Polymath

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Mathematics Department newsletter
Cal Poly, San Luis Obispo, Calif.

See page 3 for cover article

Artwork based on the Traveling Salesman Problem

CAL POLY
SAN LUIS OBISPO

Contents

Letter from the Department Chair

Joseph Borzellino

As new chair of the Mathematics Department, I'd like to start by thanking my predecessor, Don Rawlings. After 33 years of service to the department — with the last four as chair — Don is transitioning into the relaxing life of retirement. He'll be missed but will continue to teach for us as part of the Faculty Early Retirement Program. His stewardship of the department has been invaluable. I've been particularly grateful for his continued advice and support as I transition into my new role as chair.

I'm new to the role of chair but not to Cal Poly. I joined the faculty in fall 2001 after holding positions at UC Davis, UCLA and Penn State Altoona. My area of specialty is differential geometry; I earned by doctorate in 1992 from UCLA. I am honored to have been selected as chair and am looking forward to leading the department during what looks to be a promising time.

We're excited to welcome three new tenure-track faculty members this year. Eric Brussel and Emily Hamilton join us from Emory University as associate professors; Erin Pearse joins us from the University of Oklahoma as an assistant professor. You can read more about each of them in this newsletter. At the end of 2011-12, we said goodbye to both Steven Agronsky and James Mueller, who opted to participate in the Faculty Early Retirement Program. Agronsky retired after 35 years at Cal Poly and Mueller after 32. Their dedication to Cal Poly and our students has been a great asset.

Our front office has seen major staffing changes. Sheryl O'Neill retired in September after 20 years at Cal Poly; her warm personality, dedication and knowledge of the department will be missed. Fortunately, we have put together a talented office team. Clint Hahlbeck has joined us as a full-time lecturer and is in charge of our ELM/MAPE testing program and articulation. Carly Burdge, formerly department receptionist (where you may have known her as Carly Eggleston), is now department scheduler. Cheryl Schweizer joins us from the Chemistry Department, where she worked for 25 years; she is now our receptionist. Finally, Cami Reece continues her role as budget analyst. With this team of well-qualified professionals in place, I look forward to a productive year ahead.

In this newsletter, you'll read about the impressive achievements of the Mathematics Department's students and faculty, as well as news from one of our alumni. If you have any items for a future newsletter, please pass them along.

Lastly, I'd like to thank those of you who have supported us through your donations and gifts. Your generosity provides critical support for the department's students, faculty and staff. It is very much appreciated.

Best Regards,
Joseph Borzellino

Cover Article: Traveling Salesman Problem Art — Michelle Schmitt

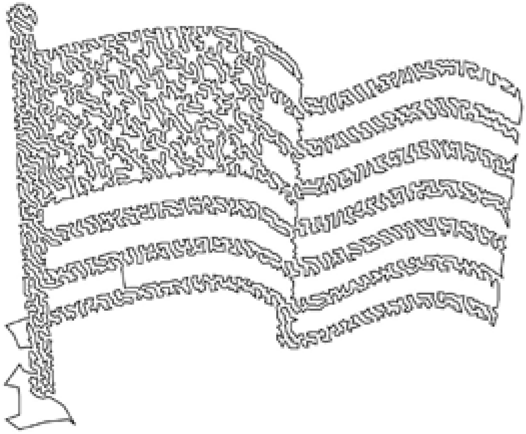
The goal of our project was to recreate target images as continuous line drawings using digital image manipulation and traveling salesman problem algorithms.

The traveling salesman problem, originally referred to in mathematics as the messenger problem, was first studied by Karl Menger in the 1930s. The problem is: Given *n* cities, we seek to find a tour *T* (a path which visits each city) such that the length of *T* is minimal.

Starting with an image, we first replace the image with a grayscale version, then stipple it. That is, we replace, in blocks, the grays with dots of a certain density. The software package, Mathematica, allows us to easily put an image into the format necessary for stippling. The three figures above show the progression of stippling on an image of an American flag.

Now that we have a stippled image, we can create a tour of the dots in the image. We used the Lin-Kernighan (LK) algorithm to construct the tour. Using Concorde, a tool developed by a group at Georgia Tech to implement the LK algorithm, we produced an image showing an optimal tour (see below).

To understand how this tour is created, we can take a closer look at the LK algorithm. The LK is an improvement algorithm: it starts with an arbitrary tour T_1 and looks for sequential improvements. The algorithm has the ability to look for an arbitrarily large number of improvements in an effort to find an optimal tour. The process continues until no shorter tour can be created. Given the dependence of this optimal tour on the initial tour T_1, the algorithm repeats the process with a completely new arbitrary tour T_2. The picture below is the result of repeating this process three times.



New Faculty — Emily Hamilton

Emily Hamilton was born in New Zealand and raised in the San Francisco Bay area; Washington, D.C.; and Vancouver, British Columbia. After graduating from high school, she spent a year working in London, England, and then attended the University of Chicago, majoring in mathematics. Hamilton earned her doctorate in mathematics from UCLA. After graduate school, she was a Griffith Conrad Evans instructor at Rice University in Houston for two years. She then joined the faculty at Emory University, where she spent the last 15 years.

Hamilton is excited to join the Mathematics Department at Cal Poly and to return to California. She is eager to engage in the department and college life and looks forward to working with the students.

