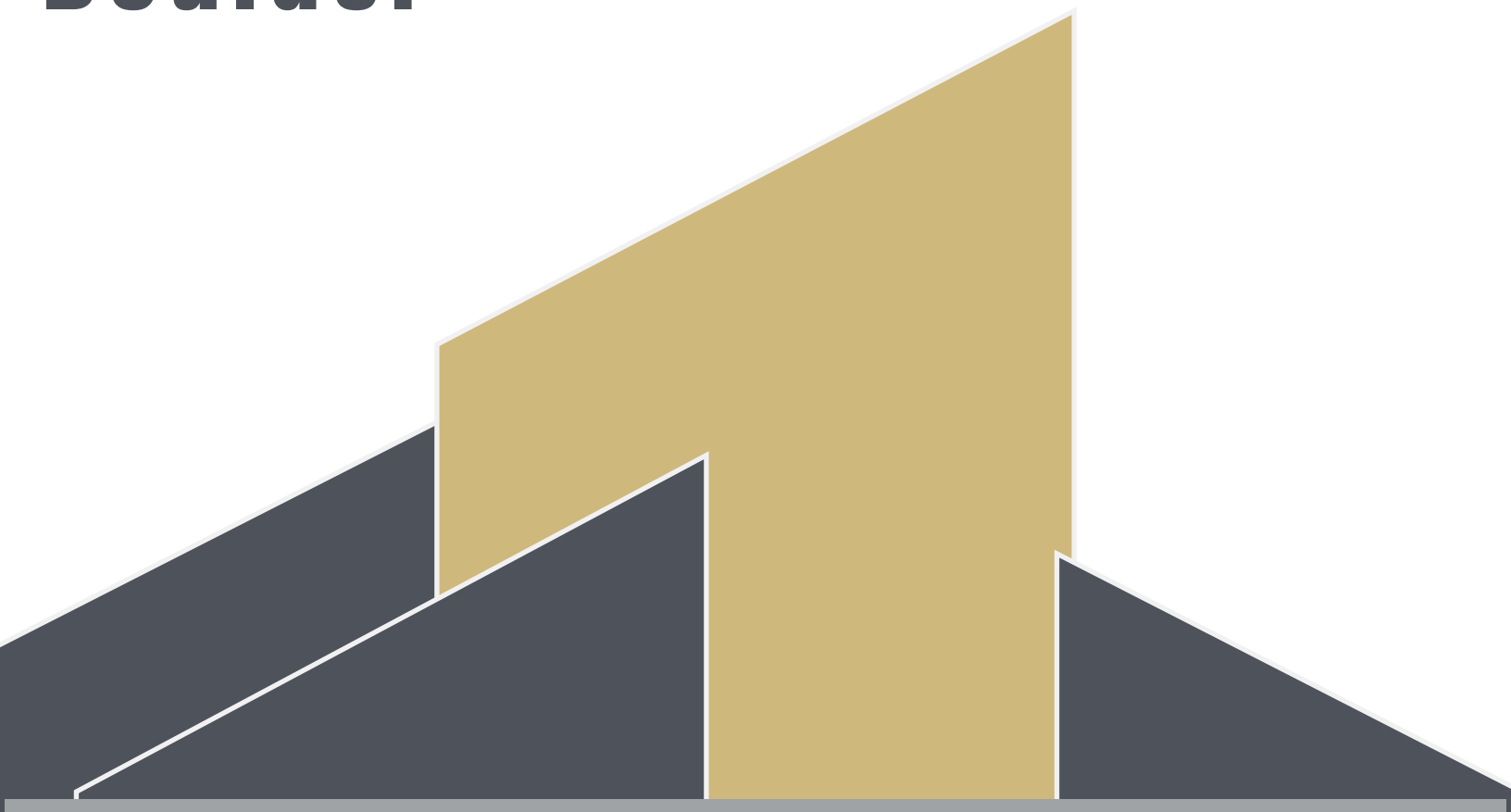
Applied Mathematics Newsletter

University of Colorado at Boulder



Summer 2023

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Letter from the Department Chair

From Keith Julien and spring interim chair François Meyer

Dear APPM community,

Academic year 2022-2023 offered us a new glimpse of contunuing new departmental norms and experiences. We all are learning how to best manage the impacts of COVID-19, it is clear that our resilience lights the way to a resourceful future.

