School of Mathematics, University of Minnesota

Newsletter Volume 13 Spring 2007

From the Head

Four down and one to go! (Referring to the years in my term as Head of the department) This is a great math department, and it is a privilege to play a role in its operation. And I will also be happy to get back to doing the things that made me want to be a mathematician in the first place (July 1, 2008).

Lawrence Gray

We had some significant successes this year. Since the last newsletter, five new mathematicians have been hired, in a variety of positions. These include Igor Pak, as Associate Professor with tenure, Kathrin Bringmann and Tyler Lawson, as tenure-track Assistant Professors, and Jonathan Rogness and Bryan Mosher, as non-tenure track Assistant Professors. Igor Pak will interact well with a number of our faculty in combinatorics, algebraic geometry, and probability theory. Those who attended his colloquium talk here know just how exciting he is. Kathrin Bringmann was re-

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cently written about in Science News, because she and Ken Ono solved an 80-year old problem that came out of the work of Ramanujan. Tyler Lawson is a strong young mathematician working in topology, an area where we have not had much hiring success in the past. Jon Rogness is one of our own Ph.D.s, a very fine teacher, and he will be working with Harvey Keynes as the Associate Director of ITCEP. Bryan Mosher comes to us from Michigan, where he was being offered the position of Director of a calculus program that has been successful with underrepresented minorities. Both Jon and Bryan will help to fulfill a vision that I have had for hiring young Ph.D. mathematicians who have a strong interest in undergraduate education.

Another major success is our new Master of Financial Mathematics program. The prime mover in the creation of this program is Scot Adams. The approval process was long and arduous, but all hurdles were finally cleared last September. This did not give us much time to get the program underway for Fall 2007, but everything is coming together. There are approximately 30 students who have been accepted. Six instructors from the financial industry have been hired, and they will work together with two of our faculty (Scot Adams and Bernardo Cockburn) to provide very strong training in the theory and practice of the "instruments" (such as options and futures) that play such an important role in the world of investments and insurance. We anticipate that this program will become quite popular, and hope that it will provide a valuable service (and earn us some money).

I have continued my work with the Minnesota Department of Education. The state Commissioner of Education appointed me as a co-chair of the committee that revised the Minnesota K-12 Math Standards. The process took almost six months, and the resulting document is now before the state legislature for approval. I believe it to be one of the strongest documents of its type in the US. Going forward, there will be a need in connection with these standards for professional development of K-12 math teachers, and I hope to be a part of that effort.

Lawrence Gray

Welcome to Incoming Faculty and New Postdoctoral Appointees

As we traditionally do each year in these pages, we extend our welcome to those faculty members and postdocs who joined the School in September 2006: Assistant Professors Kathrin Bringmann and Stephen Griffeth, and postdoctoral researchers Drew Armstrong, Marcel Arndt, Huseyin Coskun and Sen-Peng Eu. We are delighted to have these talented mathematicians join our faculty.

Kathrin Bringmann accepted our offer of a tenure-track Assistant Professorship a year ago, but has been completing the last year of her three-year appointment (2004-07) as a Van Vleck Assistant Professor at the University of Wisconsin-Madison. She will join us in Fall 2007. Kathrin earned her doctorate in 2004 from the University of Heidelberg. Her research interests include elliptic, Siegel and Hilbert modular forms, algebraic number theory, theory of partitions, analytic number theory and mock theta functions.

NSF Postdoctoral Fellow Drew Armstrong earned his Ph.D. in 2006 from Cornell University. His research area is algebraic combinatorics.

Postdoctoral Researcher Marcel Arndt earned his Ph.D. from Bonn University in 2004. His research interests include multiscale methods for continuum mechanics (upscaling techniques, quasi-continuum method), partial differential equations and numerical methods.

Postdoctoral Researcher Huseyin Coskun earned his doctorate in 2006 from the University of Iowa, Iowa City. His specialty is mathematical biology. His research interests include free boundary value problems, inverse problems, cell physiology, cell movements and viscoelastic fluid flow.

Research Assistant Professor Stephen Griffeth earned his Ph.D. in 2006 from the University of Wisconsin-Madison. Stephen's research interests include Hecke algebras, their representations, and applications to combinatorics and geometry, as well as algebraic groups, Lie groups and homogeneous spaces. As a graduate student at UW-Madison Stephen held a VIGRE Fellowship.

Postdoctoral Researcher Sen-Peng Eu is visiting our department on a Taiwanese government fellowship. His research area is algebraic combi-

natorics. His home institution is National Taiwan Normal University, Taipei.

We also look forward to the arrival next September of the new members of the School of Mathematics who accepted offers during 2006-2007. A list of these soon-to-arrive members is given in Professor Gray's message "From the Head" on page 1.

Promotions

Ezra Miller

Professor Ezra Miller was promoted to the rank of Associate Professor effective September 2006. Ezra's research is concerned with combinatorial aspects of geometry and algebra. A very interesting description of some of his work was given in the "Featured Colleagues" section of our 2005 Newsletter.

Awards and Recognitions

Bernardo Cockburn awarded Distinguished McKnight University Professorship

Professor Bernardo Cockburn has been awarded a Distinguished McKnight University Professorship. This award carries with it a $100,000 research grant over the next five years, and the title is granted for the duration of Bernardo's career at the University of Minnesota. He joins Vladimir Sverak and Vic Reiner, who are the other two members of the School of Mathematics who have achieved this honor.

Nicolai Krylov awarded membership in the Royal Society of Edinburgh and the Itô Prize

Nick Krylov, our Samuel G. Ordway Professor, was elected as a Fellow of the Royal Society of Edinburgh in March 2007. Founded in 1783, the Royal Society of Edinburgh is Scotland's national academy of science and letters.

Nick was also awarded the the 2005 Itô prize by the editors of the journal *Stochastic Processes and Their Applications*, for his paper "On weak uniqueness for some diffusions with discontinuous coefficients". The Itô prize is awarded biannually to recognize a paper recently published in the journal for its significant contribution to the theory or applications of stochastic processes.

Marta Lewicka named McKnight Land-Grant Professor

Marta Lewicka will hold a McKnight Land-Grant Professorship during 2007-09. This award is a recognition of a faculty member's outstanding contributions to her area of research and potential for future achievements. The award provides a research grant in each of two years, summer support and a research leave in the second year.

Ezra Miller receives the McKnight Presidential Fellowship and the Borja Award

Ezra Miller received the McKnight Presidential Fellow Award for 2006. The McKnight Presi-

dential Fellows Program is targeted at the most promising faculty who have been newly granted tenure and promotion to associate professor. The award provides research funds for three years.

Ezra is also the recipient of the 2007 Guillermo E. Borja award for "his contributions to combinatorial geometry and algebra that have been recognized worldwide".

Rankings Update

It is probably wise not to dwell too much on rankings, given their imprecision and the varied criteria that are employed. However, we can briefly note two reasonably good reports on the School of Mathematics that appeared recently.

In the 2008 edition of the graduate school rankings by U.S. News and World Report, among math graduate schools we tied with the University of Illinois and the University of Pennsylvania for seventeenth place. This ranking is based on a survey performed every two years.

The January/February issue of Science Watch reported a different kind of ranking. Here mathematics departments were ranked on the basis of their "relative citation impact", which refers to the average number of citations per paper over a five-year period. This type of calculation is presumably an attempt to measure the quality of research papers at each institution. At any rate, by this measure the School of Mathematics was fortunate enough to be ranked third in the nation, behind the mathematics departments of Stanford and the University of California at Berkeley.

Featured Colleagues

Gennady Lyubeznik

Professor Gennady Lyubeznik was born in Kiev (now in Ukraine). His early education was in the usual schools, but with an early curiosity in mathematics, Gennady generally would be the best in his class in mathematics. When he reached the eighth grade Gennady was sent to a special school for mathematics (there were several such schools in the region). There he met an outstanding teacher, Jacob Jankelevitch. He began participating in the math Olympiad competitions. In 1973, Gennady was second in Ukraine and seventeenth in the Soviet Union. Nevertheless, after graduation he was unable to gain admittance to Moscow State University, the top school for mathematics. He was "failed" in Physics (this was a sad time when the number of Jewish students who were accepted at Moscow State University was minuscule).

