UCDAVIS

MATHEMATICS NEWSLETTER

Blake Temple
celebrating his 60th
with Nonlinear PDEs
p. 3

Fu Liu
awarded UC Davis Hellman
to further Combinatorics Research
p. 4

Jesús De Loera
wins INFORMS Computing Prize
for Discrete Mathematics
p. 5

Contents

Letter from the Chair

by Joel Hass

"Sometimes being chair feels like going through a rapid."
- Joel Hass, kayaking on the American River

The year 2011 has been both challenging and rewarding. The Department continued to receive international recognition.

Using criteria such as number of publications, awards, and citations, the Center for World-Class Universities at Shanghai's Jiao Tong University in China produces an annual list of the world's leading research universities. In 2011 the UC Davis Department of Mathematics was ranked 30th worldwide, and 22nd among US universities. Individual faculty won several prestigious awards, as discussed elsewhere in this Newsletter, and several of our graduate students were also recognized by highly competitive awards.

Those of us who have spent time at other universities, both in the UC system and elsewhere, know that one distinction of the UC Davis campus is the seriousness with which we approach teaching. One rewarding part of being Department Chair is to hear feedback from students about the extraordinary education delivered by so many of our Department members. This year one of our lecturers, Dr. Ali Dad-Del, was awarded the 2011 Academic Federation Excellence in Teaching Award. Last year Professor Abigail Thompson received the Academic Senate Distinguished Teaching Award, following its award to Professor Motohico Mulase the previous year. This commitment to excellence in teaching extends from our introductory classes all the way to our graduate courses, and it brings with it some exciting challenges.

Our student enrollments are surging. In Fall Quarter 2011, our lower division (first and second year) course enrollments are up 14% from the previous year. Our upper division courses have increased even more, up by 24%. In total, over 6363 students are taking undergraduate courses in mathematics this Fall. The coming years are expected to bring even more growth. We remain committed to maintaining the high quality of our instruction as the campus expands.

I close with a note of thanks for those that have made donations to the Department. Private donations allow us to continue special programs. These range from Explore Math, our program for talented high school students, to conference travel funding for postdocs and pizza for student-organized seminars. In recent years we have received generous donations that have established important scholarships and prizes. All these donations have high impact and are greatly appreciated.

Honors & Awards

This has been a productive year for Departmental honors and awards.

Craig Tracy, Distinguished Professor of Mathematics, has been elected a Fellow of the Society of Industrial and Applied Mathematics (SIAM). Tracy's research focuses on probability theory, integrable systems and statistical mechanics.

Art Krener, Emeritus Professor of Mathematics, was elected a Fellow of the International federation for Automatic Control.

Michael Kapovich, a Professor at UC Davis since 2003, has won the 2011 Faculty Development Award for his work in geometry.

Ali Dad-Del, Lecturer in Mathematics, won the 2011 UC Davis Academic Federation Excellence in Teaching Award.

Yuji Nakatsukasa, who received his PhD in 2010 with Roland Freund as mentor and is currently at the University of Manchester, won the 15th Leslie Fox Prize in Numerical Analysis. This prize was awarded largely on the basis of his doctoral research.

Read more on Fu Liu's Hellman Program grant and Jesús DeLoera's INFORM Computing Society Prize as well as their research on pages 4-5.

A summary of the students and faculty recognized during the annual Departmental Awards Ceremony is on pages 12-13.

Incoming Academic Staff

New Faculty
Sam Walcott

Sam Walcott received his Ph.D. in Theoretical and Applied Mechanics from Cornell University in 2006. His thesis work was aimed at using simple mathematical models to understand various aspects of human movement, from overhand throwing to muscle contraction. After completing his doctoral work, Sam did a first postdoc with David Warshaw at the University of Vermont. There he used single-molecule techniques to explore muscle contraction through experiments and modeling. Getting back to his theoretical roots, Sam did a second postdoc with Sean Sun at Johns Hopkins University. He applied theories based on single molecule mechanics to predict the behaviors of cellular-level biological systems. At Davis, Sam will continue to apply molecular-mechanical models to derive mathematical descriptions of macroscopic biological systems.

Outside of work, Sam enjoys ultimate frisbee, fly-fishing, hiking and watching football. He is thrilled to be working in Northern California, and particularly in Davis, where he can easily pursue these activities.

New Krener Asst. Professor
Dirk Deckert

Dirk earned his doctorate at the Mathematisches Institut der Ludwig-Maximilians Universität München in 2010. In his thesis, which was supervised by his "Doktorvater" Prof. Dr. Detlef Dürr, co-supervised by Prof. Dr. Gernot Bauer (FH Münster) and Prof. Dr. Franz Merkl (LMU), he studied the question of the existence of dynamics of Wheeler-Feynman electromagnetism, a singularity-free formulation of classical electrodynamics. In this work he uses differential equations with unbounded, state-dependent delay. He also examined the existence of the time-evolution of the Dirac sea in external fields, a model of quantum electrodynamics that is used to describe electron-positron pair-creation. This area treats the lift of a unitary one-particle time evolution on time-varying, infinite, anti-symmetric tensor products of Hilbert spaces.

In August 2010 he joined the Department to work with Alessandro Pizzo on questions of renormalization of quantum field models, that work was financed by a grand of the German Academic Exchange Service (DAAD)—a very enjoyable stay that has now been extended by his KAP appointment.

His main interests revolve around a mathematically rigorous understanding of classical and quantum electrodynamics. Apart from that he enjoys playing his guitar and exploring the beautiful coastline of California, where he's trying to catch up on some basic surf-skills.

Meetings about Math

SIAM Student Research

On May 6-7, 2011, the UC Davis Student Chapter of SIAM held its fourth annual Davis SIAM Student Research Conference (DSSRC). Approximately 60 conference attendees from UC Davis and CSU Sacramento were present to welcome this year's distinguished keynote speaker. We were very proud to have Professor Yinyu Ye from Stanford University as a speaker. Professor Ye gave a presentation on "The Simplex and Policy-Iteration Methods for the Markov Decision Problem with a fixed Discount Rate." The conference consisted of 12 student talks and poster presentations on applied mathematics related to topics ranging from atmospheric science to mathematical biology to integer optimization. Presenters and attendees included students from CSU Sacramento and the faculty advisor of the CSU Sacramento Student Chapter of SIAM. This was a great networking opportunity for the Davis chapter, and has opened opportunities for future collaborations.

The conference was supported by SIAM, an NSF VIGRE mini-grant, and the UCD Mathematics Galois Group. More information on the UC Davis Student Chapter of SIAM can be found at:

http://siam.math.ucdavis.edu/

Joint Mathematics and Statistics Colloquium

The third joint Mathematics-Statistics colloquium was held on May 10, 2011. The speaker this year was Professor Peter Kim (Univ. Guelph) who discussed the intersections between topological concepts (e.g. Morse theory) and statistics, and presented an application to MRI brain scans in the study of autism. These topics were of great interest to the audience, which was composed of faculty and students from our two Departments.

Honors and Awards

Fu Liu

Fu Liu, an Assistant Professor since 2007, was awarded a research grant for 2011-12 by the UC Davis Hellman Fellowship Program to further her research in enumerative and algebraic combinatorics.

The San Francisco-based Hellman Family Foundation has funded the fellowship program annually since 2008. Its goal is to provide support and encouragement for the research of promising Assistant Professors who exhibit potential for great distinction and who have documented a need for funding.