New Faculty — Eric Brussel

Eric Brussel grew up in Urbana, Ill., and attended UC Santa Cruz, majoring in physics. After a short and challenging post-college stint teaching high school in Felton, Calif., he decided that mathematics was his true interest. He earned his doctorate from UCLA in the field of algebra in 1993, specializing in division algebras and the Brauer group. Following graduation he married Emily Hamilton (above), and after Brussel completed a postdoctoral position at Harvard, he and Hamilton accepted positions at Emory University in Atlanta, Ga., where they worked and raised a family for the last 15 years. Though comfortable in Atlanta, they always longed to return to coastal California and are thrilled to have the chance to join the Mathematics Department at Cal Poly. Brussel's mathematical interests still center on the Brauer group, while his methods have become increasingly geometrical.

Brussel is interested in music of all kinds. He also likes to ride his bicycle and takes a trip to the High Sierra every summer.

New Faculty — Erin Pearse

Erin Pearse is excited to return to California after an extended tour of the country. Following graduation from UC Riverside, Pearse held postdoctoral positions at Cornell University, University of Iowa and University of Oklahoma. “I am really looking forward to NOT moving again in three years. In fact, it would be nice not to move ever again. San Luis Obispo would be an especially difficult place to leave. Not only is the area (and the weather!) beautiful, but I was immediately impressed by the friendly and collegial atmosphere. I haven’t felt this sense of community on campus or in the surrounding area since I left the town where I grew up.” Pearse grew up in Telkwa, British Columbia, Canada, a village of 842 people in the Coastal Rockies more than 700 miles north of Vancouver.

Even as a teenager Pearse wanted to be a professor, but he always disliked mathematics in high school. “I thought it was boring and mechanistic. Geometry was sort of fun, but it was difficult to really see the point of any of it. And I never felt that I had any natural aptitude for it.” Pearse went to college intending to major in comparative literature but quickly changed to philosophy. He ended up specializing in philosophy of science and formal logic. From there, the leap to mathematics was not that big. When asked what led to the switch, Pearse said, “Around the time I first started university, my dad gave me the book ‘Chaos,’ by James Gleick. I was instantly captivated by the images and also by the idea that there was a mathematics capable of describing noisy, messy, irregular phenomena like you actually see in nature. So I started reading more about chaos theory and complexity studies and taking math courses for electives so that I could better understand the ideas discussed in the books. Eventually, I fell completely in love.” Years later, Pearse completed his dissertation on a topic from fractal geometry, and he continues to do some research on fractals, although his current interests mostly revolve around topics from network analysis.

New Staff — Cheryl Schweizer

After moving every two years during her childhood, Cheryl’s family settled in Garden Farms, Calif., just north of Santa Margarita, when Cheryl started junior high. Later, her family moved to Atascadero where Cheryl attended Atascadero High School and then Cuesta College. After a number of years, she moved to San Luis Obispo to avoid the heat. She came to Cal Poly after working for two years at Cuesta College. Cheryl joined the Mathematics Department as an administrative assistant in August 2012 after 25 years with the Chemistry Department. She has worked on campus for 36 years and enjoys working with students, faculty and staff.

Summer Research Program 2012

Seven faculty members and 16 undergraduate and graduate mathematics majors worked on research projects during summer 2012. These projects were funded by college-based fees.

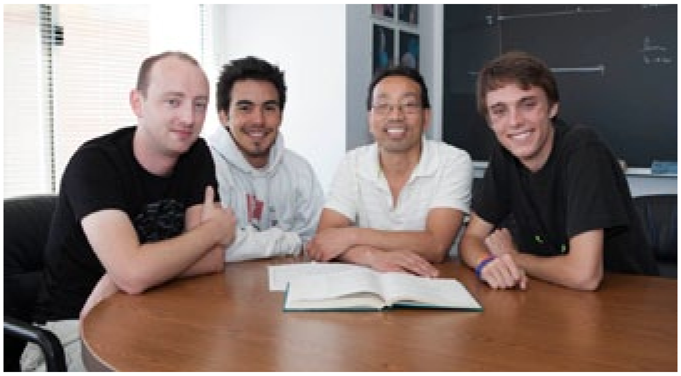
Professors Todd Grundmeier and Dylan Retsek worked with undergraduate Dara Stepanek on a project to study self-inquiry. Self-inquiry is the process of posing questions to oneself while solving a problem. The researchers used structured interviews to explore 13 undergraduate mathematics students' self-inquiry during the solution of both mathematical and non-mathematical problems. The students were asked to verbalize any thought or question that arose while they attempted to solve a mathematical problem and its non-mathematical, logical equivalent.

The student volunteers had each taken at least four upper-division, proof-based mathematics courses. Using transcriptions of the interviews, a coding scheme for posed questions was developed and all questions were coded. Data analysis of the posed questions is ongoing. Preliminary results of the work were presented at the Conference on Research in Undergraduate Mathematics Education in February 2013.

Grundmeier and Retsek with student Stepanek (left)

Professor Caixing Gu worked with students Tim McCaughey, Marino Romero and Scott Warnert on a project studying the Non-negative Matrix Factorization (NMF) technique, which was initiated by Lee and Seung in 1999. With this technique, researchers use algorithms to reduce large quantities of positive data typical in diverse fields such as text mining, music analysis, imaging processing and pattern recognition.

A recent paper examined necessary and sufficient conditions for such NMF to be unique. Last summer, the students investigated the gap between various conditions and were able to derive a necessary and sufficient condition for small size NMF to be unique.