Seriously disappointed, Gennady entered the Moscow Automobile and Road Institute. There $y = ax^2$ was not a parabola but "some sort of quadratic". Fortunately, some provincial universities were still open to Jews, and Gennady decided to transfer to Yaroslavl University. This cost him a year, but there were mathematicians there such as Efremovitch, Onischik and Chernavsky, as well as one of the Yaglom brothers. This was a real university, totally different from the "Automobile and Roads". But Gennady was not able to complete his college degree because half a year before graduation he and his family applied for a permission to emigrate. They arrived in the United States in October 1979.

Gennady Lyubeznik

We asked Gennady how he could enter Columbia University (graduate school) without an official college diploma. His response was "That's an excellent question; I don't even know the answer myself". Yaglom had told him that when he came to New York, he could talk to Professor Lipman Bers. Bers was fluent in Russian, and when Gennady finally told him of his results in the Olympiad, he arranged for a provisional entrance

to Columbia grad school, conditional on his passing two of the three prelim exams by the end of the first semester. When he passed all three prelims, he was even the best student in topology. He could brag to Bers that he (Bers) had not made a mistake.

While Gennady had an official adviser — Hyman Bass — he actually worked with David Eisenbud, then at Brandeis University. Gennady's research began with a question that he had heard in Yaroslavl from Professor Piotr Zabrejko. It concerned a generalization of a classical algebraic fact. In the original form, we are given two homogeneous polynomials, and wish to know if they have a common zero. This is settled classically by forming a new polynomial in the coefficients of the two polynomials, called the resultant of the two given polynomials, and seeing whether it vanishes for the actual values of the coefficients. The question posed by Professor Zabrejko was how this theorem could be extended to deal with the case in which we are given not two but three (or more) polynomials. Gennady's thesis showed that in its original form the same criterion would not work for three or more polynomials. However, in a different form a positive result is possible. The exploration of this problem has formed one source of Gennady's extensive research. In particular, this question led him to the study of local cohomology (which had been invented by Grothendieck, and which has proved to be a powerful tool for such problems). Although Gennady did not use local cohomology in his thesis work, Boris Moishezon learned of the connection when discussing Gennady's work with Robin Hartshorne, and it has played a major role in Gennady's research subsequently.

Gennady has had four Ph.D. students, including Uli Walther (now at Purdue) and Anton Leykin (currently at the IMA). Both have made significant advances in the computational and algorithmic aspects of commutative algebra. When we asked Gennady where he places his mathematical interests, Gennady said, "My home is commutative algebra, but I often don't live at home". We can be sure that he will continue to produce interesting results in all the areas that attract his attention.

(The newsletter committee thanks Gennady Lyubeznik for making this article possible.)

Vladimir Sverak

Professor Vladimir Sverak joined the School of Mathematics in 1993. He was named a Distinguished McKnight University Professor in the year 2000. His main research interests are in partial differential equations.

Vladimir's high-school education was in Karlsbad and Lanskroun in Bohemia. He entered the Charles University in Prague in 1978. His first mentor was David Preiss, who is now a Professor at the University of Warwick and Fellow of the Royal Society. Vladimir wrote his undergraduate thesis under Preiss, on topics in real analysis and point-set topology. Later he started working in PDEs, under the guidance of Jindrich Necas.

Vladimir emphasizes the very important role both Preiss and Necas played in his mathematical beginnings. Vladimir obtained his doctorate in 1986 and worked with Necas and other members of his group at the Charles University. Necas, who passed away in 2002, was a charismatic teacher who attracted many students.

Vladimir Sverak

In 1989 and in 1990 Vladimir visited John Ball in Edinburgh. He also spent some time here at the Institute for Mathematics and its Applications. Then Vladimir held a postdoc appointment in Edinburgh starting in 1990. The two years in Edinburgh and the collaboration with the group of John Ball played an important role in Vladimir's research. During this period, he solved an important problem of C.B. Morrey, Jr. in the calculus of variations. In Edinburgh Vladimir also met Stefan Mueller, one of his principal collaborators and a frequent visitor to our department, after Vladimir joined us. Vladimir accepted an offer to join our department in 1992, and he came to Minneapolis

in 1993, after spending some time at the University of Bonn and the Institute for Advanced Study in Princeton.

Partial differential equations (PDE's), especially regularity theory, and the calculus of variations are the main topics of his research. Regularity theory aims to describe the qualitative properties of solutions of PDE's (such as differentiability, analyticity, etc.) Some of Vladimir's work (with coworkers), focuses on the Navier-Stokes equation which describes the flow of fluids such as air and water. Vladimir was attracted to the equations of fluid mechanics while still in Prague and working with J. Necas, who had many original ideas about these equations.

Vladimir's recognitions include the Prize for outstanding young European mathematicians which he received in 1992, the Max Planck Research Award (jointly with Stefan Mueller), the invitation to speak at the International Congress of Mathematicians in Zurich in 1994, and the Keith Medal of the Royal Society of Edinburgh.

As mentioned earlier, he was named a Distinguished McKnight Professor in 2000. Despite all these successes in research, Vladimir remains a very modest and friendly colleague, and is generous with his time in discussions with faculty and students.

Graduate students hold Vladimir's courses in high regard, and he has served as Ph.D. advisor to many students: Tai-Peng Tsai, Xiaodong Yan, Kyung-Keun Kang, Seungsuk Seo, Pang-Yen Weng, Dapeng Du and Gabriel Koch. Tsai (now at the University of British Columbia) received the Andre-Aisenstadt prize in 2006 for his work on PDE's.

Vladimir keeps busy with many other activities. He is frequently visited by coworkers and he serves as an editor of the Archive for Rational Mechanics and Analysis, a well-known journal with a long association with our department (see the Golden Era article in the previous Newsletter).

(The newsletter committee thanks Vladimir Sverak for making this article possible.)

IMA News

The Institute for Mathematics and Its Applications (IMA) supports research in mathematics and its applications thoughout science and technology.

The current year saw one change in the leadership at the IMA. After three years of excellent work, Debra Lewis stepped down from the position of Associate Director and returned to her regular post at the University of California. The new Associate Director is Professor Chehrzad Shakiban of St. Thomas University, who joined the IMA in September 2006.

Annual programs

The current Annual Program is **Applications of Algebraic Geometry** (September 2006 - June 2007). The theme of this program is an excellent example of how interesting problems span different disciplines, including areas of mathematics that are often regarded as rather pure. From the IMA web site `http://www.ima.umn.edu/2006-2007/`: "Algebraic geometry has a long and distinguished presence in the history of mathematics that produced both powerful and elegant theorems. In recent years new algorithms have been developed and several old and new methods from algebraic geometry have led to significant and unexpected advances in several diverse areas of application. Motivated by these exciting developments, the year in algebraic geometry and its applications aims to bring together mathematicians, computer scientists, economists, statisticians and engineers from various disciplines in order to enhance interactions, generate new applications and motivate further progress. In the first quarter, the two workshops cover algorithms and software with a particular eye towards applications. In the second and third quarter, the workshops cover applications in optimization, control, statistics, economics and bioinformatics, coding, complexity, communications and computational geometry."

We look forward to equally exciting programs in the future: *Molecular and Cellular Biology* (September 2007 - June 2008), and on *Mathematics and Chemistry* (September 2008 - June 2009).

Shorter programs

Throughout the year, IMA holds workshops and seminars on additional topics not connected with the main theme for the year (for the complete list, see `http://www.ima.umn.edu/programs/`). The activities in summer 2007 include the following courses.