We ended the year in May 2023 by holding an in-person graduation ceremony in the Mary Rippon outdoor Amphitheater, our second since 2020. It was a joyful, but rainy, spring day. For me, it was an absolute pleasure to meet with proud parents and relatives celebrating the accomplishments of their graduating students. The graduating class displayed a customary depth and breadth in their educational portfolios and without a doubt highlighted how they are successfully transitioning into new phases of their professional careers.

Students: APPM's student body is vibrant with continued growth. This year APPM welcomed seven (7) new Doctor's of Philosophy to its alumni. Their dissertations and expertise spanned all the pillars of the applied, computational, data and statistical sciences. APPM also graduated sixteen (16) Professional Master's of Science graduates. This is a relatively new program offering students the broad opportunities for career re-direction and enhancements. Our graduates enjoy a 97% employment success rate within six months of graduation. With the inclusion of a new degree program in the College of Arts and Sciences, APPM's undergraduate has grown. This year fifty-three (53) students earned a Bachelor of Science degree in Applied Mathematics and twenty-one (21) a Bachelor of Arts degree in Statistics and Data Science.

I part by expressing my gratitude to our wider community who continue to support the department. Most significantly, the Applied Mathematics Department announced last year the John T. and Jill D. Bellows Endowed Applied Mathematics Scholarship. Through the generosity of CU alumni Dr. John Bellows and his wife Jill Bellows (deceased), APPM will support upper-division undergraduate students in Applied Mathematics who require financial assistance. Dr. John T. Bellows explained that "in this day and age, many students attend college by taking loans when they can't obtain scholarships. I hope that this scholarship will allow these specific students to finish at a time when the academic demands of college may require more time and concentration."

- Professor Keith Julien, APPM Department Chair

- Professor François Meyer, spring Interim APPM Department Chair

Department Faculty

Department Chair: Keith Julien (fall), François Meyer (spring)

Associate Department Chair: Anne Dougherty

Graduate Committee Chair: William Kleiber (fall), James Meiss (spring)

PROFESSORS:

Mark Ablowitz (Distinguished Professor)
Gregory Beylkin
David Bortz
James Curry
Vanja Dukic
Mark Hoefer
Keith Julien
James Meiss
François Meyer

ASSOCIATE PROFESSORS:

Stephen Becker
Adrianna Gillman
Ian Grooms
Zachary Kilpatrick
William Kleiber
Manuel Lladser
Juan Restrepo
Nancy Rodriguez
Eric Vance

ASSISTANT PROFESSORS:

Eduardo Corona
Yu-Jui Huang
Maziar Raissi

ADJUNCT PROFESSORS:

Natasha Flyer
Lev Ostrovsky

PROFESSOR EMERITUS:

Jerrold Bebernes
Jem Corcoran
Bob Easton
Bengt Fornberg
Congming Li
Tom Manteuffel
Steve McCormick
Harvey Segur

TEACHING PROFESSOR:

Silva Chang
Anne Dougherty
Adam Norris
Brian Zaharatos

ASSOCIATE TEACHING PROFESSOR:

Sujeet Bhat
Kris Pruitt
Eric Thaler
Ami Gates

ASSISTANT TEACHING PROFESSOR:

Robert Benim
Jonathan Kish
Judith Law
Daniel (Seneca) Lindsay

RESEARCH ASSOCIATES:

Niraj Agarwal
Tahra Eissa
Maria Camisassa
Nick Featherstone
Jose Rafael Fuentes Baeza
Brad Hindman
Lydia Korre
Nora Loose
Daniel Messenger
Lucas Monzon
Sean Nixon
Manjul Sharma
Tim Wessler
Houssam Yassin

Affiliated Faculty

Alireza Doostan - Aerospace Engineering
John Evans - Aerospace Engineering
Tomoko Matsuo - Aerospace Engineering
Daniel Scheeres - Aerospace Engineering

Juri Toomre - Astrophysical & Planetary Sciences

Julie Lundquist - Atmospheric and Oceanic Sciences
Jeffrey B Weiss - Atmospheric and Oceanic Sciences

