THE UNIVERSITY OF ARIZONA
COLLEGE OF SCIENCE
Mathematics

MATHEMATICS

IN THIS ISSUE

Fall 2015
Volume XV, Single Issue

View from the Chair

BY KENNETH MCLAUGHLIN

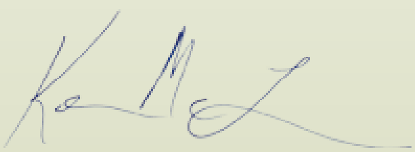
Things are borderline out of control in Arizona Mathematics this year, but control is overrated!

We are in the midst of an unprecedented move of half the department, including graduate students and all of our different types of faculty. Many are already transplanted to the new "Environment and Natural Resources 2 building." As the photos show, this new space is unique, smart, and bedecked with nature on each of its 5 main floors. There are also features for the modernists among us: shade is provided by vertical metal bars that double as a nearly perfect Faraday cage! The move has given our graduate students in the Main Math tower more space, and integrated us all in new ways, both with each other and colleagues from other departments and units. It has also put in motion innovation that will turn old office space into learning space, with smart boards, and other active learning enhancing technologies. While we are still actively looking for math-lover donor of a new Math Tower, we are grateful to be part of the latest architectural addition to our Tucson campus.

In this edition we have three research articles written with the general public in mind. First, two brief synopses: one on mathematics, cognition, culture, and language, and another on the mathematics of polymer "self-assembly." Second, our yearly, featured research article, will tell you about a new funding model based on outcomes and the "Chikungunya [Fever] Challenge."

We will spread the word about an outreach effort on mathematical modeling with Southern Arizona Teachers, and two exciting public events this year, our Science Café Series on Mathematics of Health and Disease, and the Puzzle, Proofs and Patterns hands-on exhibit ongoing at Flandrau Science Center & Planetarium.

But there is even more good stuff cooking! Right now we are excited about a new Cox Communications partnership to fund graduate student scholars working in Tucson schools, an initiative you are invited to help support. We are also creating opportunities for industry funded research assistantships, and looking forward to the next Bartlett Memorial Lecture on the topic of elections (April 2016) and the next Mathematics Educators Appreciation Day, which will take place January 23, 2016. ▲



__Ken McLaughlin__ has been a troublemaker on the University of Arizona campus since the age of five. He received his Ph.D. from New York University's Courant Institute in 1994. He is the goofiest part of a family diaspora residing in Brazil, Guadeloupe, France, and scattered about the United States. Ken's research is in the analysis of partial differential equations, in the theory of approximation, and in the theory of random matrices. His priorities are: (1) family; (2) teaching; (3) research; (4) play. But he's never made it past item (3) in this list.

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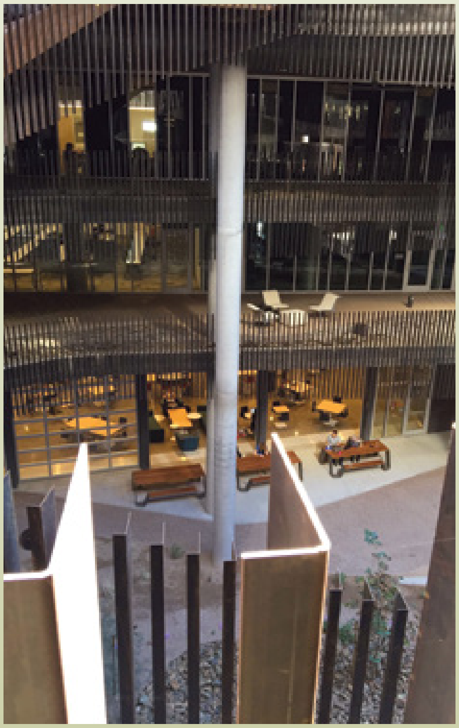
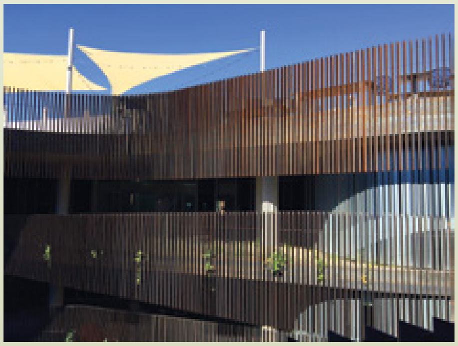
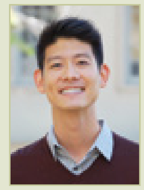




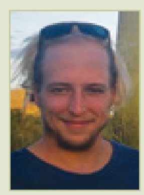
On the Cover: The new UA Environment and Natural Resources 2 Building (ENR2). Several views of ENR2 taken from the 3rd floor, overlooking the courtyard. Clockwise from left: Desert Canyon Cafe, roof top terrace, and courtyard landscape design.

BIOGRAPHIES

Faculty



Aditya 'Adi' Adiredja, a tenure-track Assistant Professor, is originally from Jakarta, Indonesia. He completed his Ph.D. in Mathematics Education at the University of California, Berkeley in May 2014 and just finished a teaching and research postdoc at Oregon State University in August. His research is on undergraduate mathematics education focusing on ways that students make sense of challenging mathematical topics in undergraduate curriculum. He is particularly interested in looking at ways to leverage intuitive knowledge in learning formal mathematics. For the past eight years, he has taught mathematics courses at different types of institutions, and worked with students with diverse backgrounds. Equity and diversity considerations are an important aspect of his teaching and research. He is extremely happy to be at the University of Arizona and is looking forward to collaborating and fostering productive relationships with colleagues in the department. In his spare time he enjoys singing and dancing terribly while going on a run.