Research Highlight

Many-dimensional Polytopes Speak Volumes

A polytope is a higher-dimensional generalization of a polygon. From a computational point of view, a polytope can be described as the set of solutions of a system of linear inequalities. Linear inequalities are among the simplest conditions one can have, arising in many applications from science and engineering to economics.

A system of linear inequalities usually has infinitely many solutions. However, in many scenarios only integer valued solutions are sought. These correspond to points inside the polytope all of whose coordinates are integers. For this reason there is a great deal of interest in counting the number of these integer points that lie within a given polytope. When studying this problem, people often restrict their attention to integral polytopes; that is, polytopes whose vertices are integer points.

In the 1960s, Eugëne Ehrhart discovered a beautiful theorem for counting integer points of integral polytopes. Ehrhart began by considering the dilation of a polytope: for each integer $m \geq 1$; define the mth dilation of a given polytope P to be the polytope $mP = \{mx : x \in P\}$. Instead of only counting the integer points in P, Ehrhart defined and studied the integer point enumerator

$$i(P,m) = \#(mP \cap \mathbb{Z}^d),$$

which counts the number of integer points in each dilation. He proved that the integer point enumerator $i(P,m)$ of a given integral polytope P is a polynomial in m whose leading coefficient is the normalized volume of P. We call $i(P,m)$ the Ehrhart polynomial of P.

By Ehrhart's theory, if the Ehrhart polynomial of an integral polytope is known, the number of integer points it contains can be easily calculated. Moreover, another fundamental property of the polytope, its volume, is also automatically obtained. Both volume computations and integer point enumerations have been shown to be very hard (i.e. #P-hard), so Ehrhart theory is a difficult and interesting field of study.

Dr. Liu's research focus is on the connections between Ehrhart polynomials and volumes of polytopes. She is particularly interested in finding families of polytopes with the property that all or some of the coefficients of their Ehrhart polynomails are positive, or, more strongly, that they can be described as summations of positive multiples of volumes.

Her first major contribution to this area was to prove a conjecture by De Loera that the coefficients of an integral cyclic polytope are given by the volumes of its projections, and therefore are positive. Later, she generalized this theorem by defining a larger family of polytopes, called lattice-face polytopes, and showing that their Ehrhart polynomials have the same forms as those of the cyclic polytopes. Moreover, she proved that any rational polytope is affinely equivalent to some lattice-face polytope. This shows that for any combinatorial type of rational polytope, one can always find a realization with positive Ehrhart coefficients.

Recently she has further generalized the lattice-face polytopes by defining k-integral polytopes. She has proved that their Ehrhart coefficients in degrees less than or equal to k are given by the volumes of projections, and their coefficients in higher degrees are determined by slices. In particular, if a polytope is fully integral, its Ehrhart polynomial has the same form as those of cyclic polytopes. One consequence of this theorem is that it becomes easy to calculate the lower degree Ehrhart coefficients of k-integral polytopes, whereas previously it had been thought to be easier or quicker to estimate the higher degree terms.

Research Highlight

An Optimizer's Work Is Never Done

Discrete optimization is the branch of applied mathematics that focuses on optimizing functions over discrete sets. A famous example is the traveling salesman problem: Given *n* cities, each of which must be visited exactly once, and the costs c_{ij} of travelling from city *i* to city *j*, one must find the order to visit the cities that minimizes the total cost. Another important discrete optimization question is how to determine the largest group of individuals within the Facebook social network who are not friends with each other.

Jesús De Loera's research focuses on developing and applying algebraic and geometric techniques to solve discrete optimization problems such as these. One particularly important question is, given a solution, how can one determine whether it is *optimal*? One approach allows one to establish when optimality is not achieved.

First one encodes the problem into a system of polynomial equations over a finite field. These systems often have interesting combinatorial properties that enable the solution of the problem. For example, to analyze the facebook problem mentioned above, we write one equation $x[i]^2-x[i] = 0$ for each member *i*, and set the polynomial $x_i x_j = 0$ if two members are friends. In this case one can show that there will be a solution to all these equations and to $x_1+x_2+\cdots+x_n = k$, if there is a group of *k* individuals that are not friends with each other.

Then one uses Hilbert's Nullstellensatz, an old result in algebraic geometry, to find a sequence of linear algebra problems that may grow in size, but eventually decide the solvability of the system and thus answer the combinatorial question. The Nullstellensatz says that a system of polynomial equations $f_1(x) = 0, f_2(x) = 0, \ldots, f_s(x) = 0$, with $f_i \in F[x_1, \ldots, x_m]$ and F a field, will have no solution over $\overline{F}$, the algebraic closure of F, if and only if there exist polynomials $\alpha_1(x),\alpha_2(x), \ldots, \alpha_s(x) \in F[x_1, \ldots, x_m]$ such that

$$1 = \sum_{i=1}^{s} \alpha_i(x_1, \ldots, x_m)\, f_i(x_1, \ldots, x_m).$$

For example, the fact that the system of equations

$$x_1^2 -1 = 0,\ x_1+x_3 = 0,\ x_1+x_2 = 0,\ x_2+x_3 = 0,$$

has no solution follows from the Nullstellensatz identity

$$1= -(x_1^2-1)+\tfrac{1}{2}x_1(x_1+x_2)-\tfrac{1}{2}x_1(x_2+x_3)+\tfrac{1}{2}x_1(x_1+x_3).$$

Hilbert's Nullstellensatz can be directly applied to prove the non-existence of solutions for a given system of polynomial equations. The polynomials α_i provide a certificate that the algebraic set described by the f_j's is empty. To find the polynomials α_i the key observation is that, given an upper bound on the degrees of the α_i's, and a parametrization of them (say in terms of monomials of degree less than a certain constant), a solution can be obtained by solving a large system of linear equations.

When we computationally implement this strategy in an algorithm we find that these linear-algebra calculations over finite fields, although large in scale, can be executed quite efficiently. Even for challenging data sets, such as the DIMACS coloring test problems, we could computationally solve graph problem instances having thousands of nodes and tens of thousands of edges that had not previously been solved, even by well-known coloring heuristics. It is hoped that these strategies can be extended to provide tractable solutions of even larger combinatorial problems.

There are many other fundamental problems in optimization where an algebraic perspective also may prove useful. For example, linear programming (LP) is a fundamental step used to solve many problems in applied mathematics and engineering. In its primal-dual form linear programming (LP) seeks vectors $\mathbf{x}$, $\mathbf{y}$, $\mathbf{s}$ that

1. Maximize $\mathbf{c}^T\mathbf{x}$ subject to $A\mathbf{x} = \mathbf{b}$ and $\mathbf{x} \geq 0$;
2. Minimize $\mathbf{b}^T\mathbf{y}$ subject to $A^T\mathbf{y}-\mathbf{s} = \mathbf{c}$ and $\mathbf{s} \geq 0$.

Here A is a fixed matrix of rank d having n columns, while the vectors $\mathbf{c} \in \mathbb{R}^n$ and $\mathbf{b} \in$ image(A) may vary.

