THE UNIVERSITY OF ARIZONA
COLLEGE OF SCIENCE
Mathematics

MATHEMATICS

IN THIS ISSUE

Fall 2021
Volume XXI, Single Issue

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View from the Chair

By Doug Ulmer

I'm writing in late September, after a very wet monsoon season. The clouds are parting, the days are clear, and the heat is starting to ease up. In short, it feels like fall.

Fortunately, **many of the metaphorical clouds overhead last year are also starting to part: we have mostly returned to in-person instruction, the students are delighted to be back,** and our Covid-prevention measures seem to be working. Although things are not exactly as they were two years ago (and probably never will be), we are happy to have more face-to-face interaction in classes, seminars, (even committee meetings!), and it all feels like something of a return to normalcy.

Despite the difficult environment, we were fortunate to recruit one new Associate Professor, **C. Douglas Haessig** from the University of Rochester; eight new post-docs, five instructors, and two new staff members. Congratulations to **Antonio Rubio**, who was promoted to Lecturer, **Adi Adiredja**, who was promoted to Associate Professor and granted tenure, and **Bob Sims**, who was promoted to full Professor. We had four retirements (professors Bayly, Cushing, Laetsch, and Zakharov), who collectively have served 165 years in the department!

Faculty accomplishments continue to be recognized at the highest level: Assistant Professor **Brandon Levin** was awarded a **Sloan Research Fellowship**, one of the most prestigious early career research awards in Mathematics. Professor **Jan Wehr** was awarded a **Simons Fellowship**, Professor **Jim Cushing** was awarded the **Aulback prize**, and Professor **Marta Civil** received the **Lifetime achievement Award from the NCTM**, the largest professional organization for teachers of mathematics. See Pages 6-7 for a research article by Professor **Laura Miller** who joined us just last year.

At the programmatic level, CRR, the **Center for Recruitment and Retention of Mathematics Teachers**, signed a major new agreement with the Arizona Department of Education to expand their services throughout the state; and **mathematics was one of nine research focus areas in a new agreement with the CNRS** (Centre National de la Recherche Scientifique), the French National Science Foundation, to make Arizona a strategic partner. Our staff continues to explore how best to support learning and invest in teaching through technology, as **Cheryl Ekstrom's** perspective on page 11 shows.

As always, **we are grateful for the financial and moral support of our many donors and friends**. See pages 4 and 10 for industry perspective articles by math alumnus **Jeff Taft** and External Advocacy Board member **Teri Suzuki**. We're also happy to have the opportunity to communicate the excitement and impact of mathematical research to the broader community. Two of our students, undergraduate **Madison Delmoe** and new Ph.D. graduate **Anthony Kling**, talked about their work on KXCI's *Thesis Thursday* (see page 5). And two of our faculty were featured as **Notable Women in Mathematics** in the Association for Women in Mathematics' (AWM) EvenQuads Playing Cards, designed in celebration of the organization's 50th anniversary (page 9).

I remain optimistic that with your support **our department will continue to fulfill its missions with excellence, commitment, and creativity**. Meanwhile, please enjoy the profiles in the rest of this newsletter, and keep in touch. We wish you all the best for health, prosperity, and safety. ▲

Doug Ulmer *is a mathematician whose research emphasizes fundamental, curiosity-driven problems in number theory and algebraic geometry. He also enjoys building academic programs and research institutions with lasting impact.*

Contact him at: **ulmer@math.arizona.edu**

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Mathematics

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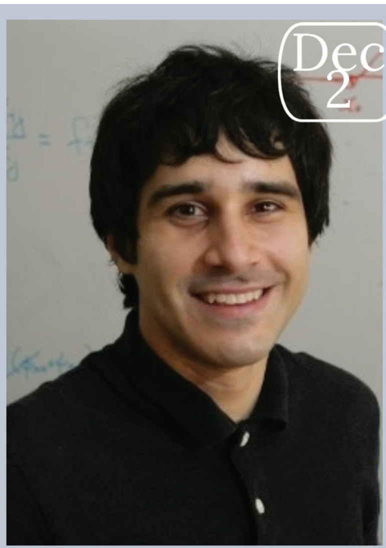


JOSEPH TERAN,
UCLA

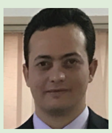
BIOGRAPHIES

Tenured Faculty

C. Douglas Haessig is a number theorist, working in an area that intersects arithmetic, geometry, and differential equations. He received his Bachelor's in Mathematics at the College of Creative Studies at UC Santa Barbara, and his Ph.D. from UC Irvine. From 2006 to 2021 he was a YellowJacket in the math department at the University of Rochester, NY. This past August he became a Wildcat and is looking forward to visiting the snow on the Catalinas (and not having to shovel it!) Doug's current research explores the p-adic cohomology of families of exponential sums. Outside of mathematics, Doug enjoys finding creative ways to spend time with his family.