Matthias (Matti) Morzfeld, a tenure-track Assistant Professor, is from Bochum, Germany. He completed his Ph.D. in Mechanical Engineering at the University of California, Berkeley. As a grad student, he joined the Math Group at Lawrence Berkeley National Laboratory and stayed there for a postdoc position (jointly with UC Berkeley's Math Department). His research interest is in the design and analysis of numerical methods for Bayesian inference with applications in geoscience and engineering. He is looking forward to starting new collaborations with his new colleagues within the university. In his spare time, he enjoys cooking, eating, listening to music and playing guitar.

continued on page 7

Cover Photography: Environment and Natural Resources 2 (ENR2) Building, by Guada Lozano
Producer and Editor: Guadalupe Lozano
Designer: Roma Krebs, UAHS BioCommunications
The Department of Mathematics Newsletter Fall 2015 Volume XV, Single Issue, is published annually by The University of Arizona Department of Mathematics, PO Box 210089, Tucson, AZ 85721-0089.

Super Pi Day 2015:

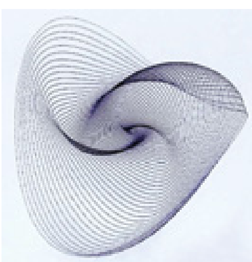
In the US, we all lived through March 14, 2015... and UA Mathematics celebrated in style!

Bruce Bayly

The Math Department came out in force to honor the transcendental number Pi, on its day: 3.14.15. On Thursday 3/12/15 (or 3.1215) several dozen children from Miles Elementary School walked the few blocks to campus and measured hula hoops and tennis ball cans, discovering a universal ratio that is the same for big and small circles, the ubiquitous number Pi (or π, in appropriate Greek style). They also joined in the tradition of inscribing the Math Bus, drawing and writing in chalk on the sides of the iconic Arizona Mathematics Road Show vehicle.

On Pi Day itself we set up early in the Science Of Pi tent, a special feature of the Science City area sponsored by the UA College of Science during the massive Festival of Books event last Spring. Besides measuring activities, the Math area featured two popular attractions.

The first, was a pendulum harmonograph, a Lissajous-drawing apparatus, whose swinging motion is governed by Pi and the length of the pendulum string.



A scan of a harmonograph – July 24, 2007.

The second crowd-pleaser was a Buffon's needle simulation of a stochastic integral for Pi. In an outdoor re-enactment of the needles-crossing-lines experiment performed in 1901 by Italian mathematician Mario Lazzarini, visitors to our area tossed 10 cm popsicle-sticks onto a square of whiteboard ruled with lines 20 cm apart, and we recorded the number of sticks that crossed a line. The ratio of non-crossings to crossings—known to approximate Pi in the long run, hovered around 3 for most of the weekend, encouraging but leading some of us to call for stricter experimental controls! UA Mathematics faculty, staff, grad students, and undergraduates all joined in the fun,

as did members of the undergraduate UA outreach club CATalyst.

> *I was amazed at how closely Buffon's matchstick method approximated Pi; judging by the delighted expressions on some of the participants' faces, I was not the only one.*
>
> –Bryden Cais, UA Mathematics Faculty

> *It was a joy to see the enthusiasm budding, elementary school mathematicians brought to the activities. And while the extreme winds threw a wrench into our plans to approximate Pi, the children still enjoyed seeing Pi show up in such a strange way.*
>
> –Brian Bennett, UA Mathematics Graduate Student

> *On Saturday morning there were more than a few young people who were "early shows" to the Math booth. These youths had clearly set their priorities and they wanted to visit the Math booth first. It was fun and refreshing to see their enthusiasm for Math. I'm sure that these young Mathematicians will have pleasant memories of the event and the encouragement they received from the volunteers at the Math booth.*
>
> –John Awalt, UA Mathematics Instructor

*Associate professor **Bruce Bayly** studied Applied Mathematics at Cambridge and Princeton Universities. He joined the University of Arizona Department of Mathematics in 1988. His outreach programs The Physics Factory and Arizona Mathematics Road Show have reached tens of thousands of children since 2003.*