One popular technique to solve LP problems is to create a curve that passes through the optimal solutions: For all real $\lambda > 0$, the system of polynomial equations

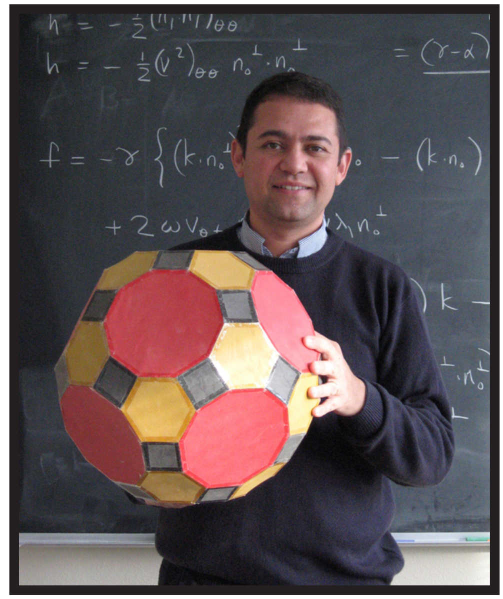
3. $A\mathbf{x} = \mathbf{b}$, $A^T\mathbf{y}-\mathbf{s} = \mathbf{c}$, and $x_i s_i = \lambda$ for $i = 1,2, \ldots ,n$,

has a unique real solution $(\mathbf{x}^*(\lambda),\mathbf{y}^*(\lambda), \mathbf{s}^*(\lambda))$ with the desired properties. As λ changes the solutions trace an algebraic curve, called the *central path*. This path connects the optimal solution of the linear program in question with its *analytic center,* which a special point in the interior of P that corresponds to $\lambda = \infty$. The central path is the key object in interior point method algorithms and software. By studying the equations (3) we can determine properties of its curvature that determine the speed of the implementing algorithms.

There are fascinating challenges ahead in this field!

Honors and Awards

Jesus De Loera



Jesús De Loera, Professor of Mathematics, has won the 2010 INFORMS Computing Society (ICS) Prize for his research in combinatorial discrete mathematics. He also has been selected as the 2012 John von Neumann visiting Professor at the Technical University of Munich.

Celebrating
Blake Temple

A conference entitled "New Perspectives in Nonlinear Partial Differential Equations" was held May 2 – 6, 2011 at the University of Michigan. This conference celebrated Professor Blake Temple's 60th birthday. It featured more than 30 prominent speakers in all areas of research to which Professor Temple has contributed in his career.

Research Highlight
General Relativistic Self Similar Waves and Dark Energy

In 1922 Alexander Friedmann discovered a family of solutions to the Einstein equations of General Relativity (GR) that express the way the universe appears to be expanding. These Friedmann spacetimes, or Friedmann universes, describe a uniform 3-space of constant curvature (measured by $k \in R$) evolving in time. They have formed the basis for the standard model of cosmology ever since Hubble showed in 1929 that the universe was indeed-expanding.

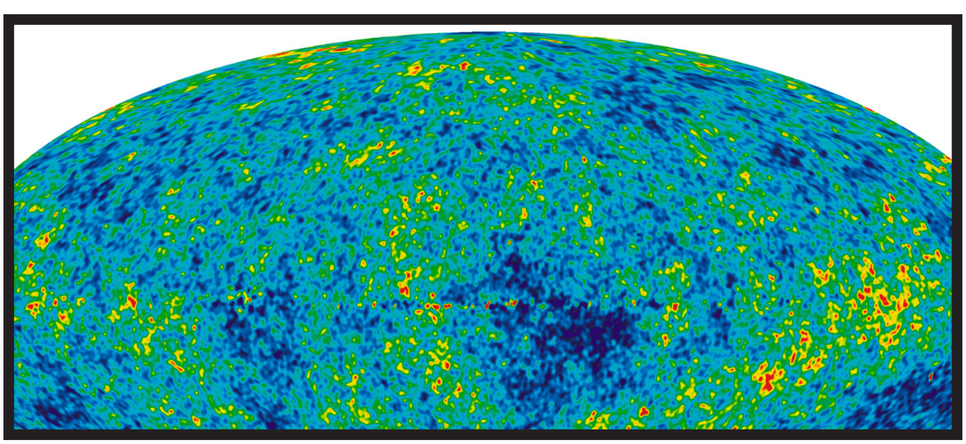
Recently, in an attempt to numerically simulate a GR expansion wave, Blake Temple and his collaborator Joel Smoller found a second family of expanding spacetimes, dierent from the Friedmann spacetimes. As far as they know, this is the only known family of spacetimes other than those of Friedmann that both solve the Einstein equations and contain and perturb the critical Friedmann spacetime that appears in the radiation phase of the standard model of cosmology. The microwave background radiation observed today (shown on the cover of this newsletter) is believed to be the remnants of this radiation epoch.

The spacetimes in this second family are spherical *self-similar* waves which expand outward exactly like the critical (zero curvature, $k = 0$) Friedmann spacetime near the center. Temple and Smoller were led to look for such a family of waves during the radiation phase because, by their earlier work on shock wave theory, they knew that the erce nonlinearities in place in Einstein's equations when the pressure k is 1/3 times the energy density ρ, (the case of pure radiation), could in principle create shock wave dissipation sucient to drive local fluctuations into wave patterns by the end of the radiation epoch. Smoller and Temple have recently become aware that this family of waves was previously known. However, their recent work is breaking new ground in investigating the implications of this family of solutions.

They are starting to rigorously explore the possibility of shock wave dissipation through the *locally inertial Glimm Scheme*, introduced by Temple and his former student Groah. This provides the first rigorous existence theory for shock wave solutions of Einstein's equations. It is able to incorporate general fluctuations, their evolution by wave interactions, and their ultimate decay by shock wave dissipation. After p drops precipitously to zero at the end of the radiation phase, these nonlinear decay mechanisms are no longer operative.

Recent observations of supernovas have shown that the velocities of distant galaxies (as measured by the redshifting of light), plotted against their distance (as measured by their luminosity), does not fit the relation implied by the Friedmann spacetimes. These observations, which earned the 2011 Nobel Prize in Physics, are interpreted as indicating that the expansion of the universe is accelerating. The only way this acceleration can be accommodated within the Friedmann spacetimes is by adding an extra term, the *cosmological constant*, to Einstein's equations, the physical interpretation of which is Dark Energy, an unknown source of anti-gravitation. Smoller and Temple are exploring the possibility that their second family of solutions might provide a dierent explanation for this redshift vs luminosity data. This alternative is based on the idea that a spherical wave, formed during the radiation

...continued on next page.



This is an image of the cosmic microwave background radiation. It shows the state of the universe at the end of the radiation era. It can be seen in closer detail on the cover.

...continued from previous page.

phase of the Big Bang, would introduce a second order correction to redshift vs luminosity, which would appear as an *anomalous acceleration* relative to the critical Friedmann expansion observed at the center. To Temple and Smoller these self-similar spacetimes provide a possible mechanism at the end of the radiation phase, by which the curvature of the spacetimes within the waves could account for the apparent acceleration observed in the redshift versus luminosity data. Such an explanation would be entirely within Einstein's original theory, and does not require a universe filled with Dark Energy.

Since there is only one free parameter within the family of self-similar waves that perturb the standard model, the second order correction to redshift vs luminosity can be matched to the second order correction observed in the supernova data (the so called *deceleration parameter*). But as this would use the single degree of freedom available, the third order correction would be a prediction that could be compared with the observational data and with the predictions of Dark Energy. Smoller and Temple recently computed the redshift vs luminosity relation up to third order. They currently are working with Zeke Vogler on a numerical simulation to bring these estimates from the end of the radiation epoch to present time in order to make these comparisons. Smoller and Temple believe that because there is only a single free parameter within this unique family of self-similar waves that perturb the FRW spacetime of pure radiation, this family of waves takes on a canonical status that makes their connection with the anomalous acceleration of interest in its own right.