Nicholas Dwork - Biomedical Informatics

John Crimaldi - Civil Engineering
Fatemah Pourahmadian - Civil Engineering

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

Carlos Martins-Filho - Economics

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

Bri-Mathias Hodge - Electrical, Computer and Energy Engineering

Dave Frits - GATS Inc

Ana Maria Rey - JILA

Stephan Sain - Jupiter Intelligence

Scot Elkington - Lab for Atmospheric and Space Physics

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

Sean O'Rourke - Mathematics

Peter Hamlington - Mechanical Engineering
Franck Vernerey - Mechanical Engineering
Patrick Weidman - Mechanical Engineering

Aimé Fournier - Massachusetts Institute of Technology

Annick Pouquet - National Center for Atmospheric Research

Meredith Betterton - Physics
Michael Calkins - Physics
John Cary - Physics
Mihály Horányi – Physics
Scott Parker - Physics

Thomas Hauser - Research Computing

Department Staff

Ian Cunningham - Office Coordinator, Undergraduate Program Assistant

Mary Fentress - Program Manager

Laura Gooch - Masters Student Coordinator

Gabriella Kirkley - Graduate Student Coordinator

Desiree Holtz - Accounting Technitian

Josh Jeng - IT Assistant

Maedee Trank-Green - Student Assistant

Patrick McCreery - Department Writer, Newsletter Editor

Doctor of Philosophy Graduates

Nicholas Barendregt

Advisor: Dr. Zachary Kilpatrick

Thesis Title: *Adaptive Decision-Making in Dynamic Environments Using Sequential Bayesian Inference*

Abe Ellison

Advisor: Dr. Keith Julien

Thesis Title: *Gyroscopic Polynomials*

Shay Gilpin

Advisor: Dr. Tomoko Matsuo

Thesis Title: *Adaptive Decision-Making in Dynamic Environments Using Sequential Bayesian Inference*

Amanda Hampton

Advisor: Dr. James Meiss

Thesis Title: *On the Three-Dimensional Quadratic Diffeomorphism: Anti-integrability, Attractors, and Chaos*

Graham Kesler O'Connor

Advisor: Dr. Manuel Lladser

Thesis Title: *Source Localization on Infection Networks*

Ruyu Tan

Advisor: Dr. Vanja Dukic

Thesis Title: *Methods for Change Points Detection and Model Selection in State-Space Models*

Kiera van der Sande

Advisor: Dr. Natasha Flyer

Thesis Title: *Contributions to Computational Techniques and Machine Learning for Applied Science*

Master's Degree Graduates

Master of Science

Leo Crowder

Byanka Estudillo

Ahyo Falick

Seunghyun Kim

Dennis Krimer

Serena Lipari-DiLeonardo

Allison Liu

Benjamin Marquardt

John Montagunick

Aviral Prakash

Kyle James Weishaar

Professional Master of Science

Meghan Buscher

Brian Cain

Rebecca Cohen

Megan Collins

Anders Harris

Michael Huffman

Ziyu Li

Brian Morales

Kevin Nguyen

Nathan Omdalen

Joshua Park

Zachary Sajevic

Sandra Tredinnick

Austin Wagenknecht

Jonathan Yang

Jongbae Yoon

Graduating Class of 2023

Bachelor of Science in Applied Mathematics

Rua'a al-Harthy ◊
Logan D. Barnhart †
Samuel C. Blackwood ◊
James Edward Carley
Claudia Chen ‡
Olivia A. Dapper •
Ellie K. Divita ‡
Charles Doremieux
Sydney E. Evans ‡
Ian Christian Falkinburg
Mason Bradley Friedberg
Trey M. Gerlach ‡
Christopher Gonzalez-Millan
Ryan James Hamilton ◊ •
Thomas Daniel Hawley
Anne Marie Hendricks
Anna Hirschmann ◊
Joel K Hoverstein
Tyler James Jensen
Julia Meilan Jess •
Kayla Nicole Johnson †
Bryce Werner Kaese †
Etash Kalra ◊ •
Arthur J. Kilgore
Samuel Y. Kwon
Nicholas James Larson
Junwoo Lee ‡
Derek Edward Leroux
Christopher Nylund
Zachary Brance Peterson
Alana Press • ‡
John Timothy Quinn ◊
Brian Denton Reagan ‡
Dane Steven Rieber ‡
Benjamin Paul Sakiewicz
Benjamin Charles Sapper ◊
Aaron Schwan •
Hugh Ephraim Scribner ‡
Robert Henry Sewell •
Jonathan David Shaw ‡
Trevor Smith
Alden Wilder Soto ◊
Soren S Sovndal
Pranav Subramanian ◊
Sean Paul Svihla †
Gabreece Van Anne ◊
Alessandro Villain •
Ryan Merrick Vogel †
Hampton Watson Walker
Amanda Victoria Wider ◊
Alexey Sergeyevich Yermakov ◊ •
Jinhua Zhang

