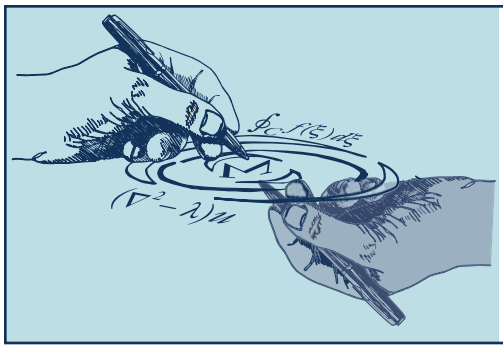


Reckonings

Reckonings: (n. pl.)
1. Computations or summations
2. Acts of thought or reasoning
3. The newsletter of the Department of Mathematical Sciences at the University of Delaware

Chair's Message

This Department will undergo a 5-year academic program review during 2005-06. In this short news article here, I can only outline a conceptual framework for the issues to be considered.

The overall enterprise of a department should be defined as simply as possible, but no simpler. Ultimately, a Department should be judged by the value that it adds to education, knowledge, culture and community well-being. I will very briefly outline our basic functions.

Firstly, a large part of the business of this department involves teaching majors of other disciplines. It is not good enough if students see their math requirement as merely one of many breadth requirements, with little connection to their core interests. We will have succeeded if UD develops a reputation for producing baccalaureate majors of other disciplines who are well aware of how mathematics has empowered their own discipline.

We have a long-standing tradition of teaching relevant mathematics to students of engineering, physical science, computer science, economics and education. We have had some successes in these areas but the road at times has been rocky. We must continually communicate with other departments in curriculum development. There should be future opportunities for extensions to social sciences, biology and creative arts.

Secondly, we produce new baccalaureates with math majors in the BS, BA, math education and math/economics programs. The department will be judged by the successes of these new graduates in the workforce and in graduate schools. There is little data to show where our baccalaureate graduates, apart from mathematics education and math/economics bachelors have found employment. However, a number of them donate to the department, so they must have some degree of gratitude. In the future, we intend to improve communications with our alumni. In order for our baccalaureate graduates to be in high demand, our curriculum should cover a core that is deemed to be common currency throughout the profession, and there should be some emphasis on the requirements of the modern workforce; specifically, ease with computer technology, adaptability in times of change, communication skills, and ability to

What's new in the Math Department...

The MEC Lab brings hands-on experiences of the mathematical sciences.

"All our knowledge has its origins in perceptions." -- Leonardo da Vinci

Starting in 2002, the Department put a new spin on research and teaching the mathematical sciences when it established an experimental laboratory on the first floor of Ewing Hall. This facility, named the MEC Lab for Modeling, Experiment