Research Highlight

Fat Knots and Links Are Different

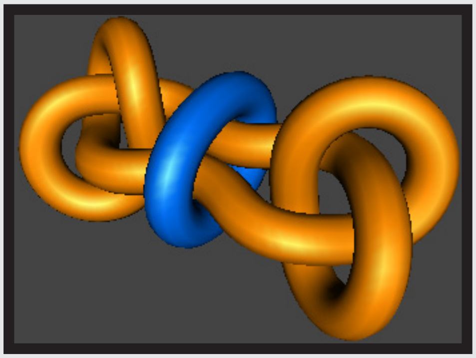
by Alexander Coward

Modern mathematics is dominated by the influence of topology and geometry. These are branches of pure mathematics that deal with the study of shape and space. For example, tools from 3-dimensional topology and geometry are crucial to understanding knots and links. These knots and links arise frequently in nature as long thin molecules. Of particular importance are DNA molecules, whose knotting and linking is crucial to understanding gene replication and expression. This is because as DNA replicates, the two strands of the double helix must separate, and as they do they can form knots and links, which must disentangle from each other if they are to become spatially separated, as they do when they separate into different cells.

Mathematically, two knots that can be moved far apart, like two strands of DNA into different cells, are said to form a split link. The traditional way that mathematicians study knots is by viewing them as one-dimensional curves in $\mathbb{R}^3$. These are often informally described as loops of string, or rope, with their ends glued together. However, real knots, such as DNA molecules, are not one dimensional, but have a positive thickness and bounded length. Indeed, most applications of knot theory are related more closely to the theory of knots of fixed thickness than to classical knot theory of simple closed curves. This raises the important question of whether the one dimensional theory of knots is a good model for physical knots.

In recent work, Joel Hass and I have proved rigorously that in certain cases the configuration space of one dimensional curves can be different from the configuration space of the same curves but with fixed width and thickness. An example of such a configuration is shown in the included figure.

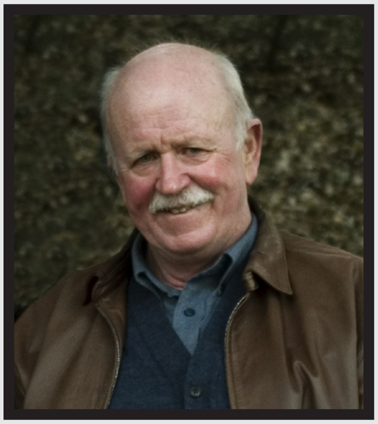
This example, called a *Gordian Split Link*, has the property that if the two thickened curves are allowed to stretch, then they can be moved far apart, say to opposite sides of a plane. But if the lengths and thicknesses of the two curves must remain fixed, and if no overlapping is allowed throughout the motion, then it is impossible to move the two curves



apart. This proves for the first time that the geometric theory of knots is different from the classical topological theory.

While the statement of this result is rather natural, like many other problems in geometry the proof is surprisingly difficult. In order to rule out a way of separating the two curves with a motion that preserves length and thickness, one must consider an infinite dimensional space of possible motions. The proof we developed opens the way to a new theory of knots and links based on the idea of curves of fixed length and thickness, which may be of more practical use than the classical theory.

Dr. Alexander Coward joined the Department of Mathematics in 2008. This is his third year as a Krener Assistant Professor. Dr. Coward's research focuses on 3-dimensional topology and geometry.



Emeriti Focus

Art Krener

Art Krener retired from UC Davis in 2006 after more than thirty five years with the Mathematics Department. He and his wife Jeanne now live on the Monterey Peninsula. Art teaches two or three courses each year at the Naval Postgraduate School in Monterey where he has an appointment as a Distinguished Visiting Professor. Art has active research projects with grants from the National Science Foundation and from the Office of Naval Research. Tom Hunt, a UCD Mathematics 2010 PhD, is now a National Research Council Postdoctoral Fellow working with Art in the area of model reduction for control systems. Cesar Aguilar, who received his PhD in 2010 from Queens University, is also a National Research Council Postdoctoral Fellow working with Art on patchy solutions to optimal control problems.

Recently Art received a Certificate of Excellent Achievements from the International Federation for Automatic Control, and was named a Fellow of that organization. He is also a Fellow of the Institute of Electrical and Electronic Engineers and the Society for Industrial and Applied Mathematics.

Emeriti Updates

Since David Barnette's retirement in 2001, he has been writing fantasy novels. His recent novel, "Paws for a Regicide, was published for the Kindle eBook reader on Amazon. It concerns an emporer's vendetta against evil that turns against the wrong person, one who is armed with cats and rhubarb.

Professor Emeritus Don Benson also has been writing. His book, "The Ballet of the Planets: A Mathematician's Musings on the Elegance of Planetary Motion," was recently published by Oxford University Press. This book describes how modern astronomy grew from theories on planetary motion described by noted thinkers from Archimedes to Copernicus and Newton.

The Explore Math Program

Starting the Year Strong

The 2011-2012 Explore Math year got off to a great start this Fall with the Math Modeling Experience (MME) for high school students and undergraduates. November 19 and 20 saw the culmination of this year's high school program as the students participated in the High School Modeling Competition in Math (HiMCM). This was a challenging but exciting two-day marathon, during which three teams of students worked twelve hour days to first solve and then write a report on a math modeling problem.

Prior to the actual competition, the high school students spent six Saturday mornings coming to the Math Department to learn different modeling techniques and practice with problems from previous years. They learned two programming languages, Python and MATLAB, during their six weeks, and used these to implement simulations of random walks, linear programming algorithms, and models of Markov processes and cellular automata. The final talk of the year was given by a guest speaker, Axel Saenz-Rodriguez, who gave the students some very practical advice on how to get a prom date through the theory of matchings of bipartite graphs.

One week before the HiMCM, the students held an open house for 20-25 of their parents, teachers, and members of our Department. Each of the three teams presented a poster on their favorite topic of the previous six weeks. If this happened to be a problem from one of the previous competitions used for practice, then the team needed to explain their approach to solving the problem and the math behind their solution. The teams chose from one of the different topics presented, explained the subject, and then gave examples of how it could be used to solve real world problems. Examples from this year included Markov processes, modeling forest fires, and designing an airport terminal.

During the 2012 Winter Quarter, our undergraduates will participate in their own competition, the Modeling Competition in Math (MCM). They have met every Thursday this Fall to learn about such diverse modeling methods as greedy algorithms, steepest descent methods, simulated annealing, Voronoi diagrams and their uses in optimization and linear programming. As with the high school students, MATLAB programming has been incorporated so they can develop their own models and implement them for the competition. As in the HiMCM, the undergraduates must solve a modeling problem and then write a technical report for the judges explaining their reasoning and the math behind the solution. The goals of the program are to increase the students' knowledge of mathematics and its uses in the design of models of real world problems, and to learn how to communicate mathematical results effectively to non-experts — all while learning how much fun math can be!

