



Head Lines
Peter Olver



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I am now nearing the conclusion of the third year of my (second) five year term as Head of the School of Mathematics. After 8 years in this office, I believe the end is now in sight, and I am looking forward to returning to the classroom as “normal” professor (as if such exists). But this will be preceded by a well-deserved sabbatical after the end of my term. Stay tuned for further details.

An important administrative development in the College of Science and Engineering is that Dean Steve Crouch announced last fall that he will step down on July 1. As I write, the Provost’s Search Committee arranged visits to campus by the four finalists, and we should know who will be selected in a few weeks. I am looking forward to working with the new Dean and promoting the cause of mathematics at the University of Minnesota, especially in view of the many and wide-ranging successes and well-acknowledged (but perhaps under-appreciated) strengths of the Department.

We are continuing to experience a dramatic increase in the number of undergraduate mathematics majors and recipients of BS and BA degrees (in CSE and CLA, respectively) — even relative to other departments in the College — to the effect that we will soon be the top degree-granting department in CSE. Our graduates go on to a wide range of career paths, including graduate Ph.D. and Masters programs, industry, including the actuarial and financial sectors, teaching, and government. Our new Ph.D. recipients are also placing well — all 14 who are expected to or have already completed their degrees this year have received high profile postdocs and industry appointments.

Our faculty continue to garner a range of prestigious awards: Svitlana Mayboroda was named a American Mathematical Society (AMS) Fellow for contributions to harmonic analysis, partial differential equations, and applications to mathematical physics. She was also awarded the first endowed Northrop

Professorship. Meanwhile, Arnd Scheel was named a Society for Industrial and Applied Mathematics (SIAM) Fellow for his contributions to applied dynamical systems and the study of pattern formation, as well as receiving a Humboldt Research Award from Germany. Mitch Luskin was named a Radcliffe Institute Fellow for his research project on multiscale modeling of two-dimensional materials.

Last May, the Department experienced a bumper crop of promotions: Jasmine Foo (math biology), Kai-Wen Lan (number theory), and Gregg Musiker (combinatorics) were promoted to associate professor with tenure, and Ben Brubaker (number theory), Gilad Lerman (data analysis), and Svitlana Mayboroda (partial differential equations) were promoted to full professor. All are outstanding researchers in their respective fields, and their promotions serve to reconfirm their very successful career trajectories and thus reinforce the overall strength of the department.

The Department hired two excellent new Assistant Professors; I look forward to welcoming them both to Minneapolis. Jeff Calder comes from a Ph.D. in Michigan and a Morrey Assistant Professorship at University of California, Berkeley, and will join the department this fall. His area of research includes image processing, data analysis, and partial differential equations. Hao Jia completed his Ph.D. here at the University of Minnesota in 2008 under Professor Vladimir Sverak and is a Dickson Instructor at the University of Chicago; he will join the department in fall of 2017 following a year visiting the Institute for Advanced Study in Princeton. His area of research is nonlinear partial differential equations arising in fluid mechanics.

In further transitional news, Professors John Baxter and Larry Gray are retiring at the end of this academic year, while Assoc. Professor Wayne Richter already retired back in September. Wayne's research area is mathematical logic. John and Larry are both known for their contributions to probability and the study of Markov processes. Larry was my predecessor as Department Head as well as serving both before and after as Director of Undergraduate Studies. I remain immeasurably indebted to him for leaving the Department in such good shape when I assumed this office. Details about their successful careers at the University of Minnesota can be found inside the Newsletter.

In sad news, Professor George Sell unexpectedly passed away last May. His singular presence in the department will be sorely missed; see inside for a description of his many contributions to research the Department, and the IMA during his long career at the University. A Memorial Service was held last fall in the Math Library, and a conference in his memory will take place at the IMA in June. Emeritus Associate Professor Howard Jenkins died in November. He served as Associate Head of the Department in the 1970's and was known for his contributions to analysis. A Memorial Service is scheduled for this fall.

Speaking of the IMA, as readers of last year's newsletter know, we continue to try to deal with the repercussions of NSF's regrettable decision not to continue its funding after 2017. Fadil Santosa and Doug Arnold are spearheading the ongoing effort to secure alternative funding from a variety of sources — government agencies, industry, universities, etc.

Please see inside this newsletter for the wide-ranging activities and successes of our many programs, including graduate, undergraduate, MathCEP, MCFAM, and MCIM.

As always, thank you for your continued interest in and support of the School of Mathematics at the University of Minnesota. If you have any comments, questions, or suggestions, please stop by, call, or send me email.

Mathematically yours,
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Welcome to New Faculty

Wei-Kuo Chen

Wei-Kuo Chen joined the School of Mathematics in Fall 2015. He was born in Koahsiung, Taiwan, and did his undergraduate degree in Taiwan at National Central University. He developed a deep interest in mathematics during his undergraduate years, and then went on to earn his Master's degree in math at National Chiao-Tung University in 2006, also in Taiwan. Subsequently he completed a Ph.D. thesis in probability theory at U.C. Irvine, working with Michael Cranston. We can claim that this established Wei-Kuo's first connection with Minnesota, since Mike Cranston did his own Ph.D. in probability here at Minnesota with Steven Orey, in 1980. After his Ph.D. degree, Wei-Kuo was an L.E. Dickson Instructor at the University of Chicago (2012-2015) before coming to Minnesota. His wife Ru-Yu Lai is also a mathematician. She works in inverse problems and partial differential equations, and she is a postdoctoral fellow in the School of Mathematics.



Wei-Kuo's Ph.D. thesis topic was "the chaos problem in mean field spin glasses", and much of his current research is related to spin glass models. Spin glasses are a central area of current research in probability, with applications to physics, computer science, and other fields which involve the behavior of complex systems. The term "spin glass" is used in physics to describe particular materials, but in mathematics one uses the same term to describe the model for any complex random system whose mathematical structure is similar to the spin glasses of physics. Wei-Kuo notes that probability theory has a long history of analyzing systems which involve many independent variables, and now, in fields such as spin glasses, researchers are tackling the challenge of understanding systems in which the variables are no longer independent, and may be highly correlated. Statistical physics provides an approach to such systems, but much research by mathematicians will be needed to solve the open problems in this area.