New Directions Short Course in "Compressive sampling and frontiers in signal processing", June 4-15, 2007,

Summer Program in "Classical and quantum approaches in molecular modeling", July 23-August 3, 2007,

Participating Intstitutions Summer Program for Graduate Students on "Applicable algebraic geometry", July 23-August 10, 2007,

Workshop for Graduate Students entitled "Mathematical modeling in industry XI", August 8-17, 2007.

Blackwell-Tapia Conference

The Blackwell-Tapia Conference was held at the IMA on November 3-4, 2006 (see `http://www.ima.umn.edu/2006-2007/SW11.3-4.06/`). This was the fourth in a series of biannual conferences honoring David Blackwell and Richard Tapia. This conference provided a setting in which to recognize outstanding mathematical work by minority researchers. A panel discussion on career opportunities in mathematics was held, as well as a panel discussion on recruitment and retention of a diverse mathematics faculty.

During the conference banquet on Saturday evening, the 2006 Blackwell-Tapia prize was presented to William Massey, in recognition of his outstanding achievements in queuing theory, stochastic networks, and the modeling of communications systems, and in increasing diversity in the mathematical sciences.

IMA Public Lectures

(`http://www.ima.umn.edu/public-lecture/all_math_matters_lectures.html`) These lectures are given by top researchers who are also excellent expositors. This year's talks were very well attended. The speakers were:

Margaret H. Wright (Computer Science, New York University), "How Hard Can It Be?", November 2, 2006;

Christopher J. Budd (Mathematical Sciences, University of Bath), "Making Sense of a Complex World", January 18, 2007;

Martin Golubitsky (Mathematics, University of Houston), "Patterns Patterns Everywhere", March 7, 2007;

Jennifer Tour Chayes (Theory Group, Microsoft Research), "Epidemics in Technological and Social Networks: The Downside of Six Degrees of Separation", April 18, 2007.

A Statistician's Report

The application of algebraic geometry to statistics is one of the topics in the Annual Program this year at the IMA. Since this is a very interesting example of a striking connection between different areas, we thought some of our readers might like to delve more deeply into the mathematical details. Michael Hardy is a statistician with a strong interest in mathematics and the foundations of probability theory. He received his Ph.D. from the School of Statistics in the University of Minnesota, and is a Lecturer in the School of Mathematics. Dr. Hardy gave us the following report, from his point of view as a statistician, on some of the presentations he attended at the IMA.

As part of its Annual Program on Applications of Algebraic Geometry, the IMA held its Annual Program Year Workshop, "Applications in Biology, Dynamics, and Statistics" during March 5-9. I attended a number of the talks and several seminars on related topics preceding the Workshop, and a public lecture at the University of St. Thomas by Professor Bernd Sturmfels from UC Berkeley.

In the present day, it seems many algebraic geometers are applying their subject to statistics, especially in the context of molecular biology and phylogenetics. In 1984, the noted statistician Herbert Robbins said in an interview, "I would like to see a distinguished mathematics department in this country tell its students: 'You are very capable and you could have a career in algebraic geometry or whatever, but we would like to encourage you to go into biostatistics.'" Who would

have thought in 1984 that people would now be studying algebraic geometry in order to apply it to statistical problems arising in biology?

Some of what was presented during the Workshop might be suspected of merely recasting things familiar to statisticians into the language of algebraic geometry and of combinatorics. Does this merely translate known material into another language, or does it make it possible to apply results of algebraic geometry to statistics and to answer statistical questions that could not formerly be addressed? That question was the topic of the Workshop's final talk, by statistician Stephen Fienberg of Carnegie Mellon University. Fienberg is the author of *The Analysis of Cross-Classified Categorical Data*. Consider a (fictional) example of the topic of that book. Randomly chosen respondents to a survey are classified by (1) occupation, (2) religion, (3) gender, (4) ethnicity, and perhaps in several other ways. If ethnicity and occupation are independent in the population from which the sample was taken, then with high probability they will be nearly but not exactly independent in the sample. Are they so far from independent in the sample that we should reject a presumed null hypothesis of their independence in the whole population? If so, might they be still be conditionally independent given religion? Or perhaps conditionally independent given both religion and gender? A statistician using a "log-linear model" represents the logarithm of the expected number of respondents in each "cell" in this classification as a sum: $u+u_1+u_2+u_3+u_4+u_{12}+u_{13}+\cdots$, where u_1 is a function depending only on (1) occupation, u_2 depends only on (2) religion, u_{12} depends only on (1) occupation and (2) religion, etc. A principle of parsimony calls for exclusion from the model of all terms whose inclusion is not supported by rejection of a presumed null hypothesis, except that whenever one includes a term with a certain set of subscripts one must include all terms corresponding to subsets of that set of subscripts. A statistician may report that the data support the model [123][24][34] (such is the efficient notation in Fienberg's book). A mathematician working in "algebraic statistics", as it is called, would then say:

- such models correspond to simplicial complexes — objects concerning which combinatorialists have developed extensive theories; and
- the set of all probability measures specified by any such model is an *algebraic variety* — one of a class of objects concerning which algebraic geometers have developed extensive theories.

But does the statistician ask any questions that those theories help answer? Fienberg's bottom-line answer: yes.

Bernd Sturmfels of Berkeley gave the Workshop's initial talk. Sturmfels is the author of *Algebraic Statistics for Computational Biology*. His favorite statistical model lives in the 64-dimensional space $\mathbb{C}^4 \otimes \mathbb{C}^4 \otimes \mathbb{C}^4$ of $4 \times 4 \times 4$ tables (p_{ijk}), where $i, j, k \in \{A, C, G, T\}$. The set $\{A, C, G, T\}$ is of course the 4-letter alphabet in which DNA sequences are written. I suspect that alone implies that the number of researchers for whom this alphabet is daily fare is at least a hundred times the number of mathematicians on earth. This model is parametrized thus: $p_{ijk} = \rho_{A_i}\sigma_{A_j}\theta_{A_k} + \rho_{C_i}\sigma_{C_j}\theta_{C_k} + \rho_{G_i}\sigma_{G_j}\theta_{G_k} + \rho_{T_i}\sigma_{T_j}\theta_{T_k}$, where p_{ijk} is a probability assigned to sequence $i\,j\,k$. Sturmfels sets himself the problem of "comput[ing] its homogeneous prime ideal I in the polynomial ring with 64 unknowns, $Q\,[p_{AAA}, p_{AAC}, p_{AAT}, \ldots, p_{TTG}, p_{TTT}]$." More generally, he advocates the following goal. "Study the geometry of maximum likelihood estimation for algebraic statistical models." Maximum likelihood estimation concerns statisticians daily, and the study of its geometry is not alien to statisticians' thinking. (For the solution of one particular maximum likelihood-related problem, Sturmfels offers a reward of 100 Swiss francs.)

For those familiar with tropical arithmetic and tropical geometry, here is a third example: the space of phylogenetic trees can be viewed as a tropical Grassmannian.

There seems to be much more to be discovered in this fascinating area.

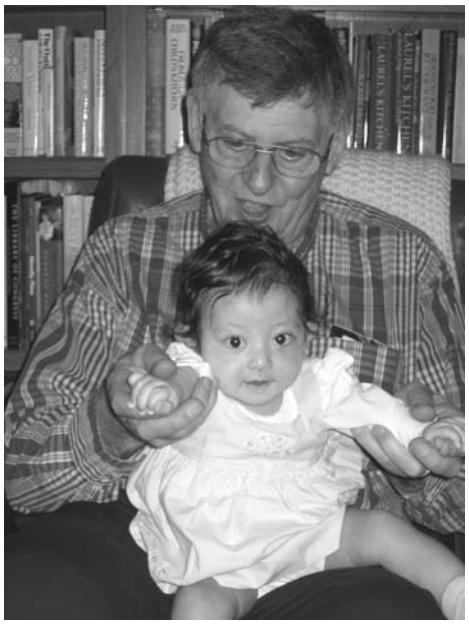
Retirements and Resignations

Max Jodeit

Professor Max Jodeit, Jr. retired in June 2006. Max earned his Ph.D. from Rice University in 1967. His advisor was Gene Fabes, who is well known to our readers and whose name lives on

in the Rivière-Fabes Symposium held annually by our department. Max's first positions, as an Instructor and an Assistant Professor, were at the University of Chicago (1967-1973), after which he joined our department.