Gu (second from right) with students McCaughey, Romero and Warnert

Summer Research Program 2012

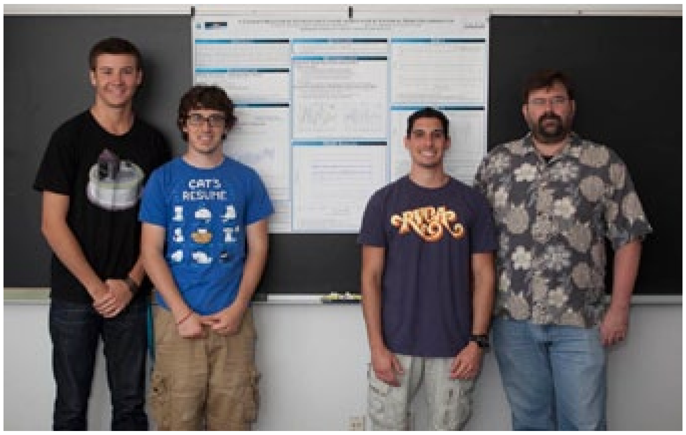
Shapiro (left) with students Duna and Gagne

Professor Jonathan Shapiro worked with undergraduates Chad Duna and Matthew Gagne on projects involving finding properties of composition operators. They investigated questions about when the product of a composition operator and its adjoint have certain asymptotic Toeplitzness properties.

Together with Professor Caixing Gu, they have written a paper containing the results of their work and have submitted it for publication.

Shelby Burnett and Ashley Chandler did research with Professor Linda Patton on linear algebra and matrix theory. The numerical range of a matrix is the set of all quadratic forms of a matrix that are generated by unit vectors; this set is a convex region in the complex plane. The numerical range of a matrix with real entries is known to be symmetric about the real axis. Shelby and Ashley proved more symmetry results about numerical ranges. They gave a presentation on their results at the Mathematical Association of America MathFest 2012 in Madison, Wis., in August and their presentation won an award.

Patton (center) with students Chandler and Burnett



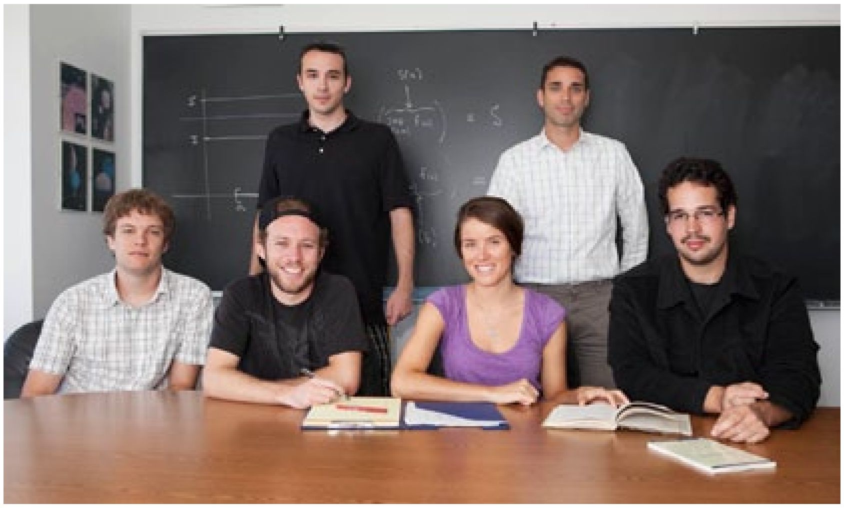
Camp (right) with students Gibson, Rodrigues and Muscarella

Matthew Rodrigues, Tanner Gibson and Zeno Muscarella — all undergraduates — worked with Professor Charles Camp on the development and implementation of time series analysis techniques and their applications to paleoclimate records and to recent satellite records of the Earth’s atmosphere.

One project focused on using new techniques to analyze recent ocean sediment records in order to characterize the mid-Pleistocene transition (MPT) in the Earth’s climate. The MPT hypotheses generated by this empirical analysis were investigated via the Maasch-Saltzman dynamical model of the Pleistocene climate.

In a separate, ongoing project, satellite records of ozone concentrations in the atmosphere were analyzed to isolate the response to decadal oscillations in the solar forcing. Research on both projects continues during the 2012-13 academic year with support from the NSF via the Mathematics and Climate Research Network.

Summer Research Program 2012



Sherman (back row, right) with students Campbell, Birdsall, Elwood, Hipolite and Garcia

Professor Morgan Sherman worked with students Derik Birdsall, Michael Campbell, Jason Elwood, Max Garcia, and Dana Hipolite investigating the behavior of the Ricci flow on Riemann surfaces. The Ricci flow is a partial differential equation on a manifold which attempts to smooth out its curvature in a manner analogous to the ways in which the heat flow smooths out heat distribution on an object. One of their projects examined how applicable this analogy is in the case in which the Riemann surface is a torus. They have several comparisons already and hope to generate more in winter quarter. They will present their findings at the spring College of Science & Mathematics Research Conference and possibly at a Mathematical Association of America (MAA) sectional conference this year.

2012 PREP Workshop

Paul Choboter, Anthony Mendes, Dylan Retsek, Mark Stankus and Stan Yoshinobu participanted in the MAA PREP workshop at UC Santa Barbara in June 2012. This workshop focused on using inquiry-based learning in mathematics in courses for future teachers and sophomore-level calculus courses. The workshop included faculty from across the country who gathered for four days of intensive training.