Camelia Pop

Camelia Pop was born in Biștrita, Romania. Her mother was an economist and her father was an engineer, which likely helped to develop her interests in math and science from an early age. In grades seven and eight she participated successfully in math olympiads, and then, thanks to an inspiring physics teacher, she switched to physics olympiads, and ultimately won first prize in the national physics olympiad in Romania. In the end she chose mathematics as her field of study. After a B.S. degree at Babeș-Bolyai University in Romania, she completed her Ph.D. thesis in mathematics at Rutgers with Paul



M.N. Feehan. Her thesis was entitled “Degenerate partial differential equations and applications to probability theory and mathematical finance”. As this title suggests, Camelia’s research interests involve both partial differential equations and the applications of probability theory, including stochastic differential equations. Incidentally, Camelia’s husband did his Ph.D. (in physics) at Rutgers as well, and is now a bio-physicist.

After finishing her Ph.D. degree Camelia was a Hans Rademacher Instructor at the University of Pennsylvania (2012-2015), coming to Minnesota in Fall 2015. During 2015-2016 she is also participating as long-term visitor at the Institute for Mathematics and its Applications here, during the thematic year on Control Theory and its Applications.

Camelia remarks that she enjoys finding mathematical formulations for applied problems, in areas such as math finance and biology, and then applying mathematical tools to obtain solutions. She often uses techniques that combine partial differential equations with stochastic methods, and her mathematical areas are very relevant to our Financial Mathematics graduate degree program. For example, the value of an American option can be modeled as the maximum of an expected value, considered as a function of the mathematical “stopping time” of a random process. The mathematical stopping time in this case corresponds to the actual time at which the option is utilized. Although the value of the option is expressed in terms of a probability model, techniques from the field of partial differential equations often seem to offer the most effective way to analyze the model. One of Camelia’s mathematical research interests is the study of regularity for solutions of partial differential equations, and the regularity of the value function plays an important role in math finance.

Featured Colleagues

Robert Gulliver

Bob was born in the city of Torrance, California, which was later the hometown of another colleague, Maury Bramson. He started out his undergraduate career at Stanford aiming at a degree in physics, not mathematics. However, he switched to a math major during his junior year. Bob remarked that his decision to switch was partly inspired by receiving the score of zero for one physics assignment. In this assignment he was supposed to analyze the behavior of a positron, but for some reason worked with an electron instead. His mathematical work was correct except for a sign error, so a score of zero sounds a bit harsh. At any rate, we are glad he made the switch. His interest in physics may have influenced his later work, which has spanned a wide range of topics related to differential geometry, partial differential equations and the calculus of variations.



Bob’s research interests are unusually well-described on his web-page at <http://www.math.umn.edu/~gulliver/>, where there are links to a series of pages about different topics that he has worked in. Bob told us that he has found that to do mathematics well, one must have one’s fingers in a lot of areas, though not in every area, foundations of mathematics

being one exception. He also mentioned a general theme in his work, which ultimately traces back to the great nineteenth century mathematician Riemann. Riemann and Levi-Civita, and earlier Gauss, realized that space is not necessarily the flat space of Euclidean geometry, and of course their work led later to Einstein’s general relativity theory for curved spacetime. In Bob’s research he has sought theorems which hold true in the curved space setting of Riemannian manifolds, so that the flat space version becomes more clearly understood as a special case of something more general.

As a graduate student at Stanford Bob worked first with Hans Samelson in algebraic topology, but found the machinery of that subject less inviting than differential geometry and variational problems. He worked for a time with Robert Finn, and then wrote a thesis with Robert Osserman on branch points of surfaces with constant mean curvature. Osserman had recently proved a major theorem in this area, disproving assertions of Douglas and Courant. This sparked Bob’s interest, and led to continued research on related problems.

After his PhD, Bob was an instructor at U. C. Berkeley during 1971-73, which not surprisingly he found to be a stimulating environment. In particular he enjoyed having an office close to those of Ed Spanier and Shiing-Shen Chern. Chern was one of the most prominent figures in twentieth century differential geometry, and had many graduate students. Once or twice a week Bob would see a long line of graduate students outside Chern’s office, each waiting their turn for a few minutes of wisdom. After Berkeley, Bob came to Minnesota in 1973. Minnesota had many people that he could interact with, including Johannes Nitsche in minimal surfaces, Jim Serrin, Hans Weinberger, Walter Littman and others working in partial differential equations, as well as David Kinderlehrer and Robert Hardt in calculus of variations and Leon Green and Bill Pohl in differential geometry. Bob also made the best of Minnesota’s weather by taking up cross-country skiing after his arrival here. Living near Kenwood park meant he could do some skiing without going very far.

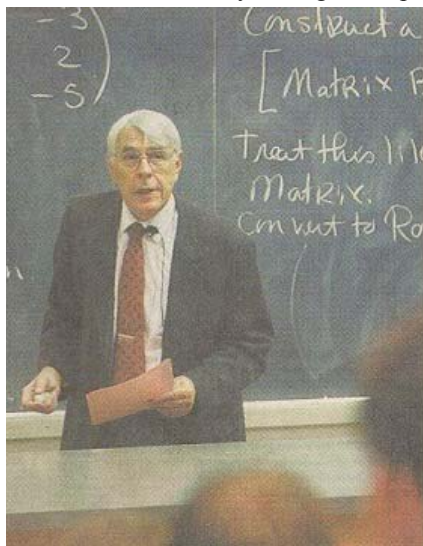
Bob has had many collaborations throughout his career with mathematicians at other institutions around the world, but he also wrote papers with several colleagues at Minnesota. Stimulated by comments of Leon Green, he wrote a paper in 1975 on manifolds without conjugate points, which led to considerable research by others, as well as a joint paper with Leon in 1984. Much later Bob collaborated with Walter Littman and others in a series of papers on control theory. Perhaps his most applied work involved a patent and a joint research paper with Fadir Santosa of Minnesota and Fadir’s graduate student Jing Wang. This work used differential geometry (related to the local Gauss-Bonnet theorem) to design multifocal lenses. Bob served twice as Associate Director at the Institute for Mathematics and its Applications (1994-98 and 2001-2002), and this application of geometry is very much in the spirit of that center.

Bob has had six PhD students, and has held many visiting positions over the years, in Germany, particularly at the University of Bonn, as well as in Italy and Australia. At Bonn Bob had an extensive collaboration with Stefan Hildebrandt, who recently passed away. Their collaboration also led a number of Hildebrandt’s students to make advances on problems raised in Bob’s research. In addition to his visits abroad, Bob has also organized many international conferences, and been joint editor of two books. In recognition of his contributions a conference on ‘Calculus of Variations and Nonlinear Partial Differential Equations’, jointly in honor of the sixtieth birthdays of Bob, Robert Hardt and Leon Simon, was held in Hangzhou, China in 2005. Bob was not able to attend the conference, unfortunately,

since he was the victim of a hit and run accident shortly before the conference, while riding his bicycle. Luckily Bob recovered well, and was able to get back to riding his bike vigorously! Currently he continues to conduct an active research program on a variety of topics, and we are especially glad that he continues to teach the next generation of students here at the graduate and undergraduate level.