Max's specialty is harmonic analysis and applications to partial differential equations and he directed the Real Analysis Seminar for many years. Max enjoys collaborative work: in addition to Fabes and Rivière, the list of his collaborators includes the famous analyst Alberto Calderon. In early 1980s Max worked with 3M scientists on improvements of the design of magnetic heads. In the 1990s he also did joint work with the distinguished Russian mathematician Boris Levitan who retired to Minnesota from the former Soviet Union. Max reminisced about his collaboration with Levitan in the 2005 issue (#11) of this Newsletter (p. 11).



Max supervised four Ph.D. students and served as Director of Graduate Studies (1983-86).

A gracious and friendly colleague, Max will be missed. We wish him and his wife Mary the best in retirement.

Phong Nguyen

One of our staff, Phong Nguyen, is leaving to assume a new position. Phong has been a valued member of the School of Mathematics since 1999, working as a Senior Data Processing Technician. He recently completed his Bachelor of Applied Science degree in Information Technology Infrastructure, specializing in Database Administration and Applied Business.

Phong's new position will be that of Information Technology Professional in the Disbursement Services department of the University of Minnesota. We thank him for his dedicated service here and wish him good luck in his new role!

Academic Visitors

Distinguished Ordway Visitors (2006-2007)

The following leading mathematicians accepted our invitations to visit the School during the current academic year under the Distinguished Ordway Visitors Program. The program brings highly distinguished mathematicians to Minneapolis for prolonged periods, significantly enhancing the creative environment of the School. The visitors typically give several lectures, including a colloquium lecture and several seminars, and the exchanges of ideas with our faculty and students often result in research collaborations. Our Ordway visitors were:

Gregory Seregin, Steklov Institute of Mathematics, St. Petersburg, April 11, 2007 - May 28, 2007;

Laurent Clozel, Université Paris-Sud, April 8, 2007 - May 5, 2007;

Weiyue Ding, Peking University, March 1, 2007 - March 30, 2007;

Mikio Furuta, University of Tokyo, September 3, 2006 - October 3, 2006

Peter Lax, Courant Institute, New York University, September 17, 2006 - September 30, 2006;

John Mallet-Paret, Brown University, April 1, 2007 - May 1, 2007.

The visits by Pierre Berthelot, from Université de Rennes 1, and Peter Sarnak, from Princeton University, have been rescheduled and are expected in the upcoming year.

The visit of Peter Lax

Peter Olver of our department has given us some details about the visit of Peter Lax.

Peter Lax of the Courant Institute was an Ordway Visitor to the Department from September 17 - 30, 2006. Lax is widely acknowledged as one of the giants of twentieth century mathematics. His work has been extraordinarily influential throughout mathematics and its applications. In particular, the fields of partial differential equations, numerical analysis, and integrable systems were profoundly changed by Lax's contributions. In 2005, he was awarded the third Abel Prize, which should be regarded as the mathematics version of the Nobel Prize. He is a member of the National Academy of Sciences, and was awarded the National Medal of Science in 1986 and the Wolf Prize in 1987.

In addition, Lax has a direct connection to Minnesota, since he came with his new wife Lori, who is the daughter of the famous mathematician Richard Courant, and the sister of U of M Emeritus Physics Professor Hans Courant.

During his stay, he delivered three wonderful lectures: a Colloquium on the zero dispersion limit for the Korteweg–deVries equation, which arises in fluid mechanics, a Junior colloquium on the change of variables formula for multiple integrals, which concluded with a spectacular proof of the celebrated Brouwer Fixed Point Theorem that was accessible to second-year calculus students, and an Applied Mathematics Seminar on positive schemes for computing compressible flows with shocks. In addition, the undergraduates at the University of St. Thomas were treated to a preview of his Gibbs Lecture, given in January at the joint mathematical meeting in New Orleans, on the relation between mathematics and physics. His memorable visit inspired and delighted many faculty, students, and postdocs.

2006-07 Continuing Postdocs and Visiting Faculty

Assistant Professors

Akash Anand (Ph.D. University of Minnesota, numerical analysis and scientific computing)

Calin Chindris, Dunham Jackson Assistant Professor (Ph.D. University of Michigan, Ann Arbor, representation theory of algebras, quivers, invariant theory, algebraic geometry, combinatorics)

Dan Drake (Ph.D. University of Minnesota, combinatorics; joint visitor with ITCEP)

Luan Thach Hoang, Dunham Jackson Assistant Professor (Ph.D. Texas A&M University, partial differential equations, dynamical systems, fluid mechanics)

Huiqiang Jiang (Ph.D. Courant Institute, partial differential equations)

Simon Morgan (Ph.D. Rice University, geometric measure theory, harmonic maps)

Mohammad Reza Pakzad (Ph.D. Ecole Normale Superieure de Cachan, nonlinear partial differential equations, geometric measure theory and geometric analysis)

Jonathan Rogness (Ph.D. University of Minnesota, topology; joint visitor with ITCEP)

Scott Wilson, Dunham Jackson Assistant Professor (Ph.D. Stony Brook University, algebraic topology, discrete geometry, mathematical physics)

Doug Wright, Dunham Jackson Assistant Professor (Ph.D. Boston University, partial differential equations)

Alexander Yong, Dunham Jackson Assistant Professor (Ph.D. University of Michigan, Ann Arbor, algebra, algebraic geometry, combinatorics, computational mathematics)

Full Professors

Moty Katzman (University of Sheffield, commutative algebra)

Minkyu Kwak (Chonnam National University, partial differential equations)

Alexander Olevskii (Tel Aviv University, harmonic analysis)

Gregory Seregin (Steklov Inst. of Mathematics, partial differential equations, fluid mechanics)

Postdoctoral Associates and Postdoctoral Fellows

(This includes IMA Postdoctoral Associates who participate in the teaching activities.)

Yassine Boubendir (Université Paris 13, acoustics and electromagnetics, applied mathematics, numerical methods)

Mihail Cocos (University of British Columbia, differential geometry, geometric analysis)

Johnny Guzman (Ph.D. Cornell University, numerical analysis of partial differential equations)

Hstau Y. Liao (Ph.D. City University of New York, statistical methods in tomography)

Anastasios Matzavinos (Ph.D. University of Dundee, applied mathematics, mathematical biology)

Christian Poetzsche (University of Augsburg, Germany; qualitative theory of dynamical systems, evolutionary equations and inertial manifolds)

Carl Toews (Ph.D. MIT Lincoln Laboratory, operator theory, imaging, applied mathematics)

Emanuel Yomba (Ph.D. University Yaouande I, Cameroon; nonlinear partial differential equations)

In Memoriam: Johannes Nitsche

It is with sadness that we report the death of our distinguished colleague, Professor Johannes C. C. Nitsche, on August 9, 2006, at the age of 81. Johannes was born in southern Saxony in 1925. He received his master's degree (Diplom) with F. Rellich in Göttingen and his doctorate with E. Hölder (the son of O. Hölder) in Leipzig. He joined the faculty of the University of Minnesota in 1957.

Johannes Nitsche

Johannes was a dedicated teacher who prepared his lectures with great care and delivered them with elegance and humor. He served as Head of the School of Mathematics from 1971 to 1978. After an initial two-year term, Johannes was the first to receive a five-year appointment as Head.