Donations

Mathematics for the Future

Your gift is welcome! The Department of Mathematics wishes to thank all alumni, parents, students, faculty, staff and friends who support the Department. For a list of our endowed funds, please see our web site:

http://www.math.ucdavis.edu/contact/donation/

Your gift to the Department is tax deductible, and you can choose to have your name published, or remain anonymous.

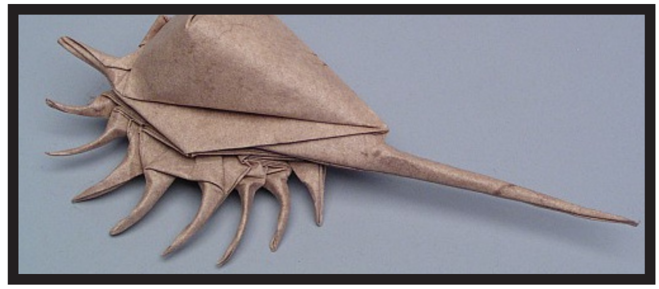
Your gift can be used towards undergraduate and graduate support, research support, or Departmental initiatives. Many thanks to all our donors in these days of difficult budget cuts. Your gifts ensure our future success.

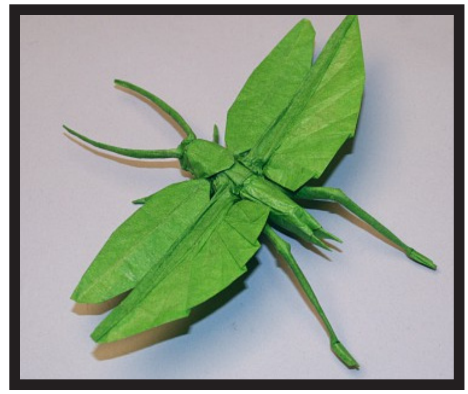
Give Online by Credit Card

Please go to the UC Davis secured giving site at:
http://giving.ucdavis.edu/DeptMath/General
Choose "Mathematics General Support" for the gift designation and follow the prompts.

MathFest 2011

From Flying Birds to Space Telescopes





This year's MathFest featured a very engaging talk by Dr. Robert J. Lang on the mathematics, design and applications of origami, the traditional Japanese art of paper folding. The talk was titled "From Flying Birds to Space Telescopes: The Modern Science of Origami."

Dr. Lang has been an avid student of origami for over forty years and is now recognized as one of the world's leading masters of the art, with over 500 designs catalogued and diagrammed. He is noted for designs of great detail and realism, and includes in his repertoire some of the most complex origami designs ever created. Each piece is most commonly folded from a single sheet of square or rectangular paper.

Dr. Lang presented the mathematical requirements for a shape to be realizable by paper folding, then showed how these concepts could be applied to generate origami figures for many objects, from traditional patterns such as swans to abstract designs and figures of astonishing complexity and realism. Several examples from his website, www.langorigami.com, are shown here by permission of Dr. Lang. The talk also showed how the algorithms and theorems that govern origami design have shed light on long-standing mathematical questions and have solved practical engineering problems. These include the design of sails and electrical generating arrays for spacecraft, and their folding for optimal deployment, as well as enabling safer airbags. This lecture was attended by a large, diverse and highly enthusiastic audience.

MathFest 2011 is part of the COSMOS Program (California State Summer Program for Mathematics and Science) at UC Davis. It was sponsored in part by a VIGRE grant from the National Science Foundation.

Updates from The Undergraduate Program

by Andrew Waldron, Undergraduate Program Chair

The Department awarded 60 undergraduate degrees this year. Among these, Katherine Burggraf, Samantha Capozzo, Kevin Chapman, Rex Cheung and Brandon Dutra earned highest honors, and Karla Lanzas graduated with high honors. The number of these honors awards is a testament to the dedication of our majors to mathematics studies.

The Undergraduate Program Committee has been actively soliciting the views of our students about the structure of our major program. The committee particularly enjoyed conducting our first meeting open to students, an experience we will repeat this year--all math majors will be welcome!

The Department is especially interested in creating course offerings and majors that are relevant to students who anticipate entering the workplace on graduation. Mattias Koeppe is leading an effort to create a new Mathematics of Operations Research Major that will focus on the mathematics of decision making. Students soon will be polled to assess their interest in this fascinating new major.

In the last year our majors have continued to be very involved in undergraduate research. You can see some of their results in the senior theses posted at
http://math.ucdavis.edu/undergrad/research/thesis

Any student interested in getting involved in undergraduate research is encouraged to visit the following site for more information:
http://math.ucdavis.edu/undergrad/research

Undergraduate research is a great way to jump start a mathematics career!

Updates from The Graduate Programs

by Thomas Strohmer, Graduate Program Chair and Naoki Saito, GGAM Chair

The Graduate Program in Mathematics welcomes 14 new graduate students this year. I am pleased to say that we had by far the largest pool of applicants in the history of our graduate program. This is a clear indication that the quality and reputation of our program continues to grow. This is also reflected in the various rankings, where our Department performs very well (See the Chair's letter, p.2).

I am also happy to report that our Math graduate students were quite successful in receiving numerous awards. The William K. Schwarze Scholarship was awarded to Anna Vershynina. Anna was also the recipient of the UC Davis and Humanities Graduate Research Fellowship. Rohit Thomas received the Henry Alder Award in appreciation of his outstanding teaching effort. Mohamed Omar was awarded the Yueh-Jing Lin Scholarship. We are particularly proud that Mohamed was also the recipient of the prestigious Dean's Prize, given to the most outstanding graduate student in the Division of Mathematical and Physical Sciences.

The second Davis Math Conference was held this Fall. This conference was organized by our graduate students under the leadership of the Galois group. An impressive list of diverse topics and outstanding talks made this conference an exciting and eclectic start to the new academic year.

The Graduate Group in Applied Mathematics, (GGAM) welcomes 12 new graduate students to the program this year, including two UCD graduate students from different graduate programs who want to pursue M.S. degrees. This is a distinguished group of students. It includes two recipients of the prestigious NSF Graduate Research Fellowship, Calina Copos and Swati Patel.

Since the last academic year, GGAM has added three new faculty to its membership: John Owens (ECE), Sam Walcott (Math), and Qing Zhao (ECE). GGAM now includes 58 students and 86 faculty members.

Our continuing Applied students have also been doing extremely well this year. First of all, Yuji Nakatsukasa, who just graduated with his Ph.D. and left for his postdoc position at Univ. Manchester, UK, won the first prize in the competition for the 2011 Leslie Fox Prize in Numerical Analysis. He is the first UC Davis graduate student to win this award. Charlie Brummitt won both an NSF Graduate Research Fellowship and a National Defense Science & Engineering Graduate (NDSEG) Fellowship, another highly prestigious award. In the end, Charlie had to make a tough choice: after serious consideration, he decided to take the NDSEG. Jeff Irion also received an NDSEG. In addition, the UCD Graduate Research Mentorship Award went to Ricky Kwok, Alice Leung Scholarship went to David Renfrew, and Yueh-Jin Lin Scholarship went to Yuji Nakatsukasa. We have never previously had such a high number of major fellowship/award recipients simultaneously in our program. We are very proud of their achievements!

The sixth Annual GGAM Mini-Conference was held on January 15, 2011. In an informal day-long forum, nine faculty members described their research interests, giving our students an opportunity to experience the broad directions available to them in Applied Mathematics. The departments and units represented at the conference include: Biostatistics, Chemical Engineering & Material Science, Civil & Environmental Engineering, Computer Science, Geology, Mathematics, and Mechanical & Aeronautical Engineering. More than 70 people, attended the dinner, that followed the conference. This provided an informal opportunity for faculty and students to get to know each other.