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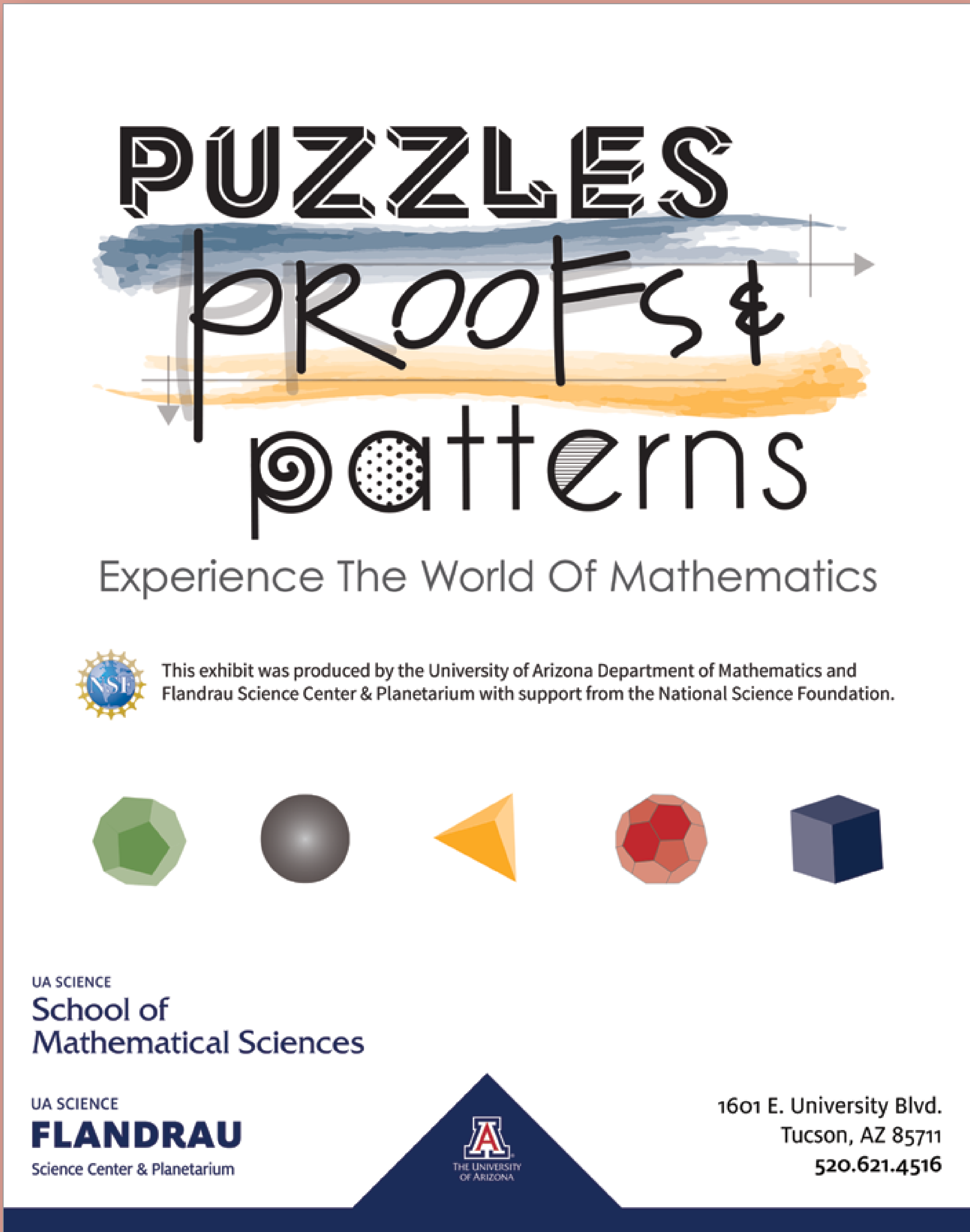
Give! To find out more about the Arizona Math Road Show and/or to help support their fundraising efforts, please visit: **math.arizona.edu/outreach/give/**



Come to the UA Flandrau Science Center & Planetarium to spark your math imagination! Solve puzzles, play games, build amazing shapes, and create fascinating patterns.

Modeling through Challenge

Chikungunya Fever in the Americas

Joceline Lega

Photo by David Dean Rodrigo T.-R. McLaughlin

In August 2014, DARPA (the federal Defense Advanced Research Projects Agency) launched a challenge, asking the public to predict the number of cases of chikungunya fever in each of the PAHO (Pan American Health Organization) countries, many of which were for the first time facing a huge outbreak of this disease. The framework was simple: predictions would be compared to numbers of reported cases, and teams would be scored on the accuracy of their approach. When a colleague in the College of Public Health, Dr. Heidi Brown, forwarded the announcement to me, I found the format both appealing and intriguing. First, this provided a unique opportunity (at least for a mathematician) to observe the unfolding of an epidemic in an area where it had never been reported before. Second, the funding approach was different.

Grants versus challenges

Academic research is typically supported by grants or contracts: funds are allocated based on proposals, which are evaluated for their intellectual merit. About 6 years ago, "President Obama called on [federal] agencies to increase their ability to promote innovation by using tools such as prizes and challenges to solve tough problems,"[1] which led to the development of the Challenge.gov platform. This site explains[2] that "With a challenge competition, you are defining the problem and framing the end-result you seek. Solvers enter the competition and have free reign and creativity to go about getting you the result you've described as the best possible outcome. If a solver meets your criteria and is judged a winner, you award them a prize (whether financial, incentive, or a combination) and your contractual relationship is complete."

A quick survey of the literature reveals that post-invention reward systems used to be the norm; they were progressively replaced by patents and procurement in the 19th century, only to come back to life "as a legitimate innovation incentive mechanism" in the past 15-20 years.[3] There is in fact a lot of current debate[4] on the efficacy of various models (prizes, grants, contracts) to promote innovation. For a researcher, participating in a challenge can be quite exciting and energizing. Moreover, supporting research with both grants and prizes seems preferable, especially since, at least in theory, "reward systems engender incentives to innovate without creating the monopoly power of intellectual property rights."[5]

Ironically, the renewed popularity of prize incentives is raising a challenge of its own: in order to compete, universities need to adapt to this new paradigm and find ways to support promising ideas and innovations before external funding is received to develop them.