Instructional Faculty

Julie Baum received her Bachelor's degree in mathematics and philosophy from Butler University, in Indianapolis. She taught high school for 8 years in a couple of schools where she was the sole math teacher. She attended Northern Arizona University for her Master's in pure mathematics, where she was later an instructor. She has two children who both attend UArizona. Her hobbies include playing the piano, reading historical fiction, and walking her chihuahua. She hopes to one day pursue a Ph.D. degree.



Oussama Ben Said received his Master's degree in Mathematics from the University of Akron Ohio in 2015. In 2021 he received his Ph.D. in applied mathematics from Oklahoma State University. Oussama's research interests lie in the field of applied mathematics and nonlinear partial differential equations, with applications to fluid dynamics. His doctoral work focused on the study of two types of fluid dynamic equations: the Micropolar Equations and the Boussinesq Equations. More specifically, he studied the d-dimensional ($d = 2$ or $d = 3$) incompressible Micropolar Equations with fractional dissipation and the stability and large time decay for the 2D Boussinesq Equations with partial dissipation.

Terry "TJ" Caldwell received his Master's degree in mathematics education from Northern Arizona University and taught there before coming to Tucson. He earned his Bachelor's degree from Western Colorado University in Gunnison Colorado. TJ lived in Colorado for 17 years where he loved to ski, camp, hike, and fish. TJ is passionate about teaching mathematics, learning effective ways to improve mathematics learning, and providing his students with a positive experience in his math classes.

Charlie Robson was born and raised in Anchorage, Alaska, where he received his Bachelor's in mathematics from the University of Alaska, Anchorage. He continued

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BIOGRAPHIES

Teach, Don't Just Prove: Your Value-Added to Math in Industry

By Jeff Taft

One thing you may take for granted if you work in mathematics is that if you prove something, then that settles it; that thing is no longer up for debate. I certainly saw the world that way until one morning my first year working for a defense contractor, when another engineer and I were debating the merits of two different algorithms. I went to the whiteboard and wrote a series of equations and "proved" that one algorithm was better. The other engineer thought for a second, then declared "I don't buy it." **My proof didn't persuade.** It wasn't exactly that this engineer didn't understand the proof or that it was wrong, it was just that mathematical proof is not a valuable currency in industry. **I should have relied less on what I learned in my math classes and more on what I learned from teaching them.**

I sometimes tell people, only half-jokingly, that the most important thing I learned in graduate school was how to teach the fundamental theorem of calculus to frustrated sophomores. To drive this point home, imagine that you're standing in front of a committee, presenting your idea for an R&D project. In the room are engineers from any number of disciplines, program managers, business development managers, and various other big-shots. Your task is to persuade them that your idea is worth funding. I say persuade but I find that in tech there is often a thin line between persuasion and good exposition. **Most likely the idea that seems best to that committee will be the one that they best understand.** And they won't understand your equations, or your formulas, and certainly not your proofs. Can you articulate why your approach has business value and, at least in broad strokes, how it works, without any math-speak?

A successful career in industry isn't as well-correlated with doing good work as it is with people knowing that you have done good work. Your work will not always stand on its own. Its validity will not always be self-evident. Sometimes people don't even have the time to give it a second look. **Your work only comes alive when you clearly present it to somebody and they understand it.** You need to be a good teacher.

A mathematician working in industry brings a lot to the table. I see my fellow mathematicians' rigorous problem-solving sensibilities often leading to innovative solutions for difficult industry problems. If you are a mathematician and you go to work for a tech company, you will probably be good at your job. But **being great at your job involves rallying people behind you and building coalitions.** Doing that successfully involves several soft skills that aren't always emphasized in academia but can be honed with practice. Most important among these soft skills is the ability to clearly explain complex ideas to a non-mathematical or even a non-technical audience. If you are pursuing a math degree at any level and might go into industry one day, I hope you take any opportunity you can find to teach or tutor math. It is probably better career training than most of the math classes you will take. ▲

***Jeff Taft** earned a doctorate in mathematics in 2010 from UArizona, and has worked in industry ever since. Following positions in biotech and aerospace companies, he is now an applied scientist at Microsoft.*

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ALUMNI PERSPECTIVE

Minute Math Stories, on Tucson's Thesis Thursday

In Spring 2021 KXCI's *Thesis Thursday* program featured 4-minute podcasts with two recent UArizona mathematics graduates— senior **Madison Delmoe**, now a Ph.D. student at the University of Utah, and doctoral student **Anthony Kling**, who successfully defended his Ph.D. dissertation this past August 2021 (see page 12).