2010 - 2011
Graduate Degree Recipients

Lawrence Austria, Ph.D., Math : Mathematician, US Navy Naval Air Systems Command
"Nonlinear Hyperbolic Surface Waves in Variational Boundary-Value Problems," Prof. Hunter

Christopher Bumgardner, Ph.D., Math : Currently job searching
"Codes in W*-Metric Spaces: Theory and Examples," Prof. Kuperberg

David Cherney, Ph.D., Math : Lecturer, UC Davis
"Detour Complexes from Jacobi (Super) Algebras and Applications to Generalized Spinning Particles, Hi Gauge Fields, and N=2 Supergravity Black Holes," Prof. Waldron

Samuel Denton IV, Ph.D., Math : Postdoctoral Researcher, York University/Fields Institute
"Excursions into Algebra and Combinatorics at $q = 0$," Prof. Schilling

Patrick Dragon, Ph.D., Math : Assistant Professor in Residence, University of Connecticut
"Integrality Theorems in Lie Groups and Quantum Mechanics," Prof. Schwarz

Thomas Hunt, Ph.D., Applied : Currently job searching, but continuing work with Krener
"A Proof of the Higher Order Accuracy of the Patchy Method for Solving the Hamilton-Jacobi-Bellman Equation," Prof. Krener

Eunghyun Lee, Ph.D., Applied : Postdoctoral Researcher, University of Helsinki
"Bethe Ansatz Solvable Interacting Particle Systems on Z," Prof. Tracy

Jia-Ming (Frank) Liou, Ph.D., Applied : Postdoc. Researcher, Max-Plank Institut Fur Mathematik
"Topology of the Krichever Map," Prof. Schwarz

Sonny Mohammadzadeh, Ph.D., Math : Assistant Professor, City College of San Francisco
"Results on the Euler Characteristic and Cohomology of Hamiltonian Vector Fields in the Plane and its Maximal Nilpotent Subalgebra," Prof. Fuchs

Yuji Nakatsukasa, Ph.D., Applied : Research Associate, University of Manchester, Mathematics
"Algorithms and Perturbation Theory for Matrix Eigenvalue Problems and the Singular Value Decomposition," Prof. Freund

Stephen Ng, Ph.D., Math : Visiting Assistant Professor, University of Rochester
"Ordering Energy Levels of Uq(sl2) Invariant Hamiltonians," Prof. Nachtergaele

Sean O'Rourke, Ph.D., Math : Postdoctoral Fellow, Rutgers University
"Spectral Properties of Random Matrices with Independent Entries," Prof. Soshnikov

Mohamed Omar, Ph.D., Math : Postdoctoral Fellow, California Institute of Technology
"Applications of Convex and Algebraic Geometry to Graphs and Polytopes," Prof. De Loera

Anastasia Raymer, Ph.D., Applied : Visiting Assistant Professor, Cornell University
"Mixing Time of the Fifteen Puzzle," Prof. Morris

Tamara Schlichter, Ph.D., Applied : Self Employed, Event Planner
"Modeling the Dynamics of Central Pattern Generators and Anesthetic Action," Prof. Lewis

Martha Shott, Ph.D., Applied : Lecturer, Indiana University Kokomo
"Traffic Oscillations Due to Topology and Route Choice in Elemental Freeway Networks," Prof. Zhang

Brian Alger, M.S., Applied : Currently job searching

Creed Erickson IV, M.A., Math : Algorithm & Software Development, Lattice Semiconductors

Shannon Ko, M.A., Math : Lecturer, SF City College

Lucianna Lautze, M.A., Math : Currently job searching

Kathleen O'Reilly, M.A., Math : Continuing with PhD, UCD

Jacob Porter, M.S., Applied : Currently job searching

Matthew Rodrigues, M.A., Math : Currently job searching

Alumni Update

Guy B. Gray
B.S., 1986

Guy Gray was a systems analyst and system administrator in Northern California before becoming a technical instructor for a telecommunications manufacturing company. This position provided him the opportunity to travel worldwide.

His son struggled to learn Algebra 2 in high school, and suggested Gray could help. Leaving his technical career, Gray has since been teaching high school math at the Verison Charter School in Elk Grove.

At the same time he has been working within his local community to help solve homelessness issues. He feels that UC Davis' vision of academic excellence should include an effort to assist struggling, low-income students, those who may not realize what programs are available to them, or just need to be provided with the right challenge. Ultimately, he feels this can help improve California's economy by providing a stronger workforce.

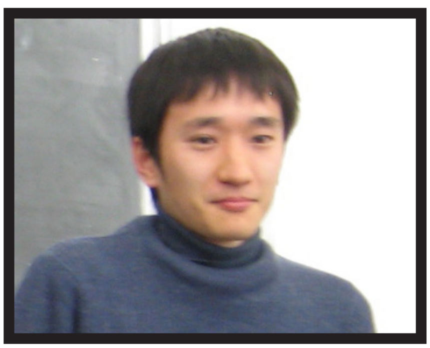
Joan Peters Ogden
B.S., 1966

Ogden continued to pursue mathematics, getting her masters at Michigan State. She discovered in graduate school that her undergraduate education was as good or better than the bulk of her colleagues', and this gave her an appreciation of the superb teaching provided by Professors Alder, Stein, Jacobson, Tuma, and countless others.

After graduating, she was employed as a mathematician for the Apollo Program. She instructed math for some time afterwards at Albion College, the University of Missouri, Bowdoin College and Bloomsburg State.

Ogden moved to actuarial work, first for Blue Cross of Utah and then for Wilcox & Co. in Salt Lake City, before starting her own actuarial consulting firm.

She is now semi-retired, married, with a daughter and grandchildren. Between camping, hiking, skiing, wine tasting (thank you, UC Davis), gardening, travel, church and community activities, she is so busy that she wonders how she had time to work.



2010-2011 Department Awards Recipients

William K. Schwarze Scholarship in Mathematics

William Karl Schwarze was born in 1942 in San Francisco. He excelled in mathematics in high school and at UC Davis, where he received a bachelor's degree. He went on to graduate school at Berkeley and a career as a mathematics teacher in San Francisco. Perhaps due to his mathematical insights, Bill also became a successful investor in real estate. After his death in 1988, a trust he established with the SF Foundation has donated to a variety of humanitarian purposes, in particular to the Schwarze Scholarship to be presented today. This award is given to graduate students in Mathematics who have demonstrated outstanding mathematical scholarship and exceptional promise of making a strong professional contribution as a mathematics teacher and educator at the pre-college or college level.

Recipient – Anna Vershynina

Alice Leung Scholarship in Mathematics

Alice Siu-Fun Leung received a Masters degree in Mathematics in 1975 from UC Davis. She later worked as a global property management accountant in Hong Kong. She remembered with fondness her days at UC Davis. She enjoyed gardening and working as a volunteer helping animals.

In her will, Ms. Leung generously provided funding to award scholarships annually to graduate students in Mathematics. This award is given to students who have shown exceptional promise in all aspects of mathematics, including research, scholarship and teaching.