Focus on Faculty Research — Morgan Sherman

The Mathematics Department faculty are engaged in a wide range of research activities. In this newsletter, we asked Morgan Sherman to explain some of his recent professional work.

I would classify my field of study as complex algebraic geometry. Loosely stated, this is the study of those geometric spaces which "locally look like $\mathbf{C}^n$." For example, a sphere or a torus would fit the bill with $n=1$. In recent years I have been investigating a particularly powerful technique known as the Ricci flow (or rather, Kähler-Ricci flow, which is the complex-variable analogue).

To help illustrate what the Ricci flow is, it helps to remember the heat flow that one encounters in a first course on partial differential equations (PDEs). For a set U in Euclidean space, we consider the PDE $\partial_t f = \Delta f$, where $f= f(x,t)$, for $x \varepsilon U$ and t a time variable. If we interpret $f(x,t)$ as giving temperature at $x \varepsilon U$ at time t, then it is a standard result that this equation will yield solutions that, over time, "smooth out" the initial temperature distribution on U.

Now we recall the famous Poincaré conjecture (now a theorem!). Originally posed by Poincaré in the early 1900s, the theorem states the following: Every three-manifold (roughly: those topological spaces which locally look like $\mathbf{R}^3$) which is compact and simply-connected (i.e., any closed loop can be contracted to a point) must be a three-dimensional sphere. This problem withstood years of attempts to prove it. The problem fascinated many mathematicians, not just the topologists (it is, after all, fundamentally a topological question). Differential geometers took up the task of trying to prove it by considering three-manifolds with the extra structure of a metric, which gives a way of computing lengths of paths as well as angles between tangent vectors (in fact, a metric is basically an inner-product defined on each tangent space of the manifold).

In the early 1980s, Richard Hamilton suggested the idea of evolving a given metric via a PDE that acted in a manner similar to the heat flow. In principle, one would hope that solutions would yield evolving metrics that would tend to "smooth out" over time, ultimately leading (ideally) to a metric with a more simple curvature. Hamilton termed this PDE the Ricci flow and laid out an ambitious program to establish the long-standing Poincaré conjecture. This program was finally completed in the early 2000s, more than 100 years after the initial conjecture, when a reclusive Russian mathematician named Grigori Perelman distributed three papers — never formally published — that contained the solution to this problem by completing Hamilton's program (as a side note, Perelman subsequently turned down a $1 million prize as well as the prestigious Fields Medal).

In complex geometry, an important class of manifolds are the so-called Kähler manifolds, which place an extra restriction on the metric (we don't need to be too specific here). As an algebraic geometer, I am most deeply interested in projective algebraic manifolds, which essentially are those sets that can be described as zero sets of homogeneous polynomials. By a deep theorem, due to Kodaira, every projective algebraic manifold admits a Kähler metric. This means that Kähler manifolds are not only of interest to differential geometers but also of fundamental importance to algebraic geometers.

The complex variable analogue of the Ricci flow, termed the Kähler-Ricci flow, has gained a great deal of prominence in complex geometry. I should first note that one extremely important problem is to verify that the flow in fact converges to something! With this in mind, let me briefly describe some of my most recent research regarding it.

When I first came to Cal Poly, I was investigating a discrete analogue to the Kähler-Ricci flow first described by Simon Donaldson. His method was to start with a particular metric g_0 and then, instead of "flowing" it as in the Ricci flow, find a sequence of metrics g_1, g_2, g_3, … which ought to behave in some ways like its continuous counterpart. This method led to a paper in which I was able to describe in some detail the convergence properties of this sequence of metrics in the case of the Riemann sphere.

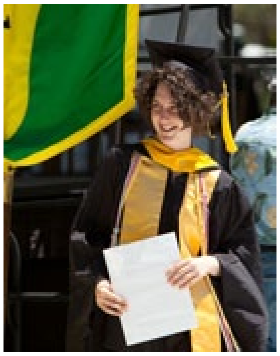
More recently, I have been working with Ben Weinkove, currently at Northwestern University. Our work brings us back to the Kähler-Ricci flow. One method to establish the convergence of the flow is to follow a so-called boot-strapping argument. Here one shows that having some numerical bound on the metric must imply bounds on derivatives to all orders of the metric. About a year ago, we proved that one can in fact make this argument local (i.e., a local bound on the metric implies local bounds on each of its derivatives); one main feature of our work was to establish this using only elementary principles, essentially just using an argument based on (a parabolic version of) the maximum principle that every student learns in a first course on complex variables.

Currently Ben and I are finishing a project that we hope will extend this argument to a wider class of complex manifolds that are not necessarily Kähler.