Chester Miracle

Chester Miracle was born in the Appalachian Mountains in eastern Kentucky. He grew up on a farm where



his family grew almost everything the humans and animals ate. There was no electricity until after the Second World War. He attended a one-room school built by the Works Progress Administration out of fieldstone. All eight grades were in one room with a coal stove in the center, the toilets were two small outbuildings, and water was in a bucket in the back

of the room. Chester attended high school in the county seat, an hour-long bus ride from home. He says he never once heard the word 'physics' in high school, but that there were some good teachers. The summer after he graduated the high school was demolished because it was declared totally unsafe.

He attended Berea College. Every student had to work at least 10 hours per week for the college, as part of the education, and the policy of 10 hours-per-week work along with zero tuition continues to this day. Chester worked in the kitchen at first, then as a janitor and finally as a monitor in charge of janitors. He graduated with a B. S. degree in physics and mathematics. He went to graduate school first at Alabama Polytechnic Institute (now known as Auburn University) to earn an M. S. degree, and then to the University of Kentucky to earn a Ph.D. degree, with a thesis on summability theory. During the summers he worked for various Air Force contractors on weapons research, often using an early computer, the UNIVAC 1103.

In 1959 he came to Minnesota to take a job in the old CLA math department which, he says, was a good fit for him. He taught the first course ever taught on closed circuit television at the University of Minnesota, live, in black and white. There was a long article about the class in the Star Tribune with a big layout and picture of Chester. His class was attended by the University President and several members of the Board of Regents. In the next few years closed circuit television spread to almost every classroom on campus. After about a dozen years the University surveyed students about how they liked taking classes on closed circuit TV and discovered that in fact they didn't. The program was discontinued. On the basis of that early experience, it is an open question for Chester whether the current enthusiasm for online courses will continue in the long run.

A few years after Chester arrived at the U, the IT and CLA math departments were combined and things inevitably changed. A number of members of the old CLA department departed, including Baxter, Kalisch, Donsker, and Spitzer. Eventually Chester also resigned and lined up a job elsewhere; but his good friend David Storvick (then associate head under head Edgar Reich) convinced him to stay as the coordinator of correspondence, night school and summer classes.

It was possible in the '70s and '80s to complete a B.S. degree in math at night. Chester found it especially rewarding to help and advise adult students who were working hard at a day job while completing a math degree. He continued as night school coordinator until about ten years ago when the program was discontinued.

In 1995 Chester became principal investigator for a federal grant called Open Access. The project provided additional education for high school math teachers, including graduate courses that met at Augsburg College, but carried University credit in the College of Education. At any given time there were about a hundred students active in the program, and while working with them Chester learned how varied the backgrounds of high school math teachers can be. He was again involved with high school math education in the early 00's as a member of the Governor's committee to write standards for high school math, along with our colleagues Bert Fristedt and Larry Gray.

In 2000 a new course was created in our department: what we now know as Math 1371-72 ("CSE calculus"). The course was set up in response to pressure from engineering departments wanting a more practical course (engineers disliked the Stewart textbook) and from high school teachers wanting a course that taught calculus using graphing calculators. Our colleague Harvey Keynes started a course in response to these ideas using a federal grant which developed into our present course. Chester has been course chairman for the last 15 years. He enjoys teaching the course and interacting with students in the workshops he regularly visits. He says that students like the course, take it seriously and work at it.

From the mid '90s to the mid '00s the Institute of Technology Student Board held an annual awards banquet. The awards were decided by a vote of students. Chester won the award as "Best Instructor in Mathematics of the Year" about a dozen times. In fact Chester only failed to win the award twice, one time losing out to our former postdoc Arthur Lim (now Professor of the Practice at Notre Dame) who was teaching IT calculus with Chester at the time. Arthur writes the following:

"I met Chester Miracle in 2001. Back then I had just graduated and landed my first visiting faculty job at the University of Minnesota Twin Cities. Chester was my lighthouse helping me to navigate the choppy waters of a first academic job; there was so much to learn about teaching! He was patient and uplifting. Chester was generous in sharing his expert teaching experience, and generous with his time listening to silly things that bothered a newbie like me. He taught me the importance of believing in what we do as professors and staying on task. He is truly an inspiration!"

The photograph of Chester included with this article appeared on the front page of the Star Tribune in 2004 to accompany an article about the trend away from blackboards toward less dusty presentation technology.

Chester's advice for teachers is simple. You have to decide in detail what is to be said, you have to be prepared to say something

interesting, and you should change the channel regularly so that you can get the lost students back with you.

Sasha Voronov

Sasha Voronov works in areas related to mathematical physics, topology and algebraic geometry, especially operad theory and higher categories. In a jovial conversation, and without much prodding, Sasha told us quite a bit about



his interesting life's and mathematical journeys. He was born in Moscow in the former Soviet Union to a family of psychiatrists and his early years coincided with the Brezhnev era. Sasha was an avid Pioneer, representing his school at the district Pioneer council.

His rapid advance in the Pioneer organization made him set his sights high, hoping to rise, in due course, to Brezhnev's job of the General Secretary of the Communist Party. However by the 6th grade he started to become aware of the fallacies of the communist system, and, to our good fortune, he gradually set out on a path to a career in mathematics.

In school Sasha was a bit rambunctious, especially during the math classes, which led to the math teacher complaining to his parents. In fact, Sasha was simply bored having quickly finished the assigned work and then distracting other students while they were still working. At this stage his parents hired him a tutor, in part to help decide if Sasha was talented enough to pursue a career as a mathematician. Sasha told us that not only was it generally known in the Soviet Union that one could pursue a career as a mathematician, and that, as their work, mathematicians solved interesting problems, but it was also viewed as one of the very desirable, politics-free professions. Sasha graduated from the Moscow high school No. 57, which together with the high school No. 2, had the highest reputation for mathematics. Many well known mathematicians are graduates of these two high schools.