Johannes was a leader in the areas of calculus of variations, differential geometry and PDE's. He was the author of more than ninety research papers in all, including eight papers co-authored with his brother, the late mathematician Joachim Nitsche. Among his outstanding papers we may

note two examples: "An elementary proof of Bernstein's theorem on minimal surfaces", *Annals of Mathematics* (1957) and "A new uniqueness theorem for minimal surfaces", *Archive for Rational Mechanics and Analysis* (1973). Johannes was the author of the definitive book *Lectures on Minimal Surfaces*. The German edition of this work appeared as Springer Grundlehren v. 199 (1975) and Part 1 of the English edition was published by Cambridge University Press (1989). He had planned two further parts to the English edition which he was unfortunately unable to complete. Some of the questions which he posed decades ago to interested mathematicians have still not been resolved: is there a smooth closed curve in three-space which bounds infinitely many minimal surfaces? Is there any curve of total curvature less than 4π which is the boundary of an orientable, non-simply connected minimal surface?

Johannes is survived by his wife Carmen, a daughter and two sons. He will be missed by his colleagues and friends.

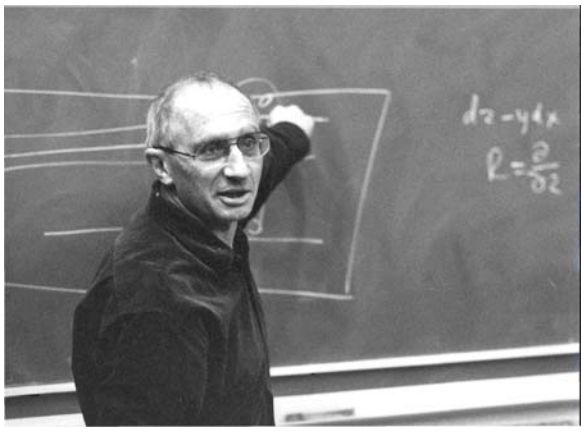
(The newsletter committee is deeply grateful to Professor Robert Gulliver, without whom this article would not have been possible.)

Symposia

Third Yamabe Memorial Symposium

The Symposium, sponsored by the National Science Foundation and the Yamabe Memorial Fund at the University of Minnesota, was held September 15-17, 2006 at the University of Minnesota. The title of the symposium this year was "Geometry and Symplectic Topology".

The Yamabe Memorial Symposium honors the contributions of Hidehiko Yamabe (1923–1960) to mathematics, and is held in alternate years at the University of Minnesota and at Northwestern University. A short history of the symposium is given at `http://www.math.umn.edu/yamabe/history.html`.



Yakov Eliashberg

Dusa McDuff

The speakers at the symposium, with titles of their lectures, were: Denis Auroux (Massachusetts Institute of Technology), "Lefschetz pencils and the symplectic topology of complex surfaces"; Yakov Eliashberg (Stanford University), "Legendrian surgery and contact homology"; Ron Fintushel (Michigan State University), "Surgery on nullhomologous tori"; Mikio Furuta (University of Tokyo), "Pontrjagin-Thom construction in non-linear Fredholm theories"; Helmut Hofer (Courant Institute), "Fredholm Theory in Polyfolds"; Dusa McDuff (SUNY Stony Brook), "Symplectomorphism groups – an introduction"; Peter Ozsváth (Columbia University),

Rivière-Fabes participants

"On knot Floer homology"; and Yongbin Ruan (University of Michigan), "Symplectic birational geometry".

The Organizing Committee consisted of Bob Gulliver (Chair), Conan Leung, Tian-Jun Li, and Jiaping Wang.

Additional details are given at the symposium's web site (`http://www.math.umn.edu/yamabe/`).

The Tenth Rivière-Fabes Symposium on Analysis and PDE

The Symposium is held annually to honor the memory of our late colleagues Nestor Rivière and Gene Fabes. For additional historical information please visit the web site `http://www.math.umn.edu/conferences/riv_fabes/` and see the separate article in this issue of the newsletter.

The tenth Symposium was held April 20-22, 2007 at the School of Mathematics. The principal speakers and titles of their lectures were: Carlos Kenig (University of Chicago), "The Energy Critical, Focusing, Non-Linear Schrödinger and Wave Equations I, II" (two one-hour lectures); Pierre Raphaël (Princeton University and CNRS), "Blow-up for some nonlinear dispersive PDE's"; Ovidiu Savin (Columbia University), "Symmetry of global solutions to certain fully nonlinear elliptic equations"; Sylvia Serfaty (Courant Institute), "Vortices in the 2D Ginzburg-Landau model with magnetic field"; Juan Luis Vázquez (Universidad Autónoma de Madrid), "The Theory of Fast Diffusion Equations: Main features and recent news" (two one-hour lectures); and Alexander Volberg (Michigan State University), "Equation of Monge-Ampère and Bellman Solutions for Certain Harmonic Analysis Problems (After Slavin-Stokolos)".

Carlos Kenig

For the abstracts please see `http://www.math.umn.edu/conferences/riv_fabes/abstracts/`

Juan Luis Vázquez

The Organizing Committee consisted of Naresh Jain, Markus Keel, Nicolai Krylov (Chair), Marta Lewicka, Peter Poláčik, Daniel Spirn and Vladimír Šverák.

Pierre Raphaël

The Beginnings of the Rivière-Fabes Symposium

The School of Mathematics is proud to have recurring lectureships and symposia, which bring many famous visitors to our department. The first of these to be established is the Rivière-Fabes Symposium. This symposium has a long history, and the reasons for its existence are as interesting as the symposium itself.

As the name tells us, this symposium honors two of our late colleagues, Nestor Rivière and Gene Fabes, who were linked both by mathematics and friendship.

Gene and Nestor were graduate students together at the University of Chicago in the early 1960's. Nestor worked with Professor Alberto Calderon and Gene with Professor Antoni Zygmund. Both these advisers would qualify for the word "superstar" and students were often somewhat intimidated by them. After some time working with Zygmund, one might expect a tiny amount of intimacy (for example, one could be invited to drop the title"Professor" and begin calling him "Mister"). At any rate Nestor and Gene thrived in this environment.

Nestor Rivière

Even as graduate students, they collaborated on research, and this tradition of joint work (some called it "a view of mathematics as a team sport") continued during the rest of Nestor's all too short life, and was reflected in Gene's wide-ranging collaborations later.

Nestor came to Minnesota first and shortly thereafter brought Gene from Rice University. Had Rice been a little quicker in seeking to hire Nestor, they might have gotten both. As it was, Minnesota was fortunate in attracting these two distinguished mathematicians. After the tragic death of Nestor in 1978, Gene — and Nestor's many other friends — decided to honor their departed colleague by creating a lecture series. A letter of solicitation was sent out to raise funds to get it started, and the first lecture in the series was delivered by Nestor's adviser, Alberto Calderon. The lecture series was very successful, and provided a chance each year for outstanding researchers to present their work in analysis, as well as to recall the contributions, both mathematical and human, of Nestor.

Gene Fabes

Tragedy struck again with the unexpected death of Gene Fabes in 1997. With the kind approval of Marisa Rivière, Naresh Jain — then Head of the School of Mathematics — moved to create the Rivière-Fabes Symposium. This has now become a three-day affair held every Spring.

While it might be distracting to list everyone who has spoken as a lecturer or symposium participant, it is important to note the extraordinary quality of the participants in the Rivière-Fabes lectureship or symposium. They include Charles Fefferman, Carlos Kenig, Jurgen Moser, J.-L. Lions, Louis Nirenberg, Elias Stein, and Dan Stroock.

The symposium has a social life, including the traditional banquet. It has also served as a magnet to attract the students and co-workers of Gene and Nestor, who are now to be found throughout the academic world. Gene and Nestor brought warmth and a generous inclusiveness to their mathematical work, and this spirit seems to be felt by all the participants in their symposium. What began in tragedy has become an annual celebration. Through the years, funds used to support this symposium have come from the NSF and from generous private contributions. Because of these contributions, we can look forward to many successful symposia in the future.

The newsletter committee would like to thank Esther Fabes, Marisa Rivière, Walter Littman, and Yoram Sager for helping us with this article.