2011-12 Graduates







Bachelor's of Science

Sofia Liliana Archuleta
Monica Miroslava Arizmendez
Maxine Cleofe Balbuena
Amanda Caroline Belleville
Karla Nicole Benefiel
Derik Dylan Birdsall
Alexander Jonathan Bozarth
Hugo Steve Campos*
Brandon Ryan Chow
Jenna N. Colavincenzo
Chelsea Alida Ditler
Kristina L. Dyer
Gregory Andrew Edwards
Alyssa Mane Eubank
Kristen Sara Yoshiko Field*
Patricia Irene Galindo
Shawn Marie Garrity***
Katie Geiser
Alex Michael Gerber*
Jennifer Lee Gildner*
Neal S. Grantham**
James Forsythe Hall***
Chad Ebner Hamilton
Alyssa Nicole Hamlin*
Taylor Park Hilburn
Gerry Hoencke
Michele Kim Jenkins*
Haley Nicole Johnson
Trevor Thomas Jones***
Timothy Patrick Joyce
Casey Lynn Kelleher***
Jeremy Joseph Lazarus
Blanca Daniela Lopez
Logan Samuel Phillip Lossing**
Nicole Louise Lund
Elizabeth Toria Mock
Michael David Mogull*
Christopher Beechum Murray*
Anna Alyssa Nickelson
Carl Douglas Olson
Elizabeth Ann Owens*
Cierra Lynn Rawlings*
Therese Marie Redlinger
Veronica Lynn Snider**
Dara Jenae Stepanek***
Nathan Darrell Taylor*
Matthew Alec Tytel
Rebecca Sandrienne Wats Weaver
Melinda C. Wiles
Benjamin Sky Woodford
Katherine Elizabeth Zirkel

**   cum laude*
*** magna cum laude*
**** summa cum laude*

Master's of Science

Casey Lynn Kelleher★
Erin Elizabeth Kelly
Suzanne Nunes Lavertu★
Michael David Mogull★
Richard Kiyoshi Neufeld
Staci Ann Pearson
Kendall Marie Rosales

★ *Graduating with distinction*

Math Major at JPL — Jenna Murphy

For senior math major Jenna Murphy, Mars came a little closer this August when the Curiosity rover touched down. Murphy spent the summer at NASA's Jet Propulsion Laboratory (JPL), where the rover was developed, as part of the STEM Teacher and Researcher (STAR) Program.

Murphy worked alongside scientists who were directly involved with the Mars Science Lab, the mission that includes Curiosity. She also got to experience the landing celebration close-up. At the convention center in Pasadena, Calif., Murphy watched the rover's progress with a number of people who had worked closely on the mission

The first picture Curiosity beamed back showed a wheel. "A guy I was talking to said, 'Oh I worked on that wheel,'" Murphy said. "It was really, really cool that I got to meet people who worked so closely on the project."

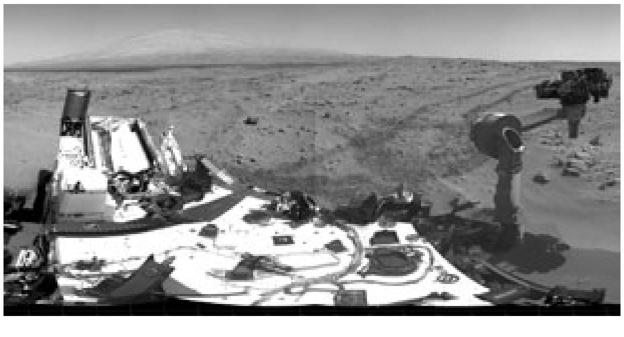
Murphy's research at JPL related to a future Mars mission that's at least a decade away — putting a rocket on the surface of Mars to collect and bring back samples. Murphy worked specifically on developing a container to hold and preserve the samples during space flight and the trip through Earth's atmosphere. Curiosity will collect and analyze samples but will not return to Earth.

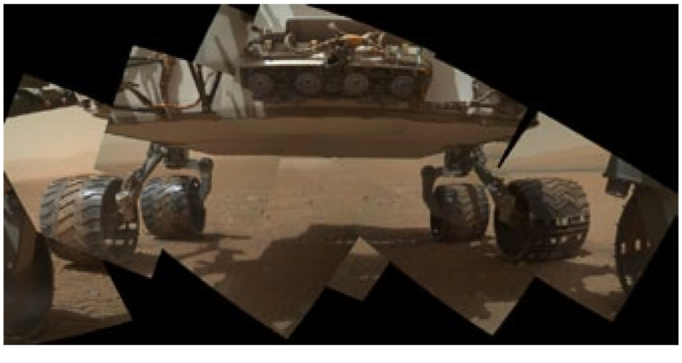
Living through a successful landing while working on a future mission piqued Murphy's curiosity about what will come next in Mars exploration. "There were a lot of ideas being traded around for the future," she said.

Murphy found that her Cal Poly math major served her well at JPL. "Math is excellent for problem solving, and for figuring out how to create a plan of attack for the job you're going to do," Murphy said.

Working on real-life research helped Murphy decide that she wants to pursue a master's degree in aeronautics or engineering. "It was really inspiring to meet so many people working towards the goal of understanding science. It would be my dream to work at NASA," she said.

Murphy plans to join Cal Poly's Cubesat program in which students build small satellites that perform scientific research and test new technologies in space.





Images Courtesy of NASA/JPL-Caltech

2012 Department Photo

Front row (left to right): Carole Simard, Anne Nakano, Mollee Huisinga, Lawrence Sze, Blanca Lopez, Anna Kopcrak, Trung (Peter) Ho, Garrett Bates, David Sacco, Lana Grishchenko, Cheryl Schweizer, Carly Burdge, Elsa Medina, Clint Hahlbeck.

Middle row: Stan Yoshinobu, Clint Florka, Jennifer Aguayo, Marian Robbins, Katherine Muckle, Michelle Schmitt, Rob Easton, Harvey Greenwald, Morgan Sherman, Joe Borzellino, Issac Comelli, Tim McCaughey, Al Jimenez, Goro Kato, Cami Reece, Emily Hamilton, Sheryl O'Neill, Mike Robertson.