Bachelor of Arts in Statistics and Data Science

Ryan Bergner
Jonathan Boucher
George Brown
Eric Flaska
Michael Ghattas
Meghan Hergert
Xiang Kan
Peter Kinder
Estelle Lindrooth
Christopher Lynch
Carissa Mayo
Frida Muedsam
Mitchell Nelson
Elizabeth Rodriguez
Connor Schwarz
Luke Secunda
Trevor Smith
Kelsie Torczynski
Keenan Warble
Taryn Welch
Elena Werner

† Cum Laude
‡ Magna Cum Laude
◊ Summa Cum Laude
• Engineering Honors

A Year in Review:

News and Events

2022 Rudy Horne Memorial Fellowship Recipient: David Armendariz

In September, the Department of Applied Mathematics announced that David Armendariz would be the recipient of the 2022 Rudy Horne Memorial Fellowship.

David is a first year Ph.D. student in the Applied Mathematics graduate program who previously graduated with a Bachelor of Science degree in Mathematics with a concentration in Applied Mathematics. Now joining the Applied Math Department here at CU Boulder, David explained his goals in his studies: "I hope to become a better learner, researcher, and educator. I am passionate about math and am very excited to be starting this next stage in my career. I'm curious about a wide range of topics and am grateful that I have the privilege to pursue those curiosities. Beyond that, I think that math can be a powerful tool and in the future I hope to use it to contribute something positive to the world!"

The Rudy Horne Memorial Fellowship, as stated by the Applied Math Department, was founded with the goal that fellowship recipients "would, through their presence in the department, contribute to the diversity of the department of Applied Mathematics and of the campus, and more generally, of the community of mathematicians." David commented on the honor to be awarded this fellowship:

"I'm humbled to be receiving this fellowship in the name of a mathematician like Rudy Horne. It serves as a reminder to stay motivated, to work hard, and to work to make math accessible for all."

The Rudy Horne Fellowship is founded upon giving an opportunity to students who are passionate about building an inclusive community within APPM and encouraging diversity in the applied mathematics field – one that only thrives with contributions from a wide range of people who come from all walks of life. David embraces this sentiment, explaining:

"There are many obstacles that others may face in the path to grad school that I can't claim to relate to, most probably much harder than those that I had to overcome. My advice to those in an earlier academic stage than me is that if you're interested in it, then that's reason enough to pursue it. There are people who want you to see you succeed and join their community working towards an overarching goal."

"I was fortunate enough to discover my passion for math from an early age and also to have enough positive experiences with math that facilitated that passion. Even still, I wasn't aware that being a mathematician was an attainable career choice and knew even less about what the path to a career in math would look like. There are many reasons that you or others around you could find as to why pursuing something that you care about is not an ideal choice."