Invited by **Kevin Harcourt**—Professional Development Director for Sahuarita Unified School District, KXCI volunteer, and member of the Mathematical Sciences External Advocacy Board— Madison and Anthony told their **abridged math stories** to Bridgitte Thum, host and producer of *Thesis Thursday*.

Each mini-podcast includes authentic **reflections about aspects of two Tucson-based mathematical journeys**, touching on research, outreach, and teaching. Scan to listen to Madison and Anthony, and browse *Thesis Thursday's* site to learn about the science pursuits of other UArizona students. ▲

KXCI 91.3

"Very recently I have gravitated to more pure or theoretical mathematics. [Rather than looking at applications] the interest for us is just looking at beautiful problems and seeing logical arguments in them."

– Madison Delmoe,
KXCI Community Radio,
Feb 22, 2021

"The fact that many of [the problems in my field] are challenging and have yet to be solved [...] the fact that they are difficult, makes cryptosystems more secure."

– Anthony Kling,
KXCI Community Radio,
Feb 22, 2021

KXCI 91.3

BIOGRAPHIES

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his mathematical studies at Oregon State University, where he defended his Ph.D. thesis in Algorithmic Information Theory. Following his graduation, Charlie served as the primary lecturer in discrete mathematics at Oregon State. Charlie's current interests include physical applications in math education, relationships between cognitive distortions and student performance, foundations in machine learning, and Markov decision processes. Charlie also enjoys 3D printing, swimming, and cats.

Postdoctoral Research Associates

Michael Conroy comes to Arizona after completing his Ph.D. in statistics at the University of North Carolina, Chapel Hill. He works in probability theory, specifically in the areas of interacting particle systems, large deviations, and stochastic simulation. Michael loves to teach, and outside the classroom he enjoys hiking and camping, especially with his wife and two dogs.

Alison Mirin received her Ph.D. in math education in 2021 from Arizona State University; she holds Master's degree in mathematics and a Bachelor's degrees in mathematics and philosophy from Mills College. Alison became interested in mathematics education research while teaching high school math. Her research includes studying how people understand mathematical sameness, and, more generally, how people understand mathematical concepts. She also works on equity issues regarding disability in higher education. When she's not working, Alison enjoys spending time outside, interacting with animals, and playing musical instruments.

John Peca-Medlin, the Richard Pierce Postdoctoral Fellow, completed a Bachelor's in Mathematics from the University of Chicago in 2006. He began working as a research analyst at the Social and Economic Sciences Research Center (Washington State University), and then as a data analyst in the Office of Research at the University of Washington. He later completed a Master's and Ph.D. in mathematics at UC Irvine. His primary research is in random matrix theory, with an emphasis on applications to problems in numerical analysis, physical system modeling, random graphs and number theory. He is also involved in educational research and outreach relating to equal access issues in STEM. Outside of math, he enjoys running, movies, trivia, and spending as much time as possible with his dogs, wife and two sons. His most recent hobby is relocating scorpions from his backyard.

Fabian Santiago was born in Oaxaca, Mexico, but grew up in northern California. Fabian received his Bachelor's degree from Sonoma State University

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BIOGRAPHIES

> “For plankton in air and water, both adaptive behavior and flow matter.”

Tiny Animals, Big Flows: How to Get from Here to There?

By Laura Ann Miller

Plankton, also known as marine drifters, are tiny organisms carried along by tides and currents. Their trajectories and final distributions are **ultimately determined by both the local flow and their own active behavior**. These organisms include marine larvae whose dispersal is critical to the health of marine ecosystems, including coral reefs. On land, aerial plankton are carried by the wind and include tiny arthropods that may be either agriculturally significant pests or biocontrol agents. **Predictive models of the dispersal of these plankton are important for many agricultural and environmental applications.** For example, high fidelity dispersal models of pests such as thrips (tiny insects that feed by puncturing leaves and flowers) and black flies could inform the location of traps and the timing of the release of parasitoid wasps used for biocontrol. In water, models of flows within coral reefs and the dispersal of marine larvae could inform efforts to conserve natural reefs and construct artificial ones.