Back row: Jonathan Shapiro, Linda Patton, Colleen Kirk, Amelie Schinck-Mikel, Charles Camp, Mark Stankus, Sean Gasiorek, Bill Hesselgrave, Jeff Liese, Dylan Retsek, Don Rawlings, Anthony Mendes, Erin Pearse, Christian Ponder, Derik Birdsall, Anton Kaul, Eric Brussel, Todd Grundmeier, Don Hartig, Ben Richert, Kate Riley, Todor Todorov, Bryce Jenkins, Paul Choboter.

Newsletter Puzzle Challenge

With this year's newsletter, we have decided to include a mathematical challenge for our readers. For the last few years, Morgan Sherman has taken responsibility for the Mathematics Department tradition of issuing a Puzzle of the Week. As an example, here is a puzzle that we invite you to try.

A Putnam Exam problem a few years ago asked whether or not the length of any parabola contained inside a unit radius circle could ever exceed 4. To the surprise of many, the answer is actually *yes*. In fact, the parabola $p_t(x)$ defined by $y=tx^2-1$ will have a length inside the circle $x^2+y^2=1$ exceeding 4 (but not by much!) when t is large enough. For this problem, we ask you to find, correct to 8 decimal places, the longest length of any $p_t(x)$ that lies inside the *ellipse* $4x^2+y^2=1$.

We also invite you to submit your solution by email to sherman1@calpoly.edu. We will recognize those submitting correct solutions to the newsletter puzzle in next year's newsletter.

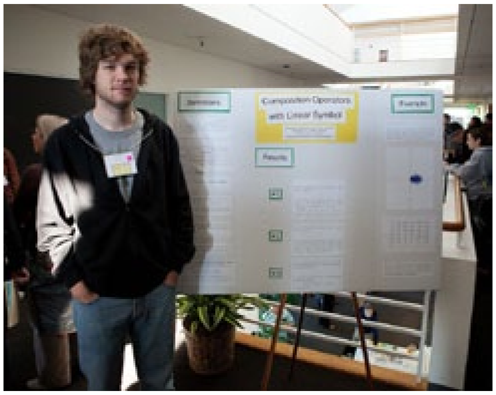
Cal Poly Noyce Scholars, Phase II — Todd Grundmeier and Elsa Medina

Todd Grundmeier and Elsa Medina received a five-year, $798,000 grant from the National Science Foundation to continue the work of the original Robert Noyce Scholars grant. The Noyce Scholars program provides scholarships to students who are committed to teaching science or mathematics in high need school districts upon the completion of a teacher credential program. The grant will support 21 Noyce scholars through their studies to become mathematics teachers and will support summer workshops in 2013-17 for up to 50 Noyce scholars from the Western Regional Noyce projects. Noyce Scholars will receive $12,000 per academic year. Scholars will be required to teach two years in a high need district for every year of scholarship they receive. The purpose of the summer workshops is to discuss issues related to teaching in high need districts. The workshops will also help develop a network of Noyce scholars in the Western Region.

Students Attend Northern California MAA Meeting

In February, 11 students and three professors attended the annual meeting of the Northern California, Northern Nevada and Hawaii Section (The Golden Section) of the Mathematical Association of America (MAA) at the Mathematical Sciences Research Institute in Berkeley.

Undergraduates Alex Gerber and Matthew Rodrigues presented a poster titled "A Characterization of Pleistocene Climate as Revealed by Empirical Mode Decomposition" on their work supervised by Charles Camp. This work was also presented at the spring 2012 Cal Poly College of Science and Mathematics Student Research Conference.



Undergraduates Derik Birdsall and Matt Gagne presented a poster titled "Composition Operators with Linear Symbol" about their work with Jonathan Shapiro.

Left: A group shot of the students who attended MAA.

Right: Undergraduate James Hall presented a poster titled "Completeness of Ordered Fields" about his work with Todor Todorov.

Working with Teachers on the New Nationwide Standards

For the second year, Kate Riley has received a $250,000 Improving Teacher Quality (ITQ) grant from the federal government. The grant funds teacher preparation for the upcoming nationwide standards for K-12 mathematics, called the California Common Core State Standards, which were adopted in August of 2010. The state plans to start testing students based on the standards in Spring 2014.

The grant allows Riley to continue leading monthly workshops for 34 fifth- through eighth-grade teachers from the Santa Maria-Bonita school district. The purpose of these workshops is to help inform teachers of the new California Common Core State Standards and to enhance teachers' conceptual understanding of the mathematical ideas aligned with the new standards.

Conceptual understanding refers to the grasp of mathematical ideas and the connections between them. It helps students link related concepts and methods in appropriate ways and understand the why and how of mathematical ideas, which in turn helps their retention of those ideas.

The new standards place a stronger emphasis on students both comprehending the mathematical procedures and developing a conceptual understanding of mathematics. For example, students will be asked not only to be able to divide fractions but also to demonstrate division of fractions using different representations, such as drawing a picture or using concrete materials.

Riley sees the workshops providing multiple layers of help for the participating teachers. "The teachers are learning about the standards, but they're also deepening their mathematics content knowledge. They're coming together and talking about how students conceptually learn mathematics."

Throughout the year, the teachers collaborate to develop and test lesson plans based on the material presented in the workshops. Then they act as ambassadors to educate their colleagues in their district about the standards. These leadership teams are part of an effort to sustain and expand the professional development opportunities offered by the grant.