Recipients – David Renfrew

Yueh-Jing Lin Scholarship in Mathematics

Yueh-Jing (Jean) Lin and Chau-Hsiung (Mike) Chuang created the Yueh-Jing Lin Fund in 2009. This endowment provides scholarship support to one or more mathematics students each year. The scholarships are available to high-achieving mathematics students, either undergraduate or graduate. Mr. and Mrs. Chuang are alumni of UC Davis who met while they were graduate students on campus. Jean received her Master's degree in mathematics in 1971, and Mike received his master's degree in agricultural education in 1969.

This year the Yueh-Lin scholarships are being awarded to two Ph.D. students, one in the Mathematics Ph.D. program and one in the GGAM. Each has already achieved an outstanding research record and shows exceptional promise.

Recipient – Mohamed Omar, Yuji Nakatsukasa

Henry L. Alder Award

Professor Henry L. Alder received his Ph.D. from UC Berkeley in 1947. After spending a year on the faculty in the Department of Mathematics at Berkeley, he joined the Davis faculty as an Instructor of Mathematics. He advanced to the rank of Professor in 1965, and officially retired in 1992. He then served as Department Chair from 1992 to 1994. After his retirement, Prof. Alder continued to teach in the Department for many years.

Professor Alder was also active in other campus programs and was always a strong advocate for quality teaching. In 1999, Prof. Alder gave a gift to the UC Davis Foundation to establish an endowment. This provides support to mathematics graduate students at UC Davis through the Henry L. Alder Prize for Excellence in Teaching, an award given each year to the graduate student who is deemed to be the top teacher among all graduate students in mathematics.

Recipient – Rohit Thomas

Robert Lewis Wasser Memorial Scholarship

Robert Lewis Wasser was born in 1973 in Sacramento. He excelled in many areas--he was selected as a National Merit Scholar in 1991, and participated in the Academic Decathlon. Robert began at UC Davis in 1991. His academic achievements were numerous and impressive. He was one of the few students in our Department who had already taken as a sophomore some of our most challenging courses, such as Math 127. His instructor in that course, Professor Don Chakerian, said how much he was inspired by their discussions and that Robert's presence made the whole class much more lively and spirited. After his tragic death in an automobile accident in 1993, prior to his Junior year, his grandmother, Vera May Wasser, initiated the Robert Lewis Wasser Endowment in his memory, with contributions from family and friends. Its goal is to benefit promising mathematics students at UC Davis.

Recipient – Maria Arias

Evelyn M. Silvia Scholarship for Future Mathematics Teachers

The Evelyn M. Silvia Scholarship for Future Mathematics Teachers was established by generous donations from family and friends of the late Professor Evelyn Silvia. Evelyn was hired by the Department in 1973 after receiving her Ph.D. from Clark University. The focus of Evelyn's passion and unwavering commitment was to develop talented mathematics teachers at the K-12 grade level. She was extremely generous with her time, whether it was as a campus committee member or as an adviser assisting students.

This scholarship honors Professor Silvia's memory by encouraging students who aspire to be future mathematics teachers. It recognizes a junior or senior with a major in mathematics, applied mathematics or statistics who has shown an interest in teaching mathematics.

Recipient – Mick Petchprom

G. Thomas Sallee Mathematics Teaching Award

The G. Thomas Sallee Mathematics Teaching Award honors Professor Emeritus Tom Sallee's 40-year career with the Department, his dedication to being an excellent teacher, and his life goal of developing and supporting talented mathematics educators.

An endowment was established in his name that allows the Department to recognize the best teaching of lower-division mathematics courses on an annual basis.

Recipient – Timothy Lewis

G. Thomas Sallee Mathematics Prize

This award is also given in recognition of Professor Emeritus Tom Sallee, and reaffirms his life goal of developing and supporting talented individuals in mathematics. This prize recognizes exceptional undergraduate students of junior or senior standing who competed in this year's Spring Mathematics Competition, held on May 7, 2011.

Recipient – Chieh Pan

Honorable Mentions – Leila Kadir, Sachin Salgoankar

Eric C. Ruliffson Scholarship in Mathematics

Eric Canady Ruliffson attended UC Davis from 1964-1968, loved the study of math and excelled in it. He was first and foremost a problem solver, which helped him to achieve life-long personal and professional success. While attending UC Davis, Eric worked as a summer intern in the actuarial department of Pacific Mutual Insurance in Los Angeles, and was hired by them upon graduation. After serving in the Navy, Eric attended graduate school in demography at UC Berkeley. In 1973 he resumed his actuarial career at Pacific Mutual Insurance. He became a partner at the San Francisco office of Coopers & Lybrand and named a Fellow in the Society of Actuaries. He was subsequently elected to the Board of Partners for Coopers and Lybrand, the first actuary to be so honored, and later served on the Board of Partners for PricewaterhouseCoopers, the world's largest consulting firm. The Eric C. Ruliffson Scholarship in Mathematics is awarded annually to students of junior or senior standing majoring in mathematics.

Recipient – Viktor Leshchik

Galois Group Service Award

The Galois Group is "the official voice of the graduate students in Mathematics." All graduate students in the Department of Mathematics are members of Galois; this is how graduate students in mathematics collectively communicate with Department faculty and staff. The group also coordinates and facilitates various activities, such as Monthly Game Nights and New Student Welcomes.

Every year, the Galois Group presents an award to recognize outstanding service and/or sustained commitment to the graduate group.

Recipient – Monica Vazirani

Departmental Citation Awards

These citations recognize undergraduate students of exceptional ability who have taken a very strong selection of mathematics courses and distinguished themselves with exceptionally high grade point averages. In addition, they have all received strong recommendations from the faculty.

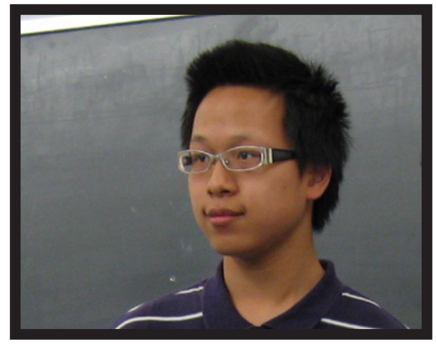
Recipients – Sonny Arora, Katherine Burggraf, Samantha Capozzo, Kevin Chapman, Rex Cheung, Cory Dostie, Brandon Dutra, Genna Gliner, Andrew Kassen, Dale Koenig, Reuben La Haye, Timothy Oakes, Mason Pelfrey, and Connor Sempek

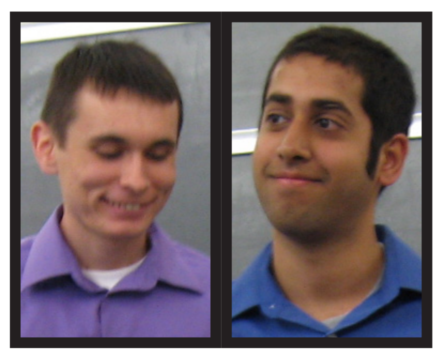
Departmental Honors Awards

Every year, undergraduate students have the opportunity to participate in mathematical research, culminating in a senior thesis. Students typically work under the guidance of a faculty mentor to complete original research. The results are reviewed, and pending on the quality and substance, the student can receive Departmental high or highest honors.