Sasha did his undergraduate work at Moscow State University. Every student at Moscow State was supposed to have a senior thesis advisor during the last two years of undergraduate education and, setting his sights high, Sasha approached the well known mathematician Yuri Manin for this. Manin replied that he could not accept him because he had recently accepted eleven new students a year senior to Sasha, and had other students as well. Seeing how disappointed Sasha was, Manin asked him about his interests. Sasha told him about his course on Lie Algebras and that he was interested in the Winnie-the-Pooh conjecture, a conjecture about the class A_5 of Lie Algebras. (The word 'opiat' (again), in a free-wheeling Russian translation of Winnie-the-Pooh, sounds like A_5). This broke the ice and Manin accepted Sasha as a student. Sasha's Senior Thesis resulted in two joint papers with Manin and he continued working under Manin for his Ph.D., in algebraic geometry related to mathematical physics. He gave a mathematical justification, now known as the super Mumford isomorphism, to the fact that the dimension of spacetime under the assumptions of superstring theory must be equal to ten. After earning his Ph.D. ('kandidat nauk') Sasha became a junior researcher at Moscow State. After one year he was promoted to senior mathematician, which Sasha described as a minuscule promotion.

One good feature of the communist system that Sasha enjoyed, was that books were very cheap. Typically, excellent

books, that would cost 30 dollars and up in the west, would cost just pennies in the Soviet Union. Sasha told us that when he saw a book he liked he would simply buy it. A small price to pay was that one would have to eschew occasional quotes from, or allusions to, Lenin, Stalin and other luminaries of communism. For example, a 900-page book on Quantum Electrodynamics in the celebrated Landau-Lifshitz series contains over a page of concluding remarks along the following lines:

... In them we find a new confirmation of the well known thesis of V.I. Lenin regarding the inexhaustibility of the properties of the electron and the infiniteness of nature. The 'essence' of things or 'substance' are also relative. ... The electron is just as inexhaustible as the atom, nature is infinite, but it exists infinitely,

This is the flavor of quite extensive philosophical quotes attributed to Lenin. If you wish to read it in original Russian, ask Sasha, who has brought the book from Russia and has it in his office, along with many other excellent books.

Meanwhile, Sasha got married and had a son, Serge. Ultimately, Serge graduated from the Saint Paul Central High School, did his undergraduate work at the University of Chicago, earned a law degree from Duke, and currently has a clerkship with a federal judge in Albuquerque. Sasha's step-daughter Anastasia got a Master's degree in Architecture from the University of Minnesota and works at ESG Architects in Minneapolis.

Sasha's first position in the U.S. was a one year position (1990) at UC Davis. From there, he applied to a small number of places and unexpectedly (to him) received a two-year postdoctoral appointment (1991-93) at Princeton University. At Princeton Sasha attended Browder's Topology seminar and interacted with a number of well known mathematicians including Pierre Deligne, Gerd Faltings, Pierre Schapira and mathematical physicist Edward Witten. During the 1993 spring picnic, Andrew Wiles explained the soft ball rules to him. Shortly after that, in June 1993, Wiles announced his proof of Fermat's Last Theorem.

Sasha's next position was at the University of Pennsylvania (1993-96) where he collaborated with J. Stasheff and M. Gerstenhaber and began to work in operad theory, an area with applications in algebraic topology, homological algebra, algebraic geometry, as well as mathematical physics. Sasha's extensive contributions to operad theory include the colorfully named cactus operad and Swiss-cheese operad, with applications to string theory.

During 1996-98 Sasha held an AMS Centennial Fellowship at MIT. He subsequently attained tenure at Michigan State before arriving to Minnesota in 2001. Here he expanded his initial contact with the mathematical physics group to the topology group. He collaborated with postdoc Bernard Badzioch and wrote a paper on higher categories with our late colleague Mark Feshbach (completed after Mark's passing).

Sasha's recent work is in the area of higher categories and topological quantum field theory. He has graduated seven Ph.D. students. Sasha served as the department's Associate Head for four years, 2007-2011. Sasha's mathematical collaborations extend throughout the world. During summers he spends one month as a Senior Visiting Scientist at the Institute for the Physics and Mathematics of the Universe at the University of Tokyo. He often visits his former Ph.D. advisor Y. Manin at Bonn University, including a one-semester sabbatical stay during 2012, after his stint as Associate Head. He spent the summer 2012 collaborating with M. Kontsevich at IHES, Paris, following an earlier collaboration in 1996.

Sasha enjoys the summer and winter activities here, including biking and downhill skiing. He did skijoring with his Labrador Toby, but now Toby has become too old. Sasha also tried fishing, but did not get hooked.

Symposia

Rivière-Fabes Symposium

The Rivière-Fabes symposium took place last Spring during the period April 17-19, 2015. It was a beautiful weekend that brought sunny, warm weather and over 80 mathematicians to Vincent Hall for an exciting program of talks and discussions.

Last year's conference, the 18th annual incarnation, continued the relatively new format where each of the four speakers delivers two one-hour lectures. The speakers were extraordinary both from the point of view of their interesting results and the care with which they discussed both their breakthroughs and the fields in which their jewels were set. The presenters were: Alessio Figalli (University of Texas); Nader Masmoudi (Courant Institute, NYU); Vitali Milman (University of Tel Aviv); and Laure Saint-Raymond (Ecole Normale Supérieure, Paris.)

The symposium actually did double duty, acting also as the 75th Midwest PDE Conference. In total there were more than 50 mathematicians visiting from outside the Twin Cities. All the attendees benefited hugely from the extraordinary work of our entire department staff. Special thanks to Harry Singh, Bonny Fleming, Diane Trager, Debra Ronningen, and Robin Dixon for their absolutely expert management and hospitality.

Midwest Combinatorics Conference

The 2015 Midwest Combinatorics Conference was held May 19-21, 2015 in Vincent Hall 16. The main topics for the conference were algebraic combinatorics and enumeration. There were 90 participants, about half of whom were graduate students. The conference featured three plenary speakers who each gave two talks: Ben Brubaker (University of Minnesota), Sergey Fomin (University of Michigan), and Steven Sam (UC Berkeley/University of Wisconsin, Madison). Fifteen other established researchers from the extended Midwest, from Kentucky to Winnipeg to Kansas, also gave talks. The topics included Hopf algebras, Coxeter groups, poset theory, and tableaux. The conference was financially supported by an NSF RTG grant, and ran smoothly due to the excellent work of the local support staff.