The hope is that all of this learning will be passed on and improve student achievement in mathematics. "They're facilitating the learning of mathematics in everything they do," Riley said.

Todd Grundmeier, Elsa Medina and Julie Herron assist with the teacher workshops. The workshops will conclude with a summer institute in 2013.

Faculty Publications and Activities

Publications:

Joseph Borzellino and **Morgan Sherman**: “When is a trigonometric polynomial not a trigonometric polynomial?,” *American Mathematical Monthly*, **119** (2012), no. 5, 422-425.

J. D. Alper (Universidad de los Andes) and **Robert Easton**: “Recasting results in equivariant geometry: affine cosets, observable subgroups and existence of good quotients,” *Transformation Groups*, **17** (2012), no. 1, 1-20.

Todd Grundmeier and **Dylan Retsek**, with undergraduates **Alyssa Eubank**, **Shawn Garrity**, and **Alyssa Hamlin**: Undergraduate Proof in the Context of Inquiry-Based Learning. Paper in the Proceedings of the RUME Conference, Portland, OR, February 2012.

Colleen Kirk and **W. Edward Olmstead** (Northwestern): “Superdiffusive blow-up with advection,” *International Journal of Dynamical Systems and Differential Equations (IJDSDE)*, **4** (2012), no. 1-2, 93-102.

Thomas Langley (Rose-Hulman), **Jeffrey Liese** and **Jeffrey Remmel** (UCSD): “Generating functions for Wilf equivalence under generalized factor order,” *Journal of Integer Sequences*, **14** (2011), no. 4, Article 11.4.2.

Dana Paquin, **Peter Kim** (Utah), **Peter Lee** (Stanford) and **Doron Levy** (UMD): “Strategic treatment interruptions during imatinib treatment of chronic myelogenous leukemia,” *Bulletin of Mathematical Biology*, **73** (2011), no. 5, 1082-1100.

Morgan Sherman and **Ben Weinkove** (UCSD): “Interior derivative estimates for the Kähler-Ricci flow,” *Pacific Journal of Mathematics*, **257** (2012), no. 2, 491-501.

Todor Todorov: “An axiomatic approach to the nonlinear theory of generalized functions and consistency of Laplace transforms,” *Integral Transforms and Special Functions*, **22** (2011), no. 9, 695-708.

Talks and other Activities:

Stan Yoshinobu won a $540,000 National Science Foundation Transforming Undergraduate Education grant. This project is a collaboration between Cal Poly, Cal State Dominguez Hills and the University of Colorado Boulder. Yoshinobu and his colleagues will conduct annual inquiry-based learning workshops for college math faculty members for three years. The project’s goal is to increase the number of faculty members using inquiry-based learning. Yoshinobu will also study the effects of professional development workshops on faculty practices and beliefs.

Linda Patton gave two invited talks:
“Numerical Ranges of Some Cubic Operators” at the AMS Joint Mathematics Meeting in Boston, MA, January 7, 2012.
“Numerical Ranges of Some Block Toeplitz Composition Operators” at the International Workshop in Operator Theory and Applications, Sydney, Australia, July 17, 2012.

Summary Math Academy

Last summer, Elsa Medina and Amelie Schinck-Mikel led the first ever Math Academy for teachers and students from Santa Maria and Pioneer High Schools. The Academy showed 18 students that math can be fun and exciting.

The week-long program introduced students to a new way of doing math. The group used a hands-on approach to algebra and geometry, drawing pictures and building models to help them discover solutions.

“There was no immediate algorithm to get to the answer,” Medina added. “They had to figure it out.”

Most of the students were not previously high performers in math. The academy, funded by the Teacher Quality Program and Teacher Recruitment Project grants held by Cal Poly’s School of Education, brought out their inner mathematician.

“The most exciting part for me was seeing how creative the students’ solutions were,” Schinck-Mikel said. “They were thinking of ways to solve problems I hadn’t thought of.”

The problems were designed to address the upcoming common core standards that will be put into practice in high schools nationwide beginning in fall 2013. The standards represent a shift in secondary math education, and the academy gave the high school teachers a taste of the changes.

Zenia Iniguez, a 9th-11th grade math teacher at Santa Maria High School, accompanied the students on a campus visit in October, the first of three visits the students will make to Cal Poly throughout the year.
“It is very enlightening just to see that students don’t mind putting that much thought into things,” Iniguez said. “More than anything, it broadens their horizons of what they can do and how they can use math in real life situations.”

Medina and Schinck-Mikel chose Santa Maria and Pioneer high schools because the student populations there are diverse. Both professors are first-generation college students, and they wanted to help students like themselves begin to think about college.

“Now they have a link to a university that’s really not that far from them,” Schinck-Mikel said.

The academy will likely run again next summer. Medina and Schinck-Mikel want to expand the program, but funding beyond summer 2013 is uncertain.

“All the kids said, ‘Please invite us again next year,’” Medina said.

Putnam Exam Competition

In December 2011, Cal Poly placed 47th out of 572 teams competing in the William Lowell Putnam Mathematical Competition. The high scorers from Cal Poly were Matthew Tytel (far left), who scored 19 points and placed 349th out of 4,440 competitors, and James Hall (third from the left in the front row), who scored 11 points and placed 646th. Jonathan Shapiro coached the team.

Mathematical Contest in Modeling 2012

The Mathematical Contest in Modeling (MCM) took place in February 2012. Cal Poly fielded three teams of three students each, all supervised by Charles Camp.