Notable Activities of the Faculty

We are grateful to those colleagues who have provided some details about their recent activities, thus helping us to give our readers a glimpse of the multifaceted scientific work of our faculty. We know that many of our other colleagues have significant achievements and we hope to report on those in future newsletters.

Professor Dihua Jiang participated and lectured in the special program on Arithmetic and Algebraic Geometry in ESI, Vienna, February, 2006, and again in February, 2007. He visited University of Paris-Sud as Clay Research Scholar in May, 2006, and visited University of Paris 7 as a Visiting Professor of Class 1 in June, 2006. He was invited to give ten lectures on representations of p-adic groups at the 11th National Graduate School of China which was held in Hong Kong in the Summer of 2006. He was invited to lecture in

the workshop in the France-Asia summer school, which was held in Summer, 2007 at ITCP, Italy.

Professor Vic Reiner gave an invited plenary lecture at the AMS Winter Meeting in New Orleans in January 2007. He says this was a hour-long talk for a general audience entitled "New combinatorics from the invariant theory of reflection groups".

Professor Arnd Scheel gave a plenary invited lecture at the SIAM Conference on Applications of Dynamical Systems 2007, held at Snowbird, Utah, and gave an invited lecture at the Workshop on Dynamics of Nonlinear Waves in Groningen. He also organized a minisymposium on "Collisions of Dissipative and Dispersive Solitons", together with our Dunham-Jackson Postdoc Doug Wright, at the SIAM Conference on Nonlinear Waves and Coherent Structures 2006, Seattle. Arnd remarks that the SIAM Activity Group on Nonlinear Waves and Coherent Structures was founded relatively recently, and the minisymposium provided a lot of exciting activity.

Undergraduate Program

New Initiatives

Professor David Frank, our Director of Undergraduate Studies (DUGS) has some new initiatives to report:

1) The School of Mathematics has joined with five local high schools to offer beginning math courses for credit in these schools. This program will allow students who are not able to come to the university (the post-secondary option) to still complete courses for credit. The program will be coordinated by David Frank and will begin with four days of workshop over the summer.

   We hope the program will be expanded to include more schools, to make this option available to as many students as possible.

2) In cooperation with Prof. Duane Nykamp, a new 5xxx level course in Mathematical Neuroscience will be offered next year. This will fit into a mathematical biology track for math majors.

3) It is expected that a re-working of the courses Math 1031 and 1051 will be completed soon. This will be coordinated by Prof. Doug Robertson and others in the Postsecondary Teaching and Learning (PSTL) program in the College of Education. In addition to the traditional lecture and recitation format, there will be an extra hour with a tutor as part of the peer assisted learning (PAL) program.

Honors Senior Project Presentations

Three of our math honors students gave outstanding presentations of their work at a special seminar in May.

Dan Colestock spoke on "Enumeration and Probability Distributions for Trees";

Brad Froehle spoke on "An Introduction to Combinatorial Garside Structures";

Alex Miller spoke on "Smith Invariants and Dual Graded Graphs".

The faculty advisors for these projects were Bert Fristedt, Peter Webb and Vic Reiner, respectively. Steve Sperber directs the honors program for all math students. Vic Reiner served as moderator for the seminar, and reports that Dan has accepted a position as an actuary with the firm of Reden and Anders, while Brad and Alex will start graduate school in the Fall at U.C. Berkeley and the U. of Minnesota.

We congratulate these students and all our honors math students on their achievements, and wish them good luck in the next stage of their careers!

The North Central Team Competition and the Putnam Mathematical Competition

Professor Bert Fristedt served as coach for the contests this year, and gives us the following reports.

Mathematical Association of America Team Competition

The tenth annual NCS/MAA team contest was held on Saturday, November 11, 2006. Fifty-eight teams from twenty-seven universities and colleges participated. All five of the U of M, Twin Cities, teams were in the top one-third. There was a two-way tie for first place—a team from Macalester

and a team from St. Olaf—with both these teams scoring 100 out of 100.

The placement of the teams from here are as follows:

In two-way tie for fifth place: Squirrels (Dan Brinkman, Derek Dalle, Jeck Hellerstedt) Score = 90

Seventh place: Maroon (Dan Colestock, Daniel Steilen, Rebecca Weiler) Score = 84

Eleventh place: Loons (Lane Lillquist, Joe Loubert) Score = 80

Fifteenth place in a two-way tie: Gold (David Molitor, Aleksandra Stankiewicz, Abe vanderBent) Score = 74

Nineteenth place: Gophers (Adil Ali, Robbie Hank, Nick Switala) Score = 70

The William Lowell Putnam Mathematical Competition

The Putnam competition was held on December 2, 2006.

There were participants from 508 schools; how many schools had a full complement of at least three participants for their team score is not reported.

The University of Minnesota, Twin Cities, ranked 34th. Its team members were Brad Froehle, Joe Loubert, and Derek Dalle.

3640 individuals participated. In view of the fact that the difficulty of the problems is such as to enable a clear distinction among the best in Canada and the United States, it is not suprising that the median score was 0. The names of the top 501 scorers are made public. This list includes three students from the University of Minnesota, Twin Cities:

Brad Froehle who ranked 193.5,

Dan Colestock who ranked 390.5,

John Lensmire who also ranked 390.5.

The total possible score is 120, and a score of 14 or better was needed to place in the top 501. The highest score by any individual was 101 out of 120.

Congratulations to the team members and high scoring individuals and hoping that all who entered had an enjoyable experience,

Bert Fristedt

Applied Harmonic Analysis and Wavelets Courses

Professor Willard Miller has kindly given us an account of the background and development of our undergraduate and graduate courses in an important area of applied mathematics.

Willard Miller

School of Mathematics course offerings on wavelets, and more generally applied harmonic analysis as it relates to signal and image processing, have been heavily influenced by the programs of the Institute for Mathematics and its Applications, at both the undergraduate and graduate levels. My first exposure to this field was in 1990 when I was asked to give a series of expository lectures at the IMA on the relation between group theory and Radar and Sonar (the topic of the 1990 summer program). In preparing these lectures I first understood the deep connections between group and semigroup representation theory on one side and fields such as Radar, Sonar, Wavelets and Fractal Image Processing on the other. This is an area in which very sophisticated mathematical analysis is linked closely with practical applications. Historically, it has been developed jointly by mathematicians, engineers and computer scientists. The 2000-2001 IMA annual program "Mathematics and Multimedia" and the 2005-2006 annual program on Imaging took up these topics again in considerable breadth and depth. The programs attracted to Minnesota such renowned experts as Ingrid Daubechies (the discoverer of the Daubechies Wavelets) and Stéhane Mallat (after whom the Mallat Herringbone Algorithm is named). As a

result of all this exposure I prepared sets of on line lecture notes, still under active development, from which I have been teaching undergraduate and graduate courses on applied harmonic analysis. The present notes are available on my web site `http://www.ima.umn.edu/~miller` in both postscript and pdf form. The addresses of the pdf files are

`http://www.ima.umn.edu/%7Emiller/waveletsnotes.pdf` (harmonic analysis and wavelets)

`http://www.ima.umn.edu/%7Emiller/radarla.pdf` (harmonic analysis, radar and sonar)

`http://www.ima.umn.edu/%7Emiller/lebesgue.pdf` (Lebesgue theory with fractal image processing)

The undergraduate course in this area, Math 5467 (Introduction to the Mathematics of Wavelets) is taught each spring, by me or another faculty member. The topics are inner product spaces, Fourier series and transforms, background theory/experience in wavelets, multi-scale analysis, discrete wavelets, self-similarity and computing techniques. When I teach it I make use of the Wavelets Toolbox in Matlab for class demonstrations, homework and projects. Filter banks from signal processing are used to motivate the theory, and there are applications to image processing. This is an interdisciplinary course, with a strong math core, meant for undergraduate students in mathematics, and graduate students in science and engineering.