Recipients of Highest Honors – Katherine Burggraf, Samantha Capozzo, Kevin Chapman, Rex Cheung, and Brandon Dutra

Recipient of High Honors – Karla Lanzas





Life After Davis

Matthew Herman

Ph.D. 2010

I was a so-called "non-traditional" student at UC Davis. Rather than the typical path of most graduate students, I returned to school after working in industry for a number of years as an electrical engineer. I did so for two reasons: I wanted to teach at the university level, but also had an equally strong desire to work as a mathematical scientist in a research and development lab. I felt that a Ph.D. in Applied Mathematics would help in both scenarios.

Research-wise, my interest has always been in signal processing and in the mathematical structure of modeling information. While at UC Davis I worked with Professor Thomas Strohmer, focusing on applications of Compressive Sensing (CS), an emerging signal processing methodology for acquiring and reconstructing data. It was exciting to prove new results on radar and system-level perturbations. I felt very fortunate to be involved with a brand new area of mathematical research.

Upon graduating in 2009 I was unsure whether to pursue a career in academia or return to industry. To delay having to make a decision, I accepted a position as a postdoctoral researcher in the Math Department at UCLA in the group of Stan Osher. There I worked on a project that applied CS to laser radar (also known as LIDAR, or LADAR). UCLA was a great research environment. While there I continued to network with others in the field and present at several conferences.

In August a fantastic opportunity came my way. I joined InView Technology Corporation, a start-up company in Austin, TX. InView is one of the first companies to take the theories of CS into reality. Specifically, we are building hi-resolution infrared cameras and hyperspectral imagers. I feel quite lucky to have found this job—one that is closely related to my Ph.D. studies, deals with realworld engineering challenges, and is quasi-research in nature. My projects include determining ways to speed up the reconstruction algorithms while improving image quality and resilience to noise. I also have regular contact with the faculty at Rice University, and hope to continue writing papers for technical journals.

Moving to Austin was not without its challenges, but there was a major draw besides the new job: Austin is known as the "Live Music Capital of the World." There are bands playing every night of the week, and there is a thriving local art scene as well. In my (sparse) spare time I have been playing the drums and exploring the city. I also plan to revive my band, Matt Herman's Mad Funk Project, which played a few times in Davis!

My four years at UC Davis were very special ones. Of course, I received a great education. But as I look back, I realize that the Math Department also had a very strong infrastructure to aid the students. In particular, the Student Support Staff of Celia Davis, Perry Gee, Jessica Potts, and Tina Denena were always looking out to help. They knew everyone's name, offered administrative guidance and emotional advice, and genuinely seemed to care about the students. I feel that this really contributed to the special environment in the department. The IT staff, Leng Lai, Marianne Waage, and Zachariah Johnson, were always very helpful, too. These elements are often overlooked, or taken for granted. But I think that they had a big impact on my success. I really appreciate all of the faculty, staff, and fellow students that I worked with and learned from at UC Davis. I am proud to have been a part of the Math Department, and hope that it continues to maintain its unique spirit!

The Mathematical Sciences Building at UCLA.

The Austin, Texas skyline.

Alumni Update

Jenny Rose Arietta

B.S., 2008

Arietta graduated from UC Davis in 2008. She is currently a secondary school teacher of Mathematics in the San Francisco Unified School District. She lives in El Dorado Hills.

Christina Lynn Staudhammer

B.S., 1990

Staudhammer first worked as an actuarial analyst at the Fireman's Fund Insurance Company in Novato, before moving to Canada to be a Forest Biometrician.

She returned to academia, lecturing at the University of British Columbia in Vancouver, Canada. Moving back to the States, she continued to follow her interest in forestry biometrics as a professor at the School of Forest Resources and Conservation at the University of Florida. She is presently an Associate Professor for Biological Sciences at the University of Alabama. In early 2010, she gave birth to her son, Wyatt.

She looks forward to reading updates in the Newsletter from the professors she studied under at UC Davis.

Irving Lubliner

M.A.T. 1988

Lubliner completed his coursework at UC Davis in 1976, finally fulfilling the last requirement for the M.A.T. in 1988. Through that time, he taught and chaired at middle schools in Novato, Berkeley and finally Oakland in 2005.

In 2006, he accepted a position as professor at Southern Oregon University, recently receiving tenure. He presently holds a dual appointment there in Mathematics and Education.

During the last 20 years, Lubliner has led workshops and presentations to provide ongoing teacher education to middle school math teachers, universities and professional organizations. He has presented in 39 states, including keynote speeches to the California Math Council, the San Diego Math Council, the UCLA Math Project, and a regional conference in Pennsylvania.

He credits the positive impact that his schooling at UC Davis provided. The effective teaching strategies and classroom activities he learned while at Davis have served him throughout his career. He is especially indebted to Prof. Evelyn Silvia for her shining examples of effective classroom practice.

Staff News

Change is in the Air

by Jessica Potts

The 2010-11 year brought several changes to the staff in the Department of Mathematics. Long term Student Services Manager, Celia Davis, retired in March 2011 and moved to Oregon. Celia's retirement provided the opportunity to restructure, using our existing staff. Perry Gee was promoted to Student Affairs Officer, Undergraduate. Tina Denena transferred from the Business Office to become the Student Affairs Officer, Graduate. Carol Crabill received a reclassification to Business Office Manager, Internal Funds.

We experienced our third and hopefully final permanent budget reduction. Our staff is extremely dedicated and has worked hard to take on additional tasks during this difficult time. I praise the staff for their hard work and dedication to the Department!

Academic Personnel Coordinator, DeAnn Ronning, gave birth to her second child, Torbin, and System Administrator, Zach Johnson, is expecting his second.

After 11 years in Mathematics, I am signing off as I have accepted the position of Chief Administrative Officer in Chemistry. My heart will always remain in Mathematics.

Are You a Graduate?

We want to hear from you! Please send us information about yourself so that we can stay in touch and share in your experiences outside of UC Davis.

Please complete our Alumni Questionnaire:
http://www.math.ucdavis.edu/news/alumni_quest
or send e-mail to:
mso@math.ucdavis.edu
We will do our best to include it in the next newsletter.

Get News by Email!

Would you like to help the environment and save the Department of Mathematics money by receiving future newsletters by email? If so, just indicate your preference on the newsletter subscription page on our web site:
http://www.math.ucdavis.edu/news/subscribe/

As always, you can also view past newsletters on the Newsletter Archive located on our web site:
http://www.math.ucdavis.edu/news/archive/

Join us on Facebook!

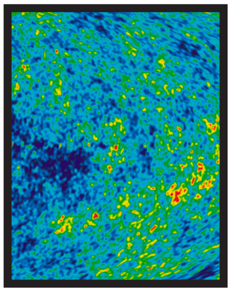
The Department of Mathematics is on Facebook! Visit us there to get updates on current seminars, events and news. We'd be happy to include any memories or photos you have of the Department on our wall.

To "like" us, search for "Department of Mathematics - UC Davis" on the Facebook web page:
https://www.facebook.com/

UC DAVIS
MATHEMATICS

1015 Department of Mathematics
University of California, Davis
One Shields Avenue
Davis, CA 95616-8633

Address Service Requested



Cover Feature

The cover graphic shows the cosmic microwave background radiation. It images the structure of the universe when it first became transparent to radiation. Read more in General Relativistic Self Similar Waves and Dark Energy, page 3.

Featuring the 2010-11 Academic Year

Newsletter Committee:

Craig Benham, Editor
Jessica Potts, Management Services Officer
Marianne Waage, Designer