Chikungunya

Chikungunya, which causes joint pain and fever,[6] is a viral disease transmitted to humans by infected mosquitoes. According to the WHO site,[7] the name means "to become contorted" and the first outbreak was reported in Tanzania in 1952. In 2013, chikungunya arrived in the Americas, where it has since then been infecting more than one million people in 44 (out of 55) countries.

3D-printed mosquito model given to challenge winners.

Forecasting the course of an outbreak is an important problem regularly faced by public health responders. Decisions (in my colleague's words, "whether to fly in surgeons, paliative care providers, or mortuary services") have to be made quickly and misjudgments have significant consequences. Mathematicians can help by developing a range of models that address both the short and long term dynamics of infectious diseases.

Predicting the spread of chikungunya fever

Heidi and I eventually decided to participate in the DARPA challenge. Last May, we were awarded first place[8] and received a $150,000 prize, which we will use to support our research activities. Our solution is extremely simple: it consists in representing the growth rate of the epidemic as a quadratic function of the number of cases, finding the

[1] *https://www.challenge.gov/about/*

[2] *https://www.challenge.gov/getting-started/*

[3] *F. Murray, S. Sternb, G. Campbell, A. MacCormack, Grand Innovation Prizes: A theoretical, normative, and empirical evaluation, Research Policy 41, 1779–1792 (2012)*

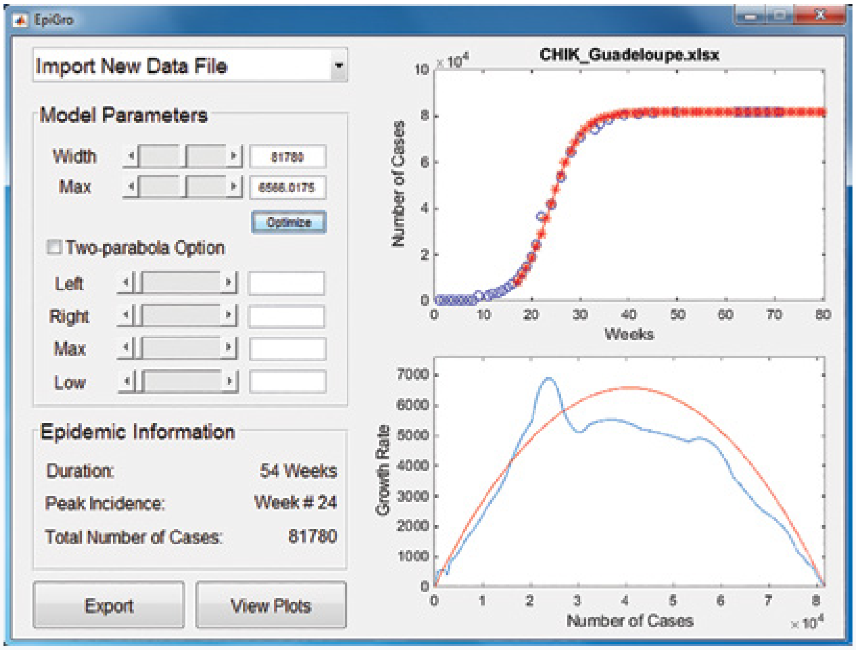
[4] *Browse for instance the talk lineup for the conference Innovation Law Beyond IP held at Yale University in March 2014 (http://isp.yale.edu/event/innovation-law-beyond-ip)*

[5] *S. Shavell and T. van Ypersele, Rewards versus Intellectual Property Rights, Journal of Law and Economics XLIV, 525-547 (2001)*

[6] *See for instance http://www.cdc.gov/chikungunya/*

[7] *http://www.who.int/mediacentre/factsheets/fs327/en/*

[8] *http://www.darpa.mil/news-events/2015-05-27*



EpiGro interactive tool showing epidemiological data for the 2014-15 chikungunya epidemic in Guadeloupe

parameters that best fit the reported data for each country, and making predictions on the basis of this simple model. In some instances, using a combination of two quadratic functions gave better results, revealing the presence of two phases (most likely due to geographic constraints) in the spread of the epidemic. At first, we were amazed that a model that did not include mosquito dynamics could still have predictive value, but we later realized that specific circumstances in the PAHO countries could justify our approach: the disease was new to the area, spread very quickly, and was carried by mosquitoes that were already in abundance in the region – dengue, an endemic disease in the Americas, is indeed transmitted by the same mosquitoes!

This realization was tremendously exciting because simplicity in modeling is both beautiful and practical. We are now working on a tool, currently in MATLAB (see figure), that implements the above approach for chikungunya and other diseases. EpiGro takes a file containing epidemiological data and gives a best guess for the future of a particular outbreak, assuming of course specific conditions are satisfied. We believe this has the potential to assist public health decision makers and thus guide mitigation efforts in certain circumstances.