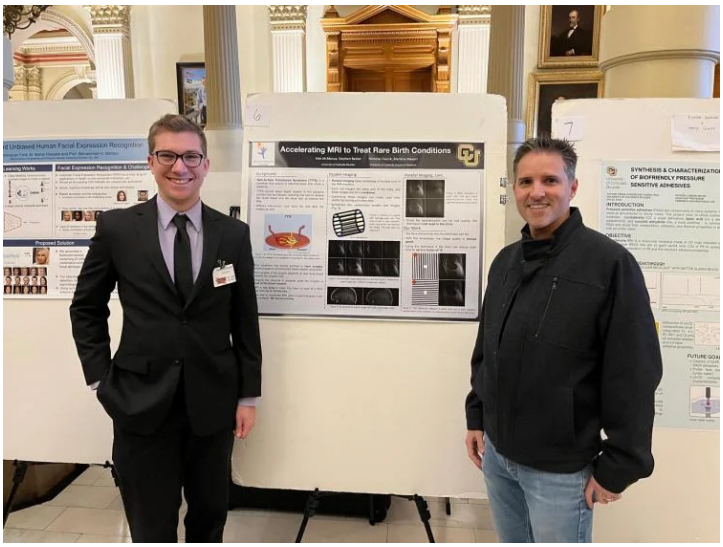
David Bortz and Stephen Becker collaborating on $15 million clean energy project

The Department of Energy (DOE) recently provided $15 million to a project pushing the development of nuclear energy as a reliable form of clean energy. To achieve this goal of sustainable nuclear energy, the required physics and computation of nuclear fusion needs to be better understood, which has created an opportunity for interdisciplinary collaboration. The Center for Hierarchical and Robust Modeling of Non-Equilibrium Transport (CHaRMNET), led by Michigan State University and Los Alamos National Laboratory, is a collaborative effort with 9 institutions, including the University of Colorado at Boulder. Specifically, Applied Mathematics' Professor David Bortz and Associate Professor Stephen Becker are included in this effort. The provided $15 million will go to create a Mathematical Multifaceted Integrated Capability Center (MMICC), which enables this interdisciplinary collaboration of researchers.

In the article written by Colorado Arts and Sciences Magazine, Dr. Bortz explained that modern computing is not capable of running full plasma simulations, meaning work is necessary to allow for plasma physicists to run simulations that investigate and optimize fusion-reactor designs. To this team, Dr. Bortz (left on image) and Dr. Becker (right on image) provides different, unique expertise. Dr. Bortz explains on his APPM webpage that his group focuses "on the methodology of data-driven modeling and model selection," while Dr. Becker's group focuses on "information extraction from various types of datasets" and sampling theory. Combined with the expertise of researchers from eight other institutions, the collaboration aims to improve our understanding of fusion reactions and the path towards sustainable nuclear energy.

The piece was written by Colorado Arts and Sciences Magazine has more information about the grant/collaboration and comments by Dr. Bortz, Dr. Becker, and the collaborators.

APPM in the News: Alex McManus



Recently, Project Bridge Colorado, AMC's Postdoctoral Association and the AMC chapter of SACNAS hosted STEM Day at the Colorado State Capitol. The stated goals of the events were to "(1) give early stage investigators practice in explaining their research to lay audiences, (2) allow local Coloradans to learn about the important research being done in their communities and (3) start a dialogue between scientists and their legislators to help enable science-based policies."

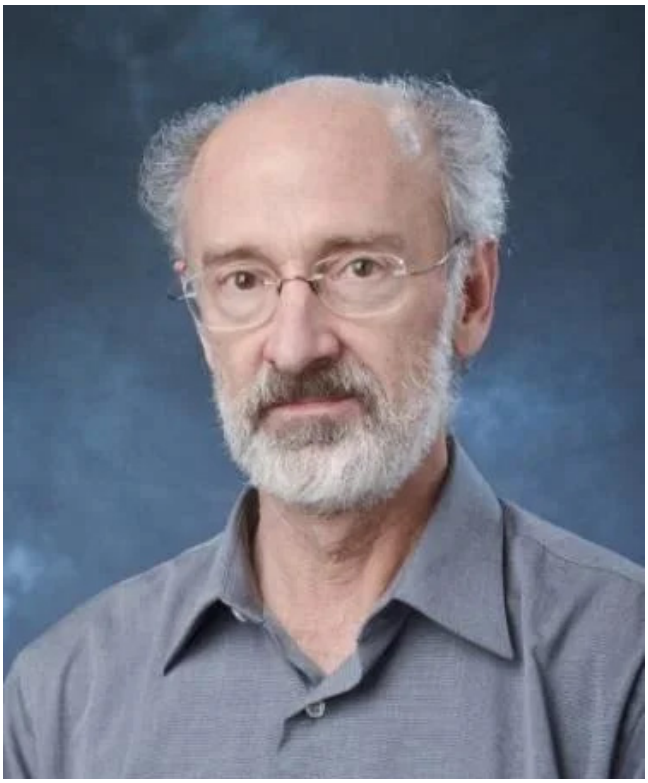
APPM graduate student Alex McManus was selected to participate in a poster session presenting his research – increasing the ability of MRI for 3D imaging during pregnancy to treat rare birth conditions. During this poster talk, Alex was able to speak to Colorado legislators and the general public regarding his important research that can help save lives.