Jerry Ericksen Workshop

The 90th birthday of Jerald Laverne Ericksen brought together an international group of researchers in the combined fields of Mathematics and Mechanics, to celebrate a career spanning seven decades. The workshop took place in Eugene, Oregon during October 23-25, 2015. There were over 80 participants, about half of them in their early career stages. The workshop was sponsored by (among others) the IMA, the School of Mathematics, and the Department of Aerospace Engineering and Mechanics at the University of Minnesota.

Jerry moved from Johns Hopkins University to the University of Minnesota in 1982, where he became a joint faculty member of the School of Mathematics and the Department of Aerospace Engineering and Mechanics. He was a pioneer in the new developments of a continuum theory of complex materials, and the foundation of a theory that bridges continuum mechanics and atomistic theory. Jerry's work has had a profound and leading impact in the fields of nonlinear elasticity, liquid crystals, and phase transitions. More recently, he has directed research efforts to relativistic studies of deformable electromagnetic materials.

At Minnesota, the professional bond that developed between Jerry Ericksen and David Kinderlehrer expanded to embrace the nonlinear analysis community of the School of Mathematics and beyond, including Robert Hardt and his (then) graduate student Fanghua Lin, and Haim Brezis, among others who initiated a tour de force to be felt for many years to come. A testimony to these endeavors is the forthcoming celebration of the 75th birthday of David Kinderlehrer to take place in Carnegie-Mellon University, July 18-20, 2016, under the title "Topics in Applied Nonlinear Analysis: Recent Advances and New Trends".

Remembering Former Colleagues

George Sell

George Sell passed away on Friday May 29, 2015. He was born on February 7, 1937 in Milwaukee, Wisconsin, and grew up in the Milwaukee suburb of Hales Corners. He was the oldest of eight children. Two of his siblings died in infancy, so he grew up with four brothers and a sister. In high school, he had the good fortune to have teachers who sparked his interest in mathematics and encouraged him to pursue the subject further. With a scholarship from General Electric, where his father worked, he attended Marquette University. It was there in 1955 that he met his wife, Geraldine, and three years later they married.



From Marquette, he went to the University of Michigan for a Ph.D., where he was jointly advised by Wilfred Kaplan and Lamberto Cesari. His thesis was awarded the Sumner B. Myers Prize for the year's best dissertation in mathematics. In addition to his graduate studies, he held a recurring summer job working at AC Sparkplug on the guidance system for the Titan rockets of the nascent space program. During this time, his four oldest children were born. After finishing graduate school in 1962, George spent two years at Harvard University as a Benjamin Pierce Instructor before accepting an assistant professor position at the University of Minnesota. His two youngest children were born during his tenure there. He was promoted to Associate Professor in 1968 after spending the previous year at the University of Southern California, and then served as Full Professor in 1973 until his death. In addition to his service on the faculty of the university, he served as the Director of Undergraduate Studies in 1969-70 and as Associate Head of the School of Mathematics in 1970-71.

In 1977-78 George spent a year as Program Director in Classical Analysis at the National Science Foundation (NSF). In the early 1980's he, Willard Miller, Jr., then Department Head, and Hans Weinberger answered the National Science Foundation's call for proposals for a new national mathematics research institute. Their proposal, for the Institute for Mathematics and its Applications,

emphasized the novel idea (for the time) of seriously connecting mathematics with its wide range of applications, in research, in industry, and in government labs. The NSF decided to fund two Math Institutes, and so the IMA began operations in 1982, continuing to this day. George served as its first Associate Director from 1982 to 1987. Over its many years of existence the IMA has had a profound and wide ranging impact on mathematics, its applications, and the many thousands of researchers who visited, organized programs, served as postdocs, etc. Later, from 1984-94, he served as the first Director of the Army High Performance Computing Research Center at the University of Minnesota.

George devoted the majority of his professional life to the study of differential equations, dynamical systems, and their applications to fluid dynamics, climate modeling, control systems, and elsewhere. Although he held sabbatical appointments at various institutions, he always returned to Minnesota to continue his work. He is the author or coauthor of over 120 research publications in these areas, as well as 5 highly popular books covering dynamics and differential equations. In 1990, George was awarded an honorary doctorate by Leningrad State University in the Soviet Union, just the second foreigner to be so honored by that institution. He supervised 16 Ph.D. students, many of whom went on to successful academic research careers of their own, as well as a large number of postdocs in both the School of Mathematics and the IMA. In 1988, he became the founding editor in chief of the very successful *Journal of Dynamics and Differential Equations*, and continued to serve in this capacity of managing editor until his death.

Those who knew George will remember him as a kind, loving, and generous person. He enjoyed good food and drink, travel, history, Paris, and the Green Bay Packers. Most importantly, though, he enjoyed simply being in the company of his family and friends. George is predeceased by his parents, George and Alice, and two brothers, Robert and Harvey (a.k.a. Luke). He is survived by siblings, William, David, and Susan; his loving wife and lifetime companion, Geraldine; his children, George (and Christine), Mark (and Penny), Marie, Paula (and Timothy), Thomas (and Dana), and Eric; and by his grandchildren, Meryl, Claire, Erin, Bethany, Matthew, and Annika.

A memorial in George's memory was held in the department on November 6, 2015, and a meeting will be held in his honor at the IMA, June 22-25, 2016.

Howard Jenkins

Emeritus Associate Professor Howard Jenkins died peacefully in his sleep in Minneapolis on Nov. 23, 2015. He was born in Pocatello, Idaho on Jan 30, 1928. He received a



BS in physics from MIT in 1945 and then his PhD in mathematics under Prof. Robert Finn from the University of Southern California in 1958. After a brief stay at Stanford, he came to Minnesota in 1962 as an assistant professor, and was promoted to associate professor in 1965. During the period 1971-79 he was Associate Head of the Department, serving under Prof. Johannes Nitsche.

He retired from the University of Minnesota in 1996.

His research was focused on partial differential equa-

tions and the calculus of variations. His collaboration with Regents Prof. James Serrin made a very important contribution to the important and well-studied minimal surface equation, as documented by Louis Nirenberg's commentary in the Serrin Selected Papers volume.

Howard was an accomplished woodworker, making kitchen cabinets, shaping his own trim molding, and such. He also enjoyed working with concrete, doing his driveway embankment and front steps. His other passions included playing classical piano, bridge, photography, science fiction, squash, downhill skiing, and his vegetable garden. He is survived by children Thomas Howard Jenkins, James Russell Jenkins, & Elizabeth Bryner Jenkins, as well as 4 grandchildren, Genevieve, Alexander, Gabriel, and Samuel. He will be missed.