The take-away message from this short article is that collaboration fosters innovation. Learning how to communicate with colleagues in other fields is a worthwhile investment, leading to synergistic activities that in turn provide unique training opportunities for graduate and undergraduate students. ▲

***Joceline Lega** is a Professor of Mathematics with expertise in the modeling of nonlinear phenomena. She received her Ph.D. in theoretical physics from the University of Nice and was a researcher at CNRS (the French National Center for Scientific Research) before she joined the University of Arizona in 1997.*

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BIOGRAPHIES

Instructional Faculty

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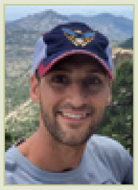


Michael Rossetti is from Canton, Ohio. He received a Master's Degree in Applied Mathematics from Case Western Reserve University in 2005. For the following year, he taught English at Sanda University in Shanghai, China. Since then, Mike has taught in the role of lecturer or instructor at Case Western Reserve University (one year), The University of Akron (six years), and Virginia Commonwealth University (one year) and spent one year as a Mathematics teacher and running coach at a private high school in Richmond, Virginia. Mike's wife, Allison, is an Assistant Professor in the Eller College of Management. Together, their hobbies include running, biking, hiking, and traveling.

PostDoctoral Fellows

Ashay Burungale is originally from India. After doing an undergrad in Indian Statistical Institute Bangalore, he obtained his doctorate from University of California Los Angeles in June 2015. He feels fortunate to be a student of professor Haruzo Hida. Number Theory and Modular Forms are his main mathematical interests. At the University of Arizona, he hopes to pursue new aspects with Professor Romyar Sharifi among others. Ashay has a keen interest in films. He is especially fond of Robert Bresson, Luis Buñuel, Hou-Hsiao Hsien, Abbas Kiarostami, Kenji Mizoguchi, Andrei Tarkovsky and Yasujiro Ozu.

Gabriela Jaramillo recently moved to Tucson from Minneapolis, where she received her Ph.D. from the University of Minnesota in June 2015. Her research focuses on exploring the role of defects in pattern forming systems using techniques from Functional Analysis. She is excited to be at the University of Arizona as a NSF Postdoctoral Research Fellow and is looking forward to expanding her interests in applied mathematics and computational methods. In her spare time she likes to read, cook, and go for long walks.

continued on page 10

Partnering for Better Outreach: Cox Communications
Gives Math in Arizona Schools a New Boost

Guada Lozano

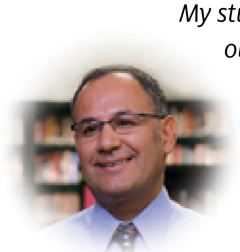
We live in a time when teacher shortages and budget cuts are the norm, and in a state that trails behind most others in K-12 education. But, with creative thought and the commitment of key corporations like Cox, being last creates the perfect opportunity to be first.

This fall of 2015, UA Mathematics began to realize a long-standing dream: partnering with private and corporate stakeholders to address pressing needs, enhance the value of our graduate student education, and infuse new life into valuable university-K-12 school partnerships that forever impact the education of Tucson youth.

Cox Communications, inspired by the advocacy of Lee Herbst, UA Mathematical Sciences External Advisory Board Member, is the first-ever corporate sponsor of the first-ever Mathematical Sciences Graduate Scholar in Outreach, mathematics master's student Arias Hathaway.

The Cox-UA Math partnership is an innovative hybrid-funding model to support exceptional math graduate students who, like Arias, want to collaborate with K-12 teachers in Tucson schools, developing special-focus math lessons and relevant material for K-12 mathematics courses.

The sense that "mathematicians-in-training," like Arias, can have a real, positive impact in local K-12 classrooms is quite plain to her middle school partner-teacher, Arnulfo Velazquez:



My students look forward to having Arias in our classroom every week. They trust her for being math-savvy and for caring about their learning. My hope is some of my female students will be inspired by Arias' presence and passion for teaching, choosing to pursue technical or teaching careers. Having UA visitors is always great for students who, like ours, still view college education as a hard-to-realize dream.

The Mathematical Sciences Scholars Program in Outreach adds value to the efforts of K-12 Arizona teachers like Arnulfo, but it also adds unique value to the life of our graduate students, who receive direct mentoring and practice in the work of teaching in K-12 schools, like Arias:

Working at Roskruge Bilingual K-8 School allows me to incorporate my passion for speaking Spanish with my career in mathematics for the first time. It is exciting to see the math education courses I'm currently taking reflected in the experiences I see in the classroom, and to realize how much my classroom teaching can inspire the students, especially the girls, in Arnulfo's class.

Opportunities for mathematicians to work alongside K-12 teachers illustrating the value of the "M" in STEM to local youth, enrich all: mathematics graduate education, the work teachers do in our local schools, and the future of Arizona youth.

Innovative partnerships like the one with Cox make these opportunities a reality: they enable us to rise above the constraints of budget cuts and expired grants, and give local corporations like Cox the power to drive educational enrichment locally in Tucson, now.