THE DEVELOPMENT OF PREDICTIVE MODELS

As an applied mathematician, I use my background on fluid dynamics and biology to understand how organisms deal with big flows. I am currently working in collaboration with UArizona faculty in Geosciences and Ecology and Evolutionary Biology, as well as colleagues at the University of Tennessee and the College of New Jersey, to develop predictive **models of the movement, settlement, and capture of plankton where both behavior and flow patterns matter**. Our goals are to leverage existing mathematical methods (utilized in agent-based models and fluid-structure interaction) to develop new frameworks for modeling and analyzing the movement of plankton in flow. Agent-based models are models in which individuals (such as tiny animals) are described as autonomous entities that can interact with each other and/or their environment. They have adaptive behavior that can include continual adjustments to changes in their environment, the presence and behavior of other agents, or to their internal states. These models are typically stochastic in nature and are particularly well suited to the task of exploring how simple, single-organism dynamics can give rise to population-level, aggregate phenomena. Our group’s ***Planktos* software is unique in that it allows for 2D or 3D simulations of agents with active behavior** that are carried with the flow in spatially and temporally heterogeneous environments. Our group is also applying tools from dynamical systems and stochastic analysis to reveal how organism morphology, behavior, and environmental conditions enable microscopic plankton to find their way in these macroscopic flows. This work is synergistic with research on crayfish swimming by Calvin Zhang Molina, previously featured on this newsletter (see math.arizona.edu/outreach/newsletters/2017#p=6).

CASE STUDY: UPSIDE DOWN JELLYFISH

Filter feeding by upside down jellyfish represents an interesting test case of the *Planktos* framework. **Jellyfish are extremely efficient consumers of plankton,** often outcompeting fish and other commercially and ecologically important species such as crabs and corals. We have been traveling to the Key Largo Marine Research Lab to quantify the feeding currents generated by upside down jellyfish for the past five years. These jellyfish rest upside down on the bottom of shallow estuaries and bays (Fig 1). The pulsing of the bell generates a strong vortex that can trap the slow swimming plankton (Fig 2). If the plankton detect a disturbance in the fluid, they initiate an escape response and can potentially escape. A successful escape is highly dependent upon the ratio of the swimming speed to the background fluid velocity, the escape direction, and the disturbance threshold required to initiate an escape. If they cannot escape, the plankton within the vortex are pushed upwards and through an elaborate array of oral arms that are used for filter feeding (Fig 2). ***Planktos* is currently being used to understand**