Awards and Recognition

Paul Cazeaux

Paul Cazeaux, a postdoc working with Prof. Mitchell Luskin, won a best poster prize at the June 2015 meeting of the French Applied Math Society, for their research on two-dimensional heterostructure materials.

Mitchell Luskin

The Radcliffe Institute for Advanced Study at Harvard University selected Prof. Mitchell Luskin to be a Radcliffe Institute fellow for the 2015-2016 academic year. Prof. Luskin will pursue a project in Multiscale Mathematical Modeling of 2D Materials within the Institute's multidisciplinary community.

Svitlana Mayboroda

Svitlana Mayboroda has been awarded the first Northrop Professorship at the University of Minnesota. She was also named Fellow of the American Mathematical Society in the 2016 list.

Arnd Scheel

Arnd Scheel has been named a Fellow of the Society for Industrial and Applied Mathematics. He is also a recipient of a Humboldt Research Award. Award winners are invited to spend a period of up to one year in Germany collaborating on a long-term research project.

Retirements

Wayne Richter

Professor Wayne Richter retired in June 2015 after 46 years of service. Wayne is an expert on hierarchies in recursion theory, arithmetic and set theory. He was born in New York City and he and his wife Anne have now moved to New York state where they will continue to live in retirement.



Wayne did his undergraduate work at Swarthmore, where he was the captain of the baseball team. By coincidence another of our colleagues, Steve Agard (also retired), was Wayne's second baseman. He earned his Ph.D. from Princeton in 1963 under the logician Alonzo Church. The list of Church's students is a veritable 'Who's Who' of mathematical logic, and includes Alan Turing from an earlier generation. Wayne's choice of thesis topic was, however, influenced by a talk given by the philosopher-

logician Hilary Putnam who, soon after, left Princeton for Harvard. He completed his thesis while teaching at Rutgers, at a time when Church himself was also absent from Princeton on a two-year visiting professorship at UCLA. Wayne provided an interesting sidelight from that time when he told us that the famous analyst Salomon Bochner, from whom he took the complex analysis class at Princeton, smoked through his lectures.

Wayne arrived in Minnesota with his family in 1969, joining his brother Ket who had been a professor in the Economics Department since 1960. Ket, sadly, passed away in 2014. Between them they accumulated 100 years of service to the university.

Wayne has done a lion's share of teaching our logic courses and seminars. His lectures were always meticulously prepared. He covered the blackboard with small neat handwriting, writing with his left hand. He impressed students and colleagues alike by erasing with his right hand what he had written earlier, while continuing to write. Wayne liked teaching the UNITE distance-learning classes, since it afforded him an alternate way of organizing his lectures: namely, displaying definitions and theorems on the screen and being able to focus on proofs, commentary and working examples. He served as Director of Undergraduate Studies for one year (1990-91). Wayne advised two Ph.D. students and has 83 'descendants', arising because his 1985 Ph.D. J. Baeten has been quite prolific with 24 students, and some of those have had many students.

Wayne spent two memorable sabbatical years at Berkeley: 1964-65, and 2002-03. During 1964-65 he attended Tarski's lectures on Universal Algebra and interacted with well known logicians including J. Addison, W. Craig and L. Henkin. Also, 1964-65 was a tumultuous year for the free speech movement at Berkeley.

He has always engaged in a number of sports, including tennis and running: he ran a Twin Cities marathon and has played tennis at a competitive level. He also used to bicycle to work. His hobbies include roasting his own coffee beans, making wine and brewing beer.

Wayne has been an excellent colleague, in particular to the logic group, and he will be missed. We wish Wayne and Anne the best in retirement.

School of Mathematics Center for Educational Programs (MathCEP)

The University of Minnesota Talented Youth Math Program (UTMYMP) continues to thrive, with enrollment in 2015-16 matching our largest enrollments in history. Although we are growing accustomed to dealing with over 500 students in UMTYMP courses on the Twin Cities campus, the challenge this year has been to run all of those courses on the West Bank, far away from our offices in Vincent Hall. Construction on the East Bank has caused a classroom shortage, with the result that all UMTYMP courses have been moved across the river to Blegen Hall until at least 2017. The MathCEP staff has been hard at work to manage the complicated logistics of this change, carting classroom equipment, course materials, homework and exams back and forth across the river multiple times per week.

The biggest news for UMTYMP this year is that the program has resumed in Duluth for the first time in decades, with an UMTYMP Algebra course meeting on the University of Minnesota - Duluth campus, and UMTYMP Calculus is running in Rochester for the first time in 10 years.

MathCEP now has three postdocs who teach UMTYMP and run enrichment programs. Two of them are leaving at the end of this year. Daniel Schultheis will move to Smith College in the Fall of 2016 and, as of this writing, Bevin Maultsby is likely to accept an Assistant Teaching Professor position at North Carolina State University. To take their place we have hired Lauren DeDieu, who is completing her PhD at McMaster University in Hamilton, Ontario; a second hire is in the works, with details forthcoming in a future newsletter.

The Director of MathCEP, Jonathan Rogness, continues to serve as faculty advisor for the department's MS in Mathematics with an Emphasis in Math Education degree. One student, Jesse Williams, is completing her student teaching in the Wayzata district this spring and will graduate from the program in the summer.

We encourage readers to check out the summer options on our webpage, www.mathcep.umn.edu, and forward the information on to any interested friends or colleagues. In particular, in June we will run a Summer Math Institute for high school teachers, and a Math Modeling Camp for High School Students, in conjunction with the IMA.

Minnesota Journal of Undergraduate Mathematics

We are pleased to announce the new Minnesota Journal of Undergraduate Mathematics (MJUM), which began publishing in the Fall 2015 semester. The first volume has a wide variety of articles, ranging from the use of differential geometry to detect tumors, to applying graph theory to analyze the passing tendencies of both collegiate and World Cup soccer teams.

There has been a large emphasis on undergraduate research in mathematics during the last two decades, but there has not been a corresponding increase in the number of outlets where students can publish their work. This new journal aims to help fill that void, by providing an open access, peer reviewed publication dedicated to projects completed by undergraduates. The journal is completely electronic and free, with no cost for authors or readers. The director and postdocs of the Math Center for Educational Programs (MathCEP) are managing the operations of the journal, with guidance and advice from the editorial board, which is comprised of mathematicians from around the country.

The Minnesota Journal of Undergraduate Mathematics focuses on original mathematical research done primarily by undergraduate researchers in all areas of mathematics and its applications. Faculty may be involved in the research and writing, through advising, mentoring, editing, and being a coauthor, but the majority of the original work and writing must be completed by students.