Our dedication to growing local K-12 outreach, tied to Cox's commitment to supporting specifically Mathematics within STEM, is the first example of a partnership to privately help fund and nurture in-the-school-classroom experiences for mathematics graduate students. We are grateful to Cox Communications Southern Arizona Market Vice President, Lisa Lovallo, and her fantastic team for pioneering this effort. And we call on others to follow Cox's lead. For us, the ultimate measure of success will be long-term corporate and private commitment to the Mathematical Sciences Graduate Scholars program. ▲

Guada Lozano *is an Assistant Research Professor of Mathematics in charge of brokering partnerships such as the one with Cox, in her capacity of Director of External Relations and Evaluation for the Department of Mathematics and the School of Mathematical Sciences.*

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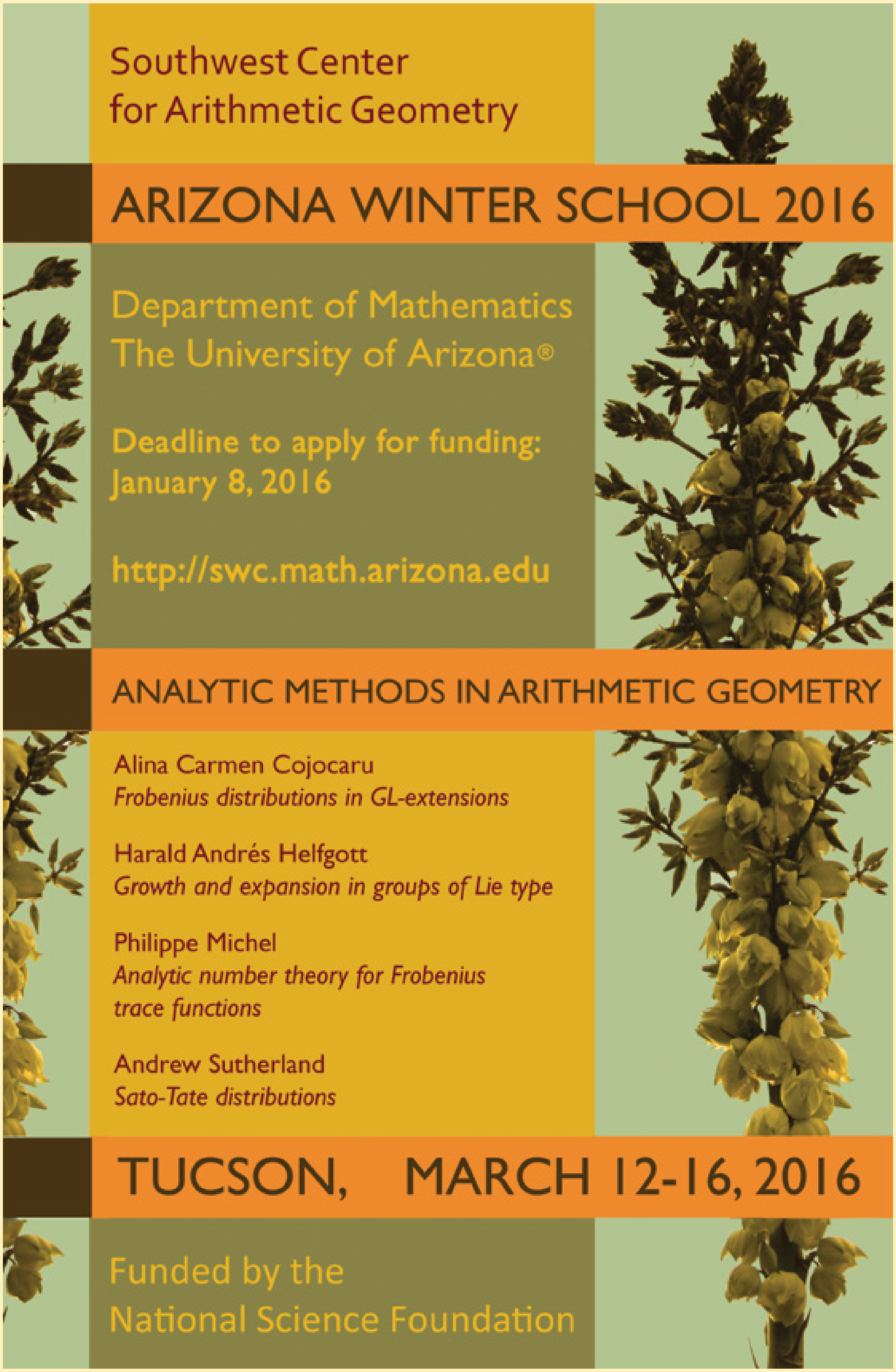
The Mathematical Sciences Graduate Scholars in Outreach initiative is currently modeled after the G-TEAMS Extension program, which builds on the successful G-TEAMS (Graduate Students and Teachers Engaging in Mathematical Sciences) Program, an NSF-funded project that ran from 2009 to 2014, under the direction of PI Joceline Lega.

Arias Hathaway*, is completing her Master's degree in mathematics and has an interest in math education at both the curriculum-policy level and at the application-to-the-classroom level. Arias plans to work in the public or private sector, likely in the area of mathematics education policy.*



The eighteenth annual Arizona Winter School (AWS) is coming up in March. At the AWS, arithmetic geometry Ph.D. students from around the world attend distinguished mathematicians' lectures by day, and work collaboratively and intensely on research projects by night. ▲

Give! *Supporting a Mathematical Sciences Graduate Scholars costs 10.5K a year*. To give or find out more about this program and other opportunities to help fund graduate teaching and research training please visit: **math.arizona.edu/outreach/give/**

Visiting Faculty

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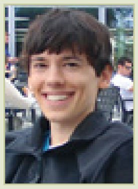
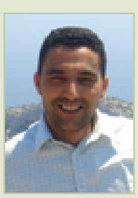


Jeremiah Birrell grew up in Lenox, Massachusetts. In 2007 he earned his bachelor's in physics from Brigham Young University in Utah, and in 2014 he completed his Ph.D. in applied mathematics at the University of Arizona, studying cosmology and the relic neutrino background. His current research focuses on the dynamics of particles influenced by random noise. Jeremiah finds the outdoors and physical exercise to be good companions to scholarly work. When not engrossed in mathematics, you'll likely find him rock climbing, hiking, or practicing yoga.