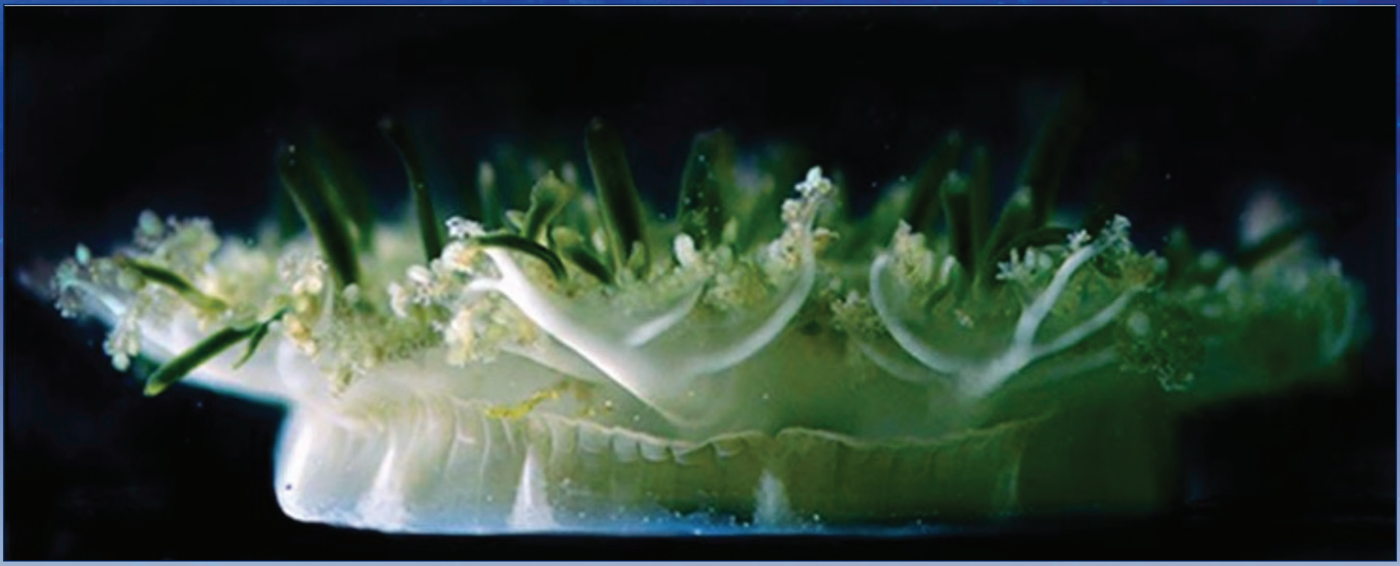

Fig. 1. Side view of the upside down jellyfish. These jellyfish rest upside down in shallow waters, extending their frilly oral arms to filter feed on plankton.

how the flow structures generated by the upside down jellyfish allow them to be such efficient feeders, and also to understand the mechanisms that plankton have evolved to escape.

SIGNIFICANCE TO AGRICULTURE AND CLIMATE CHANGE

The *Planktos* framework, which can be applied to both aerial plankton (e.g. insects, spiders) and marine plankton, can **inform environmental policy and conservation efforts** in several ways. Climate change has caused rapid shifts in insect migratory patterns, leading to emergent invasive insects. Such species have detrimental effects on agriculture: upwards of 40% of crops are lost to pests (both invasive and otherwise) resulting in about 220 billion dollars lost to the global economy each year. Biocontrol (the release of insect predators) offers a plausible strategy to be used in concert with pesticides. Recently, proper biocontrol showed a 100-1000 times return on investment in protecting plants from invasive insects. There are many factors, however, that affect successful biocontrol efforts, including understanding the optimal timing and release of the insects. Another example of where mathematical frameworks like *Planktos* can directly **inform conservation efforts involves coral reef health**. Climate change induced temperature stress has caused coral bleaching events on a massive scale. The death of a reef negatively impacts not only ocean biodiversity, but critical fishing economy, including jobs and food supply. The recovery of reefs, thermal stress tolerance, and even the construction of man made reefs require an understanding of the coral larvae settling process (density of individuals, chemical cues, reef structure, etc.) precisely the type of phenomenon frameworks like *Planktos* can help predict. ▲

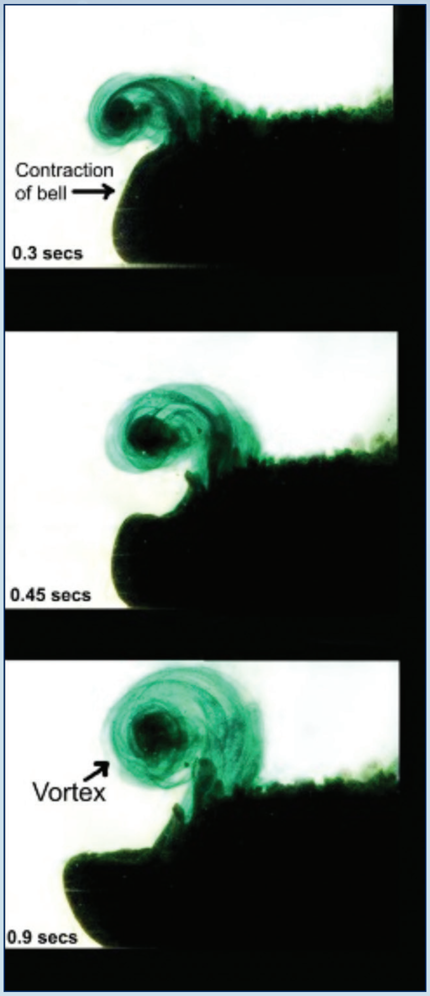

Fig. 2. Dye visualization of the advection of the starting vortex after the jellyfish bell contracts. Plankton are swept up into the vortex and pushed across the oral arms where they are trapped and consumed.