See the journal's website, mjum.math.umn.edu, for more information, to learn about the submission process, and to read the latest articles.

Minnesota Center for Industrial Mathematics (MCIM)

In July 2015 Gilad Lerman was appointed as the MCIM director, replacing Daniel Spirn. MCIM aims to expose our graduate students to the mathematical challenges and skills that arise in industry, while helping them become possible leaders in industry (or leaders in academia with broad background in industrial applications). It also aims to foster research in this direction.

The joint IMA/MCIM Industrial Problems Seminar has been very active and hosted a wide range of industrial speakers from corporations that include Proto Labs, Inc, USAA Asset Management Company, 3M, Allstate, Astronautics Corporation of America, Tempo Automation, UnitedHealth Group, Eaton Corporation, Plethora, Argonne National Laboratory, MaxPoint, Thomson Reuters, Medtronic, Corning Incorporated, and Quantitative Scientific Solutions, LLC.

The seminar talks provide a window on the daily activities of mathematicians in industry. Moreover, the industrial visitors get to learn about the strength and expertise within our department. These visits resulted in several summer internships as well as discussions that may potentially turn into collaborations. By early April, eleven internships were arranged for our students in the following corporations: 3M (2 different internships), Astronautics Corporation of America, Cray Inc., Los Alamos National Laboratory, Mitsubishi Electric Research Laboratories (2 different internships), National Geospatial Agency, Sense AI, Surgical Information Sciences and Vital Images. This is a significant number, even though it was not an easy year for internships in applied mathematics. MCIM has also helped with job positions for graduating students. One example is a quantitative analyst position with Google's advertising team.

Further activities have been started to address the increasing interest of graduate students in MCIM and industrial careers in general. A webpage with resources on industrial internships was created and is being updated by the MCIM director and students. Close ties with the SIAM students chapter at UMN were initiated. Also, the Career Center for Science and Engineering (CCSE) and the Minnesota Center for Financial and Actuarial Mathematics (MCFAM) have helped our students in their application process. Beyond the usual ties with industry, MCIM and the IMA are closely working with 3M and the office of the vice president of research to develop mutual research collaboration.

Math Library News

The Mathematics Library has a fresh look, with new carpet and more space in the Reading Room for students and faculty members to work and study. There is also a new asbestos-free ceiling, but we'd rather focus on the unique artwork: the Helaman Ferguson sculpture, "Knotted Wye II," has a more prominent spot; Prof. Lisl Gaal's painting, "Markov process with two states, one of which is an absorbing state," was made and given in memory of Prof. Charlotte Striebel; Prof. Donald Kahn's photographs of mathematicians now hang above the computers; and the inspirational painting by Ning Jia (PhD 2007), commissioned by the School

of Mathematics, illuminates the stairs to the book collection. Another piece is on the way: an oil portrait of a young Prof. Hans Weinberger. Members of the mathematics community were invited to a Sept. 1 open house to celebrate the enhanced space, which also provided an appropriate setting for Prof. George Sell's memorial service in November. As a tie-in to the renovations, the Fall exhibit highlighted the Sofa Moving Problem, the Piano Mover's Problem, Sierpinski carpets and Penrose tiles.



Lisl Gaal: Markov process with two states.

The library's services are continually updated as well. A session on best practices for data management was incorporated into two 5000-level Statistics courses, by a team including Math Librarian Kris Fowler as well as data management specialists from the University Libraries and the College of Liberal Arts. Topics covered included finding re-useable data sets, sharing and preserving research data in the Data Repository for the University of Minnesota (DRUM) or other open venues, and data documentation practices that support reproducibility. A full suite of resources for data management, including tools for complying with funding agencies' requirements, is available on the Libraries' Researcher Support webpage (www.lib.umn.edu/researchsupport).

Minnesota Center for Financial & Actuarial Mathematics (MCFAM)

MCFAM was busy with new people and activities over the past year. The Actuary Club started an innovative practice of site visits with two local companies: Mercer and Allianz Life of North America. MCFAM also began a new collaboration with the Carlson School. Leaders of the MCFAM and the new Carlson MS in Finance are working together to showcase the different student and employer needs our programs fulfill. Students will participate in joint activities to learn how to work together before going to industry.

Dan Mitchell, new to the University's Industrial and Systems Engineering Faculty, is collaborating with MCFAM. He will teach Math 5075-Mathematics of Options, Futures, and Derivative Securities I in fall 2016. Dan has a PhD in Information, Risk, & Operations Management from the University of Texas.

Breanne Richins joined MCFAM full time in 2015. She is a Fellow of the Society of Actuaries and worked as an actuary at Securian Financial for 10 years. She teaches two actuarial courses, is advising students on senior projects and supports the

enhancement of the current actuarial program and associated activities..

Dr. Kaisa Taipale is working with MFM students on research projects in conjunction with industry practitioners. One project is with Ameriprise under the guidance of Senior VP of Capital Solutions, Dr. Phil Jones, an alumnus of the School of Math. Kaisa will also lead a summer student research seminar on Federal Reserve Risk Stress Testing.

Doreen Vescelius has significantly increased the goodwill with companies participating in the popular actuarial problem solving course "Actuarial Mathematics in Practice Course". Each semester 3 different companies send their actuaries to lead a 5-week actuarial problem solving case. Students work with models and learn to communicate using a variety business communication techniques. Ten local firms are now involved in this industry-academic educational collaboration.

Allianz Life sponsored a new Financial Mathematics (FM) Actuarial Exam Workshop. If students pass their FM exam they get full reimbursement through the MCFAM/Allianz FM Exam Reimbursement Fund. MCFAM also launched a new online Probability Exam Workshop which features video instruction created by MCFAM alumni and instructors.

At the end of July 2016 MCFAM will be a major co-host of the 51st Actuarial Research Conference, along with the University of St. Thomas. The theme for this year's conference is "Strengthening Industry and Academic Collaboration". There are 20 firms involved in the organizing committee and we have unprecedented support from industry sponsorship, having raised at this time \$84,000.