Fulbright Scholars

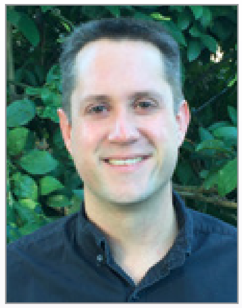
Dr. Jodie Hunter is a lecturer in mathematics education at the Institute of Education at Massey University, New Zealand. She is currently working at the University of Arizona as part of a Fulbright New Zealand Scholar award. Previously Jodie worked as a Research Fellow at Plymouth University, United Kingdom where she also received her doctorate. Her doctoral work focused on working with teachers to support them to integrate algebraic reasoning into their everyday mathematics teaching. Recently Jodie has been involved in a large-scale project funded by the New Zealand Ministry of Education which focuses on developing culturally-responsive teaching to address under-achievement in mathematics for Pasifika and Māori students at low socio-economic schools. Jodie enjoys travelling, reading and spending time with her husband and two young daughters.



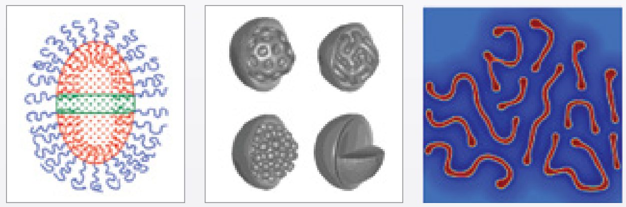
Halim Hasnaoui, a Fulbright scholar under the mentorship of Lotfi Hermi, grew up in Tabarka, a Tunisian coastal town. He earned his BS in 2004, MS in 2008 and went on to complete his Ph.D. in 2014, all in mathematics, at University of Tunis El Manar, Tunisia. Hasnaoui is currently Assistant Professor

Natural and Synthetic Self-Assembly

Karl Glasner



Many natural phenomenon – complex molecules, living cells, schools of fish (even schools of humans!) – arise from a spontaneous assembly of smaller units. Although these aggregates have properties unlike their individual components, their existence is entirely encoded in often simple governing rules. In the case of molecular self-assembly, these rules are those of attractive and repulsive interatomic forces. In larger scale systems, other mechanisms, such as chemical reactions, fluid and elastic forces, or psychological motives might be involved. The fact that simple interaction rules can produce arrangements which are much more than the sum of their parts is a source for amazement and a vast array of scientific studies.



Examples of polymer self-assembly: (left) two types of copolymers (red/blue and blue/green) assemble to form a "hamburger" micelle; (middle) tubes and membranes fold in various ways to form nanodroplets; (right) worm-like monomer rich regions arising from self-replicating patterns.

Self-assembly can be harnessed to build structures in a way that requires little or no external intervention. This is useful, for example, to design materials with intricate microscopic details at a scale intractable by conventional engineering techniques. Many novel uses of these materials are envisioned, including creating parts for molecular-sized machines and synthetic biological membranes to treat disease.

The best molecular candidates for synthetic self-assembly are block copolymers, materials which have long been used in adhesives and soft plastics like contact lenses. Copolymers are long chain molecules composed of more than one type of building block, called monomers. Just like oil and water, monomers of different type try to separate into distinct phases. But they cannot separate completely, thus forming "microsegregation" patterns–microscopic regions each rich in one type of monomer. This process can result in small aggregates (called micelles) or layers which fold into tubes and other shapes.

Remarkably, fairly simple (albeit nonlinear) partial differential equations can capture a wide range of microsegregation behavior. My research seeks to understand the dynamics leading to self-assembled microsegregation patterns, in contrast to simply studying the resulting equilibria. This may pave the way to discovering new and exotic arrangements, with unique and desirable physical properties. Another important goal is to investigate how segregation processes can be externally guided by applying, for example, electric fields. These theoretical efforts are first steps in a bold objective: building microscopic structures and devices by letting them build themselves. ▲

Karl Glasner *earned his Ph.D. from the University of Chicago and is an Associate Professor. His research interests include theoretical aspects of material science, fluid and solid mechanics, singular perturbation theory and computation.*

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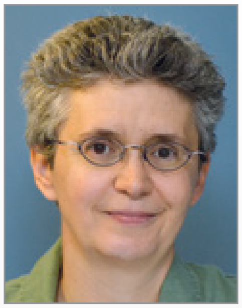
Connecting Cognition, Culture, and Language in Mathematics Education

Marta Civil



Mathematics learning and teaching do not happen in a vacuum. Consider, for example, a fairly typical school mathematics word problem: a watermelon and two cantaloupes cost $4.65. Three watermelons and two cantaloupes cost $10.15. How much does one watermelon cost? While we could solve the problem by setting up a system of equations, we may also note that from the particular fruit combinations given, we can deduce that two watermelons cost $5.50, which gives us one watermelon at $2.75. This is precisely how David, a prospective elementary teacher, reasoned. As he considered his answer, however, David said, "Actually, I probably should use algebra because I'd come with proper numbers. My solution could be wrong." Why did David think his solution might be wrong? He thought the watermelon was too expensive. David was trying to make sense of the problem based on his experiences from everyday life.