The graduate course is taught from time to time under the number Math 8600 (Topics in Advanced Applied Mathematics) and I will give it again during Spring Semester 2007. This course is devoted to topics in applied harmonic analysis, much of it motivated by the analysis of signals and by imaging: Wavelets, the Ambiguity Functions of Radar and Sonar, and Fractals. I begin with a brief review of Hilbert space theory and develop some essential results from Lebesgue integration theory, from the point of view of the completion of an inner product space to a Hilbert space. Group and semigroup representation theory lies at the core of the applied topics, particularly in its relationship to multi-scale analysis and self-similarity, and I develop group theory as needed. Most of the course lies on the interface between theory and applications and we again use Matlab frequently.

Steven Damelin spent the 2005-2006 Imaging year at the IMA as New Directions Professor, where he became very familiar with the latest developments of imaging. He is presently using my notes for a course at Georgia Southern University called "Fundamentals in wavelets, image and signal processing". We have decided to pool our resources and produce a book based on my notes but with considerable revision and much new material provided mostly by Steven: many more motivating examples and problems, multiresolution analysis on point clouds, diffusion wavelets, multiresolution analysis and networks, functions of bounded variation and applications to Besov spaces, compression, applications to tomography, etc. I find this an exciting project that will strengthen our applied analysis offerings at Minnesota. If you check my web site from time to time you can follow our progress.

Willard Miller, IT Distinguished Professor

Graduate Program

A report by Scot Adams, Director of Graduate Studies in Mathematics.

This year there are 22 incoming students. Sixteen are international; five are women. We congratulate our recent graduating Ph.D. students (October 2005 to September 2006):

Akash Anand, *An Efficient High-Order Algorithm for Scattering from Penetrable Thin Structures*, Fernando Reitich, advisor; Caltech and Mathematical Systems and Solutions Inc.

Daniel Allen Drake, *Towards a Combinatorial Theory of Multiple Orthogonal Polynomials*, Dennis Stanton, advisor; University of Minnesota, ITCEP

Ryan Scott Gantner, *Branching Annihilating Random Walks and Their Application to Traffic Flow*, Lawrence Gray, advisor; St. John Fisher College in Rochester New York

Eric Neal Harrelson, *The Homology of the Open-Closed Riemann Surface Dioperad and Open-Closed String Topology*, Alexander Voronov, advisor; Stony Brook University

Pilwon Kim, *Invariantization of Numerical Schemes for Differential Equations Using Moving Frames*, Peter Olver, advisor; The Ohio State University

Gabriel S. Koch, *A Liouville Theorem for the Two-Dimensional Navier-Stokes Equations*, Vladimir Sverak, advisor; University of Chicago

Chu-Feng Nien, *Models of Representations of General Linear Groups over p-adic Fields*, Dihua Jiang, advisor; returned to Taiwan

Jinhae Park, *Mathematical Modeling and Analysis of Ferroelectricity in Liquid Crystals*, Carme Calderer, advisor; Purdue University at West Lafayette

Mariya Ponomarenko, *Function Approximation and Signal Reconstruction from Data*, Fadil Santosa, advisor; Schlumberger Doll Research in Cambridge, MA

James Andrew Swenson, *The mod-2 Cohomology of Finite Coxeter Groups*, Mark Feshbach, advisor; University of Wisconsin at Platteville

Nicoleta Eugenia Tarfulea, *Mathematical Modeling of Signal Transduction and Cell Motility in Tumor Angiogenesis*, Hans Othmer, advisor; Purdue University at Calumet

Muge Taskin, *Properties of Four Partial Orders on Standard Young Tableaux*, Victor Reiner, advisor; York University in Toronto

Todd C. Wittman, *Variational Approaches to Digital Image Zooming*, Fadil Santosa, advisor; UCLA

Fei Xu, *Homological Properties of Category Algebras*, Peter Webb, advisor; University of Aberdeen

Tianyu Zhang, *Numerical Simulation of Ferromagnetic Shape Memory Thin Film*, Mitchell Luskin, advisor; Florida State University

Math Picnic: applications of bifurcation theory

Master of Financial Mathematics

Professor Scot Adams is also the Director of the new Master of Financial Mathematics (MFM) program which has been developed under his leadership. This is a professional Master's program, which offers a range of courses, from theoretical to practical, including a mathematical course sequence on stochastic processes and a practitioner's course sequence offering hands-on practice to learn financial software tools. There is also a programming course sequence with a focus on learning to use software to present technical material to a not necessarily technical audience. Finally, for those who may need to refresh some of their math skills, or otherwise need background, there is a preparatory course sequence available.

Generally, the program is more mathematical than an MBA.

Courses are offered in the evenings to accommodate working professionals. The program is designed with a possibility for full-time students to complete all requirements in one year.

Program website: http://www.math.umn.edu/finmath/

Scot has also provided a very informative article about the program, and financial mathematics in general, in the May/June 2007 issue of MAA Focus (available on the web at http://www.maa.org/pubs/mayjune07web.pdf, page 9).

Minnesota Center for Industrial Mathematics (MCIM)

Professor Fadil Santosa, Director of the MCIM, has kindly provided the following report on MCIM activities.

News From MCIM: Math to the rescue!

Word has gotten out that we can help solve challenging problems from industry. The School of Math gets calls on a regular basis from local area companies asking if there is expertise in the department to help them with a particular problem they are facing.

A major rebate fulfillment company, Young America, based in Norwood, Minnesota called us to see if we can help with developing methods for fraud detection. Apparently there are people out there who try to submit more than one rebate claim for an item they have purchased. With the help of UMTYMP student Ben Weitz and undergrad (now a Math Ed MS student) Matt Deidrick, Fadil Santosa devised a way to cluster records that look suspiciously similar. The mathematics involved is linear algebra and algorithm design. The key step is how to convert records into high-dimensional vectors.

CarHop is a car dealer that operates dealerships in several states including Minnesota. We got a call from them to help assess their credit scoring process. In the course of our investigation, we found that we may be able to improve upon their procedure. They are committed to hiring an intern this summer to work on using sophisticated learning theory and statistics in classification and ranking of loan applicants.

Defects and flaws, in the form of excessive wear or cracks, need to be removed from railroads in order to prevent serious accidents. LORAM Maintenance of Way is a quiet giant in the business of railroad maintenance. It operates internationally and is headquartered in our state. They contacted us about getting some help with image processing. They have developed a sophisticated camera-based system to take images of railroads as the maintenance vehicle rides over them. They wanted a computer based tool that recognizes presence of flaws. Gilad Lerman, Fadil Santosa and a student are working on this project starting this summer. The next time you take a train ride, remember that mathematics has had a hand in making it safer.

Developing fundamental understanding of the behavior of advanced materials used in medical devices is important to Medtronic. Carme Calderer and her students Hang Zhang and Brandon Chabaud have been working closely with Dr. Suping Lyu of Medtronic on building highly sophisticated mathematical models of materials with the goal of understanding their behavior under environmental influences. This research has not only guided further experimental investigations at Medtronic but also generated rich mathematical research. No less than two Ph.D. thesis on this topic are in the process of being completed with more on the way.

Fernando Reitich is continuing his research on ultrasonics with Dr. James Greenleaf and his group at the Mayo Clinic. Considered to be the top research group in medical ultrasound, the team led by Dr. Greenleaf is credited with inventing new imaging modalities currently used in clinical applications. Fernando and his students, Jiaqi Yang and Fanbin Bu, and a former IMA postdoc, Alison Malcolm have been working with Dr. Greenleaf's group in devising a mathematical model for their measurement process. The goal is to not only obtain an image, but to determine material properties of tissue anomalies. It turns out that doctors can tell if an anomaly is a tumor based on its material properties. This research could potentially lead to new diagnostic tools for early detection of cancer. Mathematics, in the form of computational partial differential equations, is playing a key role in providing insight into the process and guiding the team with design of the imaging system.

More information about this program is available on the MCIM web page (http://www.math.umn.edu/mcim/).