2023 Erdős–Rényi Prize Recipient: Daniel Larremore

Last week, Applied Mathematics doctoral alumnus and Associate Professor in the Department of Computer Science Daniel Larremore received the 2023 Erdős–Rényi Prize of the Network Science Society. Each year at the International Conference on Network Science, an early-career researcher is given the prize to highlight extraordinary work in network science, specifically towards interdisciplinary progress of the field.

Specifically, Dr. Larremore received this prize "For socially impactful contributions to network models of human-disease dynamics, with applications to malaria and the COVID-19 pandemic, and for foundational research in the theoretical and practical use of algorithms for community detection." Part of the prize includes giving a lecture at the NetSci International School and Conference on Network Science.

Professor James Meiss Named 2023 SIAM Fellow



The Society for Industrial and Applied Mathematics (SIAM) recently announced their Class of 2023 fellows, which included Applied Mathematics's Professor James Meiss "For contributions to the understanding of the onset of chaos and transport in Hamiltonian and volume-preserving dynamical systems."

Meiss received his Ph.D in Physics from the University of California Berkeley, then become a plasma physics research scientist at the Institute for Fusion Studies. In 1989, the newly-constituted CU Boulder Applied Mathematics program hired Dr. Meiss to become a professor. During this transition, he would attend the SIAM Snowbird Dynamical Systems conference in 1992. Speaking about this experience, Professor Meiss explained:

"I was amazed at how welcoming this group was to a broad spectrum of interests, including mine—of course. I ended up co-organizing the next Snowbird meeting, becoming involved in the formation of the new Dynamical Systems Activity group (through what is now DSWeb), and was one of the founding editors for the new SIAM Journal of Dynamical Systems in 2002. I still view SIAM as my home scientific community, and am extremely pleased that I was selected to be a fellow."

Professor Meiss's work in chaos and transport has had a large impact on the field of dynamical systems, with the MacKay-Meiss-Percival (MMP) papers reaching close to 750 citations and Meiss and Ott publishing a paper with 368 citations. The MMP papers lead to a founding theory regarding transport in systems that are neither completely integrable or uniformly hyperbolic. The Meiss and Ott paper provided theory regarding observations of "stickiness" among islands in area-preserving maps. In 2020, Meiss provided a review of his field for the journal Chaos, which was celebrating their 25th anniversary. Meiss's work in Hamiltonian and Incompressible dynamics, as well as generalizations of Lagrangian coherent structures to non-autonomous systems have been impactful to the field of dynamical systems, has placed him as a leader in the field, and deserving of recognition via this momentous accomplishment of being named as a SIAM fellow.

The Department of Applied Mathematics congratulates Professor Meiss on this career achievement following decades of hard work and dedication to the field of dynamical systems!

APPM Research Associate Daniel Messenger selected for Heidelberg Laureate Forum

Recently, Applied Mathematics Research Associate Daniel Messenger was selected to attend the 10th Heidelberg Laureate Forum (HLF), a yearly networking conference for esteemed scientists and upcoming young researchers in mathematics and computer science.

The HLF occurs during the final full week in September, and Dan will be attending the conference this year as one of only 200 young researchers selected by the Heidelberg Laureate Forum Foundation (HLFF). During this conference, Dan, and other attendees, will interface with Abel Prize, ACM A.M. Turing Award, ACM Prize in Computing, Fields Medal, IMU Abacus Medal and the Nevanlinna Prize recipients in an effort to connect some of the most productive researchers in their respective fields.