Laura Ann Miller *joined the faculty of the Department of Mathematics at the University of Arizona in the fall of 2020. She is also an affiliate member of the Program in Applied Mathematics GIDP and an Adjunct Professor in the Department of Biomedical Engineering.*

Contact her at: **lauram9@math.arizona.edu**

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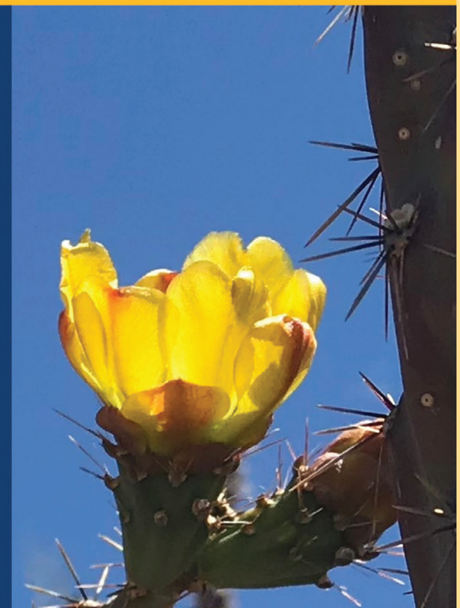

http://swc.math.arizona.edu

Deadline to apply for funding: November 24, 2021

AUTOMORPHIC FORMS BEYOND GL_2

Ellen Eischen
Algebraicity and automorphic forms on unitary groups

Wee Teck Gan
Automorphic forms and the theta correspondence

Aaron Pollack
Modular forms on exceptional groups

Zhiwei Yun
Rigidity method for automorphic forms over function fields

with **Akshay Venkatesh**, Clay Lecturer

TUCSON, MARCH 5-9, 2022

Funded by the National Science Foundation
Supported by the National Security Agency
and organized in partnership
with the Clay Mathematics Institute

Notable Women in Math in Celebration of AWM's 50th Anniversary

The year 2021 marked the 50th anniversary of the Association for Women in Mathematics, a professional society committed to empowering women and girls to pursue careers in the mathematical sciences. The half century celebration catalyzed a vision of Ruth Haas and Karoline Pershell (past President-elect and Executive Director of AWM, respectively) and brought to life the first of four decks of **EvenQuads, a mathematical game about identifying and collecting "Quads"** developed by Dr. Lauren Rose and Jeffrey Pereyra.

The project considered over 1400 nominations and ultimately selected 64 women deemed to have substantially contributed to the mathematical sciences in various specific ways. The project also showcased novel creative talent, featuring artists volunteers who portrayed the 64 women selected for Deck 1. **Two UArizona mathematics faculty**, Distinguished Outreach Professor **Marta Civil**, and Associate Research Professor and Director **Guada Lozano were featured in the inaugural EvenQuads deck.** ▲

Visit awm-math.org to read more on the project, nominate other women or to purchase decks and learn how to play.

AWM
ASSOCIATION FOR WOMEN IN MATHEMATICS

BIOGRAPHIES

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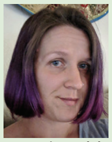
and his Ph.D. in applied mathematics from UC Merced. Fabian's research interests are the application and development of mathematical and data-driven approaches for understanding biological phenomena. He is very interested in open science principles and practices. In his free time Fabian enjoys spending time with his wife and two dogs, early morning hikes, and trying new food and restaurants.



Matea Santiago is from Calistoga, California. She graduated with distinction from Sonoma State University with a Bachelor's degree in applied mathematics, then received her Ph.D. in applied mathematics at UC Merced. Her research focus is computational fluid dynamics and fluid-structure interactions in biological applications. In her free time, Matea enjoys hiking with her husband and dogs, exploring new restaurants, and going to concerts.

Aparna Upadhyay was born in Ballia, a city in the state of Uttar Pradesh, India. She earned her undergraduate degree with honors in mathematics from St. Stephen's College, University of Delhi, and her Master's degree from the Indian Statistical Institute. She received a Ph.D. in mathematics from the University at Buffalo. Her research interests focus on representation theory of finite groups, especially symmetric groups and the combinatorics of partitions. She is excited to expand her research horizons and further develop her teaching skills here at the University of Arizona. In her spare time she enjoys cooking, sketching, and playing badminton.

Lei Yang grew up in China, where she obtained her Bachelor's degree. She earned her Master's degree in Europe. She then came to United States and received her Ph.D. in mathematics from Northeastern University. Her main research interest lies in algebraic geometry, especially birational geometry of moduli spaces of curves. Outside of mathematics, and whenever she finds the time, Lei enjoys reading and listening to music.