The teams for the 2012 MCM were:

Team 1: Brian Jones, Matthew Larson , Andrew Wang
Team 2: Wade Kelley, Matthew Murachver, Dwight Townsend
Team 3: Max Bigras, Josh Fernandes, Kelly Odgers

Team 1 received an honorable mention for their work, a designation which was given to only those in the top 38 percent of the more than 3,700 teams that entered.

The team members tackled a problem that required them to analyze and optimize boat and camping trips along a river. They had to develop the best schedule for the trips and ways to determine the carrying capacity of the river, given that no two sets of campers can occupy the same site at the same time. They also had to prepare a one-page memo to the managers of the river describing their key findings.

Ninth Annual Math Awards Banquet

Robert P. Balles Mathematics Scholarships
Eric Cramer and Chad Duna with Math Department Chair Don Rawlings

Raytheon Company Scholarship
Allison Scheppelman with Don Rawlings

Katrina J. Killgore Memorial Scholarship
Nora Ortega with Don Rawlings

W. Boyd Judd Award
Dana Hipolite with Jonathan Shapiro

Ralph M. Warten Memorial Scholarships
Kathryn Burton, Dana Hipolite, Stephen Calabrese, Leah Avila and Katherine Chiccone with Don Rawlings (not pictured: Alastair Curley, Zeno Muscarella, and Andres Rodriguez Mendez)

Volmar A. and Viola I. Folsom Scholarships
Marino Romero, Michael Ion, Lumin Sperling, Khoa Nguyen, Adrian Tamayo, Courtney Good and Nicolas Rodriguez with Don Rawlings (not pictured: Adam Liu)

George H. McMeen Scholarships
Ashley Chandler, Kelsey Grantham, Blanca Lopez and Anna Kopcrak with Don Rawlings (not pictured: Leah Stamer)

George C. Laumann Scholarship
Michael Ion with Don Rawlings

Ralph E. Weston Memorial Award
Matthew Tytel and James Hall, each with Jonathan Shapiro

Marie Porter Lehman Math Educator Scholarship
Veronica Snider with Todd Grundmeier, Elsa Medina and Don Rawlings

Kappa Mu Epsilon Founders Award
Michele Jenkins with Jonathan Shapiro

TC Reece Mathematics Award
Alyssa Hamlin with Cami Reece

Carol S. and W. Boyd Judd Scholarship
Kristin Symer with Carol Judd and Don Rawlings

Outstanding Students

Outstanding Teaching Associate
Garrett Bates with Dylan Retsek

Charles J. Hanks Excellence in Mathematics Award
Matthew Tytel and Trevor Jones with Don Rawlings

Outstanding Mathematics Educator Awards
Nathan Meinert, Jason Del Aguila and Cammie Oertel with Elsa Medina

Accenture Outstanding Junior in Mathematics
Eric Cramer with Don Rawlings

Outstanding Seniors in Mathematics
Dara Stepanek, James Hall, Shawn Garrity and Trevor Jones with Don Rawlings (not pictured: Casey Kelleher)

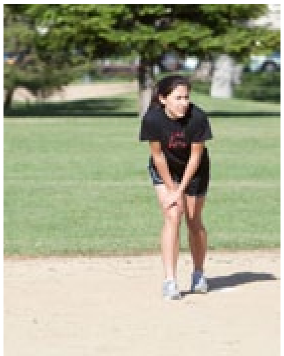
Bryant Russell Memorial Award
Maro Tsiifte, Elizabeth Owens and Cierra Rawlings with Don Rawlings

Charles J. Hanks Scholarship
Chad Duna with Don Rawlings

End-of-Year BBQ and Softball

Undergrads vs. Faculty and Grads

The faculty team won this round, 10-3 in seven innings — a dominating performance that extended the faculty's winning streak to four games.



Gene Denk, Class of 1960

After graduating from Cal Poly, Gene worked as a systems programmer at the Pacific Missile Range. He then spent 25 years at IBM in Manufacturing Development and the Product Test Laboratory. Gene recently published a book, "Birth of an Industry, Computers in the Early Years." In it, he tells of his experiences during the early development of the computer industry:

> The way of life in the computer world at that time is a story that few people are left to tell, and it is important that those days are not forgotten. They were the foundation for the technology of today.

Gene now lives with his wife of 54 years in San Luis Obispo, Calif. They have nine children and eight grandchildren. Gene shared a photo of Cal Poly from 1956, which he took from a friend's Cessna aircraft. Gene explains the photo:

> I can say with some certainty that the rock formation in the picture's lower right (and the little street that is no longer there) are now O'Neill Green.
>
> The stadium would be to the right of the lower right corner of the picture. The larger building near the center of the picture was the old Administration Building. Below it (running across the picture) is College Avenue. Buildings 2 and 3 are there now.
>
> I think the curved street near the lower left was a (now non-existent) extension of California Blvd.
>
> The roughly two dozen Quonset huts in the right-center of the picture were World War II surplus, used for various purposes, such as classrooms. The second one from the bottom, to the immediate right of the third and fourth parked cars (counting upwards), was the Post Office.

2011-12 Honor Roll

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Please email your alumni news submission to math@calpoly.edu OR mail to:
Polymath Editor, Mathematics Department
California Polytechnic State University
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Phone: 805-756-2206 FAX: 805-756-6537
E-mail: math@calpoly.edu Web: www.math.calpoly.edu

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