David's case is not unique. What happens to students who like David are trying to make sense of mathematics by building on their everyday knowledge? This question led me to the research on out-of-school versus in-school mathematics and the implications of this work for underrepresented students. Why is it that some individuals are successful in out-of-school mathematics and yet do not experience success in in-school mathematics? To increase the opportunities to learn mathematics for all students, we need to consider not only cognition but also the social, cultural, and political context in which this learning happens.

My work centers on the role of culture and language on the teaching and learning of mathematics. In particular, I work on issues of participation, with questions such as: Whose knowledge and experiences are represented and valued? Whose language(s) and forms of communication get privileged? How can teachers build on the knowledge and experiences that students and their families have? What are Latina/o immigrant parents' perceptions of the teaching and learning of mathematics? How can we engage parents as intellectual resources in mathematics education, particularly those parents whose voices are often not heard?

Equity in mathematics education is at the heart of each of these questions. Ultimately, my research is about turning language and cultural diversity into educational assets for the mathematics education of all students. ▲

***Marta Civil** is a Professor of Mathematics Education and the Roy F. Graesser Chair. She earned her Ph.D. at the University of Illinois in Urbana-Champaign. Her research centers on equity in mathematics education, in particular with Latina/o students and their families Her work as PI in NSF-funded CEMELA (Center for the Mathematics Education of Latinos/as, math.arizona.edu/~cemela/) still inspires the research agendas of many former graduate students and post-docs.*

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

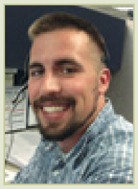
BIOGRAPHIES

Fulbright Scholars *(continued)*

at Al-Qassim University, Saudi Arabia. His research interests focus on the geometry of the spectrum, particularly isoperimetric inequalities for wedge-like membranes and compact manifolds with lower bound constraints on the Ricci curvature. Hasnaoui is on a year-long Fulbright visit to the US. After a semester at University of Arizona, he will go to Georgia Tech to work under the mentorship of Evans Harrell.

Staff

Rory Barnes grew up in an Air Force family, and had the opportunity to live in many parts of the country before settling in Tucson in 2000—the place he considers his hometown. Rory completed his B.A. in Mathematics through the University of Arizona in 2011. With an emphasis in Secondary Education, he spent the next four years teaching mathematics in various schools and to various grade levels for the Vail School District. Because of his experience and passion for teaching, he was excited to take on the role of Coordinator for the Math 100 program at the University of Arizona. When not at work, he enjoys spending time with his family, cooking, and playing board games.



Matt Poag grew up in Michigan and got his bachelors in Political Science at Central Michigan University. He moved to Tucson in 2013 to escape the winters. Matt was hired by the University of Arizona in the Financial Services Offices (FSO) as a Financial Services Specialist specializing in travel. He stayed with FSO for two years when the Department of Mathematics offered him a job as an Accounting Specialist. He is currently taking classes for his MBA through the University of Arizona and is hoping for a graduation date in early 2017.

continued on page 12

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BIOGRAPHIES

Appointed Personnel

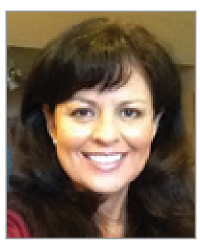
continued from page 11

Melissa Hosten, Co-Director at the Center for Recruitment and Retention of Mathematics Teachers, has worked in education for more than 15 years. Melissa has taught high school, middle school, and elementary school. She has worked at the state and regional level as a mathematics specialist. She is involved in assessment and instruction projects at the local and national level. Her interests surround equity, especially gender equity and equity for students learning English. Melissa is President of Women and Mathematics Education, serves on the Joint Committee for Women in the Mathematical Sciences, is a Board Member of Arizona Mathematics Leaders, and is an active member of TODOS: Mathematics for All. Melissa just received the 2016 Copper Apple Award for Leadership in Mathematics. She lives with her husband, two sons, and daughter. ▲

BIOGRAPHIES

Mathematical Modeling with Southern Arizona Teachers

Cynthia Anhalt



Southern AZ teachers have an opportunity to expand their content knowledge and experiences with mathematical modeling through an outreach project, ***Mathematical Modeling in the Middle Grades*** (***M³***), offered through the Department of Mathematics. ***M³*** seeks to use mathematical modeling tasks as the setting for strengthening teachers' content knowledge that they teach and experience mathematical modeling as a practice as intended in the Arizona Standards. Modeling is an under-represented area of mathematics in the k-12 curriculum and task design and enactment are difficult endeavors. ***M³*** teachers are working in school-based teams to broaden their understanding of mathematical modeling, and to create, adapt, implement, and reflect on modeling tasks in their classrooms. ***M³*** is delivering on-site professional development through two summer institutes, 2015-2016, and teacher study groups throughout the academic year. ***M³*** has the potential to make a deep impact as we target developing teachers' knowledge and instructional strategies for implementing modeling tasks with diverse groups of students. ▲

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__Cynthia Anhalt__, Mathematics Education faculty, is the Principal Investigator working with co-director, __Erin Turner__, College of Education, and __Amy Been__, mathematics graduate student. __M³__ is funded by the AZ Board of Regents, Improving Teacher Quality Division for $112,000.