Staff

Keenan Anderson has lived in Tucson almost his whole life. He attended the University of Arizona and lives with his wife, Maryam, and his 1.5 year old son, Rasul, in Southern Tucson. Keenan and his wife enjoy being outdoors and have lately been occupied quite a bit with drawing, coloring, and crafts—things Keenan's son has developed an interest in. Keenan joined the math department a few months ago as a senior accountant; he appreciates being a part of the team.

BIOGRAPHIES

Math, Statistics, and the Effectiveness of New Cancer Drugs

By Teri Suzuki

Cancer is the World's leading cause of death. As Director of Biology at Reglagene, I work with biologists, chemists and mathematicians to design approaches for evaluating potential new cancer drugs. Here, I outline three examples of the work of the team at Reglagene. In all cases, mathematics and statistics play a key role.

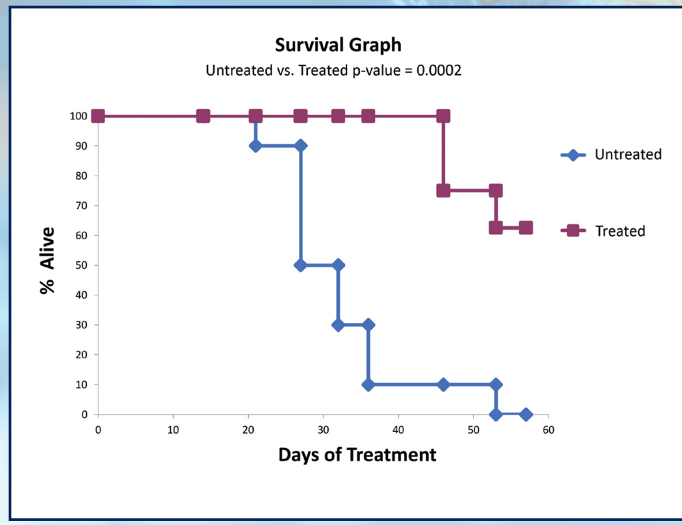


Fig. 1. Comparison of survival rates of mice treated with Reglagene compounds (red) and untreated mice (blue).

IN VIVO STUDIES: ENSURING A TREATMENT WORKS

Would a patient with cancer live longer if treated with a potential drug than without it? To answer this critical question, the FDA requires numerous experiments, including those using rodents with tumors as a model system.

Using a specific combination of human cancer cells and mice models, Reglagene recently designed a study carried out in collaboration with the Arizona Cancer Center (Gillian Paine-Murrieta, EMSR). A second team charged with evaluating outcomes (Kathylynn Saboda, and Prof. Denise Roe, Biostatistics and Bioinformatics Shared Resource) determined **the number of deaths in mice treated with Reglagene's compound was significantly less** than in the untreated controls (see Fig. 1). Such in vivo studies answer the key question "does it work?" Combination chemotherapy answers "is it better with a cocktail?"

COMBINATION CHEMOTHERAPY: EVALUATING DRUG COCKTAILS

Chemotherapies are often given in combination to minimize resistance to treatment. **Combined drugs yield three possible responses: additive** (equivalent to administering agents separately), **antagonistic** (combination reduces effectiveness), and **synergistic** (combination increases effectiveness). Reglagene evaluates drug combinations using the method of Chou-Talalay, which incorporates several classic biological equations. They include the Michaelis-Menton equation, relating the rate of a biological reaction to the concentration of reactant, and the Hill equation, relating a biological response to the concentration of an active molecule. We collaborate with mathematically trained scientists, such as Dr. Chung-Yi Kung (Belltree Consulting) to ensure we correctly categorize drug cocktails (that include our compounds) as additive, antagonistic or synergistic.

NEXT GENERATION SEQUENCING: ASSESSING CHANGES IN GENE EXPRESSION

Another key focus at Reglagene is understanding how a cancer drug is working. **We use next generation sequencing to analyze how our compounds influence cellular mRNA**, the "message" between DNA and the proteins used by our cells. (By the way, mRNA is also how Covid-19 vaccines such as Moderna and Pfizer produce protein.) These experiments produce massive amounts of data. Reglagene works with experts in biostatistics, including Dr. Bonnie LaFleur (Biostatistics, Bio5 Institute), to compare the mRNA in treated and untreated cancer cells. Understanding how our compounds work at the cellular level sheds light on which patients may benefit the most from particular treatments.