IMA News

Since the announcement of the NSF decision to end its funding of the IMA through its Math Institutes program, the directorship has been actively working toward establishing a new vision of the IMA where global leadership in the mathematical sciences is achieved by bringing transformative change to industry, government, and academia. This new vision includes leveraging the IMA's strengths in its brand, industrial expertise, its ability to convene experts to solve problems, and to develop talent. As a start on this new path, the IMA is responding to the needs of the mathematical sciences community by developing exciting new programs that will create career pathways for young mathematical scientists and meet the burgeoning needs of industry in data analytics. The new IMA Data Science Lab is being led by Gilad Lerman from the School of Mathematics. The goal of the lab is to serve as a hub for collaboration between industry and academic researchers and to provide industry with access to academic research and tools for data analysis.

The IMA Thematic Annual Program for the 2015-16 academic year is on "Control Theory and its Applications." Tryphon Georgiou from the Department of Electrical and Computer Engineering has been an instrumental organizer in shaping the program that has focused on the interdisciplinary nature of control theory and the wide range of applications where control concepts and techniques are relevant. Another organizer is Anders Rantzer of Lund University, who was an IMA postdoctoral fellow during the first IMA program

on Control Theory in 1992-1993. Anders has been a long-term visitor for the duration of the current program year. Math faculty have been involved as well, including Yochiro Mori and Camelia Pop. As the program winds down in May, the IMA is gearing up for the 2016-17 program in Mathematics and Optics.

June will be a busy month. The IMA is holding its first "Math-to-Industry Boot Camp," a program similar to the popular "Mathematical Modeling in Industry." Graduate students will continue to work in teams on industrial projects while receiving guidance and mentoring from industry scientists. The camp is designed to train graduate students for employment outside of academia. The IMA will also offer its third "Math Modeling Camp" for high school students. The camp is a collaboration with the MathCEP and continues to be a popular program. There will be a workshop on "Frontiers in PDE-constrained Optimization" emphasizing the related applications and problems arising in industry, with support from ExxonMobil. Finally, the IMA is offering a two-week course on "Mathematical Optimization" in August.

Continuing the IMA's tradition of Abel Conferences, the influence of John Nash and Louis Nirenberg's work was the focus of the 2015 meeting which was held in November. The conference took place over two and one-half days with 87 people attending. In addition to the nine talks given by mathematicians who were deeply influenced by either Nash or Nirenberg's work, the IMA hosted a banquet at which former students had a chance to share stories.

Undergraduate Program

Graduate teaching assistants Mauricio Flores, Ryan Goh, and Kimberly Logan won the 2014-15 Outstanding Teaching Assistant Award. Students in mathematics courses submitted approximately 480 nominations in support of their TAs.

Twenty-five of our approximately 575 math majors will be awarded 2016-17 merit scholarships totaling approximately \$58,000 from the Othmer, Gilquist, Segal, Lando, Christofferson, and Thorpe funds.

Five math majors, Rajendra Beekie, Emily Daniel, Morganne Igoe, Naomi Ollila, and Katherine Schroepfer, were awarded merit scholarships from the College of Science and Engineering.

Graduate Program

Graduate Student Fellowship Awards

Richard McGehee, Director of Graduate Studies in Mathematics and The Graduate School congratulate the following graduate students who received fellowships.

Guosheng Fu, 2015 Doctoral Dissertation Fellowship, Superconvergent HDG Methods for Partial Differential Equations, Bernardo Cockburn, advisor.

Ryan Goh, 2015 Doctoral Dissertation Fellowship, Pattern Formation in the Wake of External Mechanisms, Arnd Scheel, advisor. He has been awarded an NSF Postdoctoral Fellowship and will be going to Boston University, Prof. Eugene Wayne, advisor.

August Hagen, 2015 College of Science & Engineering (CSE) Graduate Fellowship, Mitchell Luskin, advisor.

Erin Oakley, 2015 Knowles Science Teaching Foundation (KSTF) Fellowship, Jonathan Rogness, advisor.

Cameron Thieme, 2015 College of Science & Engineering (CSE) Graduate Fellowship, Alexander Voronov, advisor.

Nicholas Switala, 2015 Ph.D. Graduate, postdoctoral fellow at the University of Nebraska-Lincoln has been awarded an NSF Postdoctoral Fellowship and will be going to the University of Chicago, IL, Gennady Lyubeznik, advisor.

Nicholas Switala, Some invariants of nonsingular projective varieties and complete local rings, Gennady Lyubeznik, advisor; Postdoctoral Faculty Fellow, University of Nebraska-Lincoln, NE

Xu Wang, Searching, Clustering and Regression on non-Euclidean spaces, Gilad Lerman, advisor; SEW Assistant Professor, University of California San Diego (UCSD), San Diego, CA

Ph.D. Graduating Students

Richard McGehee, Director of Graduate Studies in Mathematics and The Graduate School congratulate our recent graduating Ph.D. students (May 2015 to February, 2016).

Adil Ali, Boundary-value problems on spaces of automorphic forms, Paul Garrett, advisor, Teaching Specialist, School of Mathematics, University of Minnesota, Minneapolis, MN

Kevin Dilks, Involutions on Baxter Objects and q-Gamma Nonnegativity, Victor Reiner, advisor; Postdoctoral Research Associate, North Dakota State University, Fargo, ND

Robert Edman, Diameter and Coherence of Monotone Path Graphs, Victor Reiner, advisor; Research Scientist, Adventium Labs, Minneapolis, MN

Gabriella Jaramillo, Inhomogeneities in Spatially Extended Pattern Forming Systems, Arnd Scheel, advisor; Postdoctoral Fellow, University of Arizona, Tucson, AZ

Thomas McConville, Biclosed sets in Combinatorics, Pavlo Pylyavskyy, advisor; Instructor Applied Mathematics, Massachusetts Institute of Technology (MIT), Cambridge, MA

Stephen McIntyre, Understanding and analyzing APD alternans, Yoichiro Mori & Alena Talkachova, advisors; Instructor, Virginia Tech, Blacksburg, VA

James Melbourne, Convex Measures and Associated Geometric and Functional Inequalities, Sergey Bobkov, advisor; Postdoctoral Researcher, University of Delaware, Newark, DE

Derek Olson, Formulation and Analysis of an Optimization-Based Atomistic-to-Continuum Coupling Algorithm, Mitchell Luskin, advisor; Postdoc, School of Mathematics, University of Minnesota, Minneapolis, MN

Vincent Quenneville-Belair, A new approach to finite element simulations of general relativity, Douglas Arnold, advisor; Chu Assistant Professor of Applied Mathematics, Columbia University, New York, NY

Madeline Schrier, Barcode Decoding in a Camera-Based Scanner: Analysis and Algorithms, Fadil Santosa, advisor; Product Development Intern, Ford Motor Co., Palo Alto, CA

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