Math Library News

Kris Fowler, Head Librarian for the Mathematics Library, gave us the following interesting report on some very significant library activities and issues.

Kris Fowler

It's the age of expansion! Thanks to increased investment by the University, the Mathematics Library has been able to provide even more resources to support research and teaching in mathematics. Subscriptions to several new journals have been added, to the satisfaction of faculty members who had been asking for "Interfaces and Free Boundaries", the various sections of the European Series in Applied and Industrial Mathematics (ESAIM), and others. The Springer mathematics e-journal backfile has been purchased, extending online access of important journals such as "Inventiones Mathematicae" back to volume 1. We have also been able to expand the acquisition of books—primarily research monographs and graduate-level texts, but also undergraduate study guides, which are very popular.

The new journal subscriptions are mostly online-only, but still space restrictions dictated that we move several older journals to storage. Considering only those with online equivalents, the librarian in consultation with the Math Library Committee and the rest of the faculty chose the journals least likely to be consulted in print. Of course if someone does prefer the print to the electronic version of the 1929 "Commentarii Mathematici Helvetici", for example, the stored print volume can be fetched upon request. While access to some of these online journals depends on our subscriptions, some are freely available thanks to the digitization efforts of various institutions and, in particular, EU funding to convert many European journals.

All these resources can easily be found on the library's redesigned website (`http://math.lib.umn.edu`), which links as well to such services as library web pages for specific courses and the New Books list. (Kris mentions that she also comments on selected new books in her blog, *Book Ring*, which is located at `http://blog.lib.umn.edu/fowle013/mathematicslibrary/`.) The computers in the library's third-floor reading room, recently replaced with new, faster ones, provide improved delivery quality of video-streamed lectures and easier interface with users' flash drives, among other advantages. An additional computer is on its way into the book stacks for access to the online library catalog without having to leave the fourth floor. Of course readers in any part of the library can use their own portable devices to connect to the internet, through the university's wireless network.

Thus with a combination of technological service improvements and traditional collections growth, the Mathematics Library continually grows stronger as a resource for mathematics learners, teachers, and researchers.

Alumni and Friends

Peter March becomes NSF Mathematics Director

Peter D. March, who received his Ph.D. at Minnesota with Steven Orey in 1983, has become the new Director of the Division of Mathematical Sciences (DMS) at the National Science Foundation, replacing William Rundell. Peter was previously Chair of Mathematics at the Ohio State University. His research area is probability theory.

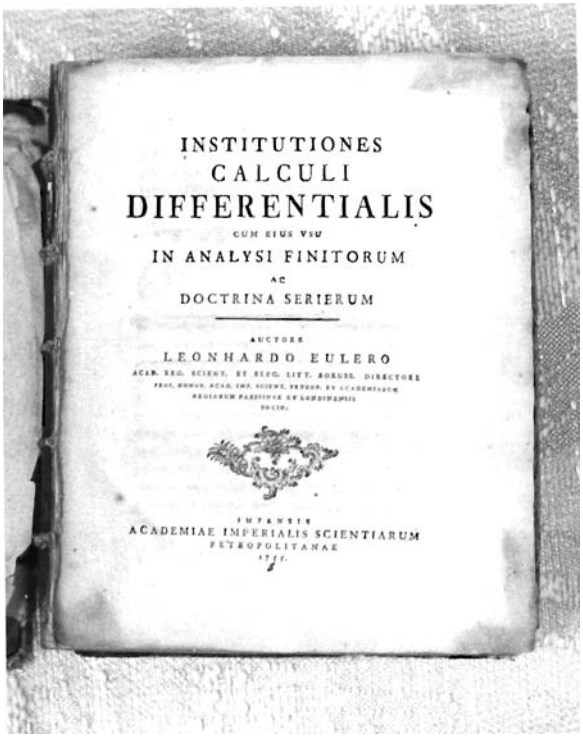
A book with a past

Professor Carme Calderer recently received a fascinating gift from a friend of many years, Professor Jerry L. Ericksen, Emeritus Professor in the Faculty of Aerospace Engineering and Mechanics. Professor Ericksen held a joint appointment in Aerospace and the School of Mathematics.

He is famous for his research in the theory of crystalline structures, and has made many contributions to applied mathematics in the course of his work.

Jerry Ericksen

Carme Calderer



He reports that while a friend, James Bell, was in England, he noticed a lady putting some old books in the trash. There he found and retrieved a classic book by Euler, entitled *Institutiones Calculi Differentialis*. Bell learned that the lady was a descendant of the mathematician Sylvester, so Euler's book may well have been in his library. Subsequently the book passed to Jerry, and he decided that Carme would be the right person to have charge of it in the future.

IT Center for Educational Programs (ITCEP)

The Institute of Technology Center for Educational Programs continues to be very active in both teaching mathematics and training future instructors. ITCEP's director, Professor Harvey Keynes, is continuing in his role as the adviser for students in our unique "Masters in Mathematics with an emphasis in Mathematics Education" program. Graduates of the program frequently go on to be leaders in their school districts. Our professional development network for elementary teachers is also thriving, with 42 teachers participating in events throughout the year, and two courses scheduled for the summer semester.

This year over 400 students enrolled in the University of Minnesota Talented Youth Mathematics Program (UMTYMP). The majority attend classes at the Twin Cities campus, but satellite programs are being taught in Rochester and St. Cloud as well. Forty UMTYMP alumni are currently undergraduates at the University of Minnesota; ten are graduate students here. Eighteen have earned Ph.D.s in Math.

Over 450 students in grades three through seven participated in ITCEP's academic year enrichment programs. One particularly exciting program is Girls Excel in Mathematics (GEM), which provides enrichment for girls in grades 4-7 throughout the year. GEM culminated with special events at the 16th Annual Math and Science Fun Fair in March. GEM has tripled in size since its inception, and continues to grow.

This spring ITCEP hired Jonathan Rogness to be the new Associate Director. Dr. Rogness earned his Ph.D. in Mathematics from the department in 2005 and has worked with ITCEP for five years, first as a graduate student and later as a postdoc with a shared appointment between ITCEP and the School of Mathematics. Another new postdoc, Brian Lindaman, will be starting this summer. Finally, Scott Gilbert was hired in July 2006 to administratively oversee the ITCEP office.

Contents

The Newsletter Committee is composed of John Baxter, Donald Kahn (Chair), Karel Prikry and Peter Rejto.

School of Mathematics
University of Minnesota
127 Vincent Hall
206 Church Street S.E.
Minneapolis, MN 55455
http://www.math.umn.edu
dept@math.umn.edu
telephone: (612) 625-5591
fax: (612) 626-2017

Department Head:
Lawrence Gray (612) 625-5591
gray@math.umn.edu

Graduate Studies:
Scot Adams, Director, (612) 625-1306
adams@math.umn.edu

Undergraduate Studies:
David Frank, Director, (612) 625-4848
frank@math.umn.edu

Institute for Mathematics and its Applications (IMA)
Douglas Arnold, Director
Arnd Scheel, Deputy Director
Chehrzad Shakiban, Associate Director
400 Lind Hall, 207 Church Street S.E.
Minneapolis, MN 55455-0463
http://www.ima.umn.edu
telephone: (612) 624-6066
fax: (612) 626-7370

Minnesota Center for Industrial Mathematics (MCIM)
Fadil Santosa, Director
Fernando Reitich, Associate Director
http://www.math.umn.edu/mcim
mcim@math.umn.edu
telephone:(612) 625-3377
fax:(612) 624-2333

IT Center for Educational Programs (ITCEP)
Harvey Keynes, Director
4 Vincent Hall
206 Church Street S.E.
Minneapolis, MN 55455
http://www.itcep.umn.edu/
telephone:(612) 625-2861
fax:(612) 626-2017

School of Mathematics
University of Minnesota
127 Vincent Hall
206 Church Street S.E.
Minneapolis, MN 55455