Whether we are asking if a drug works, works better in combination, or how it is working, **mathematics and statistics play an integral role in Reglagene's drug discovery program**, which finds molecules that kill cancer cells while sparing healthy cells. ▲

Teri Suzuki *is the Director of Biology at Reglagene. She holds a Ph.D. in biochemistry from UArizona and has worked for more than 20 years in pharmaceutical and biotechnology companies. Teri is a member of the Mathematical Sciences External Advocacy Board.*

Contact her at: **suzuki@reglagene.com**

> “The recorded lectures are great. I think recorded lectures should be the standard even after everything is normal again.”
>
> – Fall 2021 math undergraduate

Class Recordings Then and Now: Greater Access, Deeper Learning, and Other Virtues

By Cheryl Ekstrom

March 2020 saw a steep learning curve as teachers everywhere scrambled to learn new technologies to continue their classes in a new online format. A year after abruptly pivoting to online tools something amazing happened: **instructors began noticing the possibilities of using new technologies for better learning**. Students are also reflecting upon advantages brought about by the massive scale-up of online learning, among them, recorded lessons.

In an informal survey of 800+ students across all levels of math at UArizona in May 2020, **92.8% responded that having course documents and recordings posted online helped their individual learning**. Students also voluntarily talked about specific ways in which class video recordings were supporting their learning including:

ACCESSIBILITY

Recordings that can be paused and replayed at will can make lessons more accessible, particularly when accurate closed captioning is included. Students told us:

> *"Being able to watch pre-recorded lectures […], helped me learn better by having the ability to move at my own pace.”*
>
> *“The recorded lectures […] provided me the ability to re-watch and go over concepts that are missed in class [and] the chance to learn the concepts if you were too afraid to ask in class.”*

ATTENTION AND WELLBEING

Recordings enabled students to be more “present” in class, listening and engaging rather than taking notes, while reducing anxiety tied with multitasking. Students told us:

> *“With lectures in real time only, I would get so distracted writing things down that I would miss things being said in the lecture.”*
>
> *“Being outside of the in-person classroom setting, which gives me anxiety troubles, helped me handle my stress levels better […]. [The] recordings […] helped me understand the material better on my own.”*

REVIEW AND CLARIFICATION

Recorded lessons also enabled deeper and better learning in a number of ways. Student told us:

> *“I really liked being able to go back on any given lesson and refresh myself on the content.”*
>
> *“I could re-watch portions of the videos to improve my notes, rework problems, and see new concepts multiple times.”*

Recorded lectures offer an opportunity to partake in the learning experience when we must miss class for health or other reasons. While attendance generally adds value, recorded lessons allow students to know (and be better able to catch up on) exactly what they missed.

The pandemic has enabled many options for providing video recordings to students, including giving them access to a video library, and video-capturing your in-person class automatically using Zoom or Panopto. A Zoom video capture can also be set up to allow students to join remotely, making your class more accessible, and also more rewarding. If you teach, please contact me to learn more.

The technology that rescued us a year ago has been tremendously enhanced to add value to teaching and learning. Let’s use it! ▲

Cheryl Ekstrom *joined UArizona math as instructional faculty in 2003 where she taught for 10 years. She now provides academic support to teaching faculty, specializing in digital tools and online learning. She believes that everything done in the classroom may also be done online--it may just look a little different.*

Contact her at: **ekstrom@math.arizona.edu**

THE UNIVERSITY OF ARIZONA
COLLEGE OF SCIENCE
Mathematics

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Department of Mathematics
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UARIZONA MATHEMATICS

Master and Ph.D. Recipients, 2021

A complete list of graduates since 1992, including links to recent theses, may be found online.

Doctoral Degrees

Hannah Biegel - Near Real-Time Forecasting of Epidemics Using Data Assimilation with Simple Models
Advisor: Joceline Lega
Employer: SomaLogic
Position: Scientist I-Bioinfomatics

Madhav Kaushish - Theory Building in Geometry Education: Developing and Implementing a Course for 12 to 15 Year Old Students
Advisor: Rebecca McGraw

Anthony Kling - Comparison of Integral Structures on the Space Modular Forms of Full Level
Advisor: Bryden Cais

Master Degrees

Omer Aktepe - Discontinuous Galerkin Methods For One And Two Dimensional Schrodinger Equations
Advisor: Moysey Brio

Bud Denny - Extended Finite-Difference Time-Domain Method for Dynamics in Ferrite Material
Advisor: Moysey Brio

Florence Dungan - A Nonparametric Test for Equality of Distributions
Advisor: Kevin Lin

Justin Perkins-Ollila - Image Quality Improvement in Generative Adversarial Nets using the Structural Similarity Index Measure
Advisor: Helen Zhang