The HLFF emphasizes the importance of conferences fostering an atmosphere that connect young and established researchers:

“Mathematics and computer science have evolved into a matter of utmost importance in our modern society. We are confronted with the product of mathematical and computational research in all situations and aspects of our daily lives. To ensure that this technical revolution continues to thrive, science in all of its facets has to be persistently promoted and encouraged. The Heidelberg Laureate Forum rises to this challenge by bringing together the most exceptional mathematicians and computer scientists of their generations.”

Especially important to the organizers is to differentiate the HLF from other conferences by organizing the forum to produce tangible results. The HLF notes that their goal is to coordinate “a space for ideas to take shape and evolve” by inviting laureates to give lectures that will promote intensive discussion with the young researchers.

Applied Mathematics Joins Math Alliance's Graduate Program Group

Beginning this academic year, the Applied Mathematics Graduate Program will join the Math Alliance Graduate Program Group (GPG). The Math Alliance was created in 2001 as a collaboration between the Iowa State Regents universities and a few Historically Black Colleges and Universities (HBCUs). Today, the GPG has over 40 programs across the nation with members steadily growing year-to-year.

MATH ALLIANCE

Building a New American Community in the Mathematical and Statistical Sciences

The Math Alliance's website elaborates on the goals and motivations to form the alliance:

"The Alliance was organized as a community of mentors and students … Each student had an undergraduate mentor at his or her home institution as well as a graduate mentor at one of the Iowa schools … During its early years, the Alliance concentrated on the transition point from undergraduate school to masters and doctoral programs.

As the number of students who were ready for the transition to graduate programs grew, the Alliance began to work with math sciences graduate faculty nationally to build Alliance Graduate Program Groups: groups of faculty at math sciences graduate programs that have committed themselves to the best practices and community building which has been the hallmark of the Alliance."

APPM's application, spearheaded by Associate Professors Nancy Rodriguez and Manuel Lladser, was motivated by goals to increase diversity at within our department, as well as to build a more inclusive community. According to Rodriguez and Lladser, the department has increased the representation of minority groups at the level of faculty; however, it has not been successful at the graduate level. Efforts to increase our diversity in the graduate program are sorely needed. Being a Math Alliance GPG group is one of the efforts we earmarked to help with our recruitment efforts.

Attracting diverse, qualified candidates into the graduate program has been challenging over the years. Various graduate committees have attempted to tackle the problem of a monochrome student body from different angles, but complex financial, cultural, and systemic hurdles continue to thwart plans to bring in and maintain a diverse community. Applied Math's Graduate Student Coordinator explained the impetus behind APPM's push to become a GPG member: "Joining the Math Alliance is, in essence, calling in professional help to look at our current DEI strategies to assess and optimize their efficacy. We've laid bare our program stats for review, in order to be coached and mentored by experts on how to provide and promote a safe, inclusive working environment for all students."

APPM's strategic plan aims to address academic challenges, personal challenges, and social challenges. The application organizers outlined the details of how they will address each challenge:

"To address social challenges, we will hold a social activity between Math Alliance students (and any other student from a marginalized community) and Math Alliance mentors. The aim is to help build a community through social interactions. These events will provide an opportunity for Math Alliance students to develop a sense of cohort and to socialize with mentors in a low-key setting. We also plan to bring at least one underrepresented minority (URM) speaker for the Applied Mathematics Colloquium each semester, with whom students can meet and socialize before and after their talk.

We plan to help address academic challenges by giving students special office hours. Our Math Alliance faculty mentors will hold office hours every week. During these office hours, students will be able to get help with Analysis, Probability and Statistics, and Numerical Analysis, which are the core classes for our graduate program."

Joining the Math Alliance is a crucial step towards diversity in applied mathematics, and can further bolster the program's leading research in the field. Students wishing to read more about the Math Alliance can visit their website to find more information, including the history, currently accepted university programs, and goals of the alliance.

"Our plan is to help address Math Alliance students' personal challenges in graduate school through mentoring. Math Alliance graduate students will be paired with a faculty mentor selected from our Math Alliance mentors (in addition to their general Faculty mentor to whom all first-year students are assigned). Faculty mentors will meet with students, where mentors will assess how students are doing beyond their coursework and program requirements and give students a safe space to share concerns or issues with faculty invested in their success."

- APPM GPG Application Organizers

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We appreciate your contribution and note that donations are tax deductible.

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https://www.colorado.edu/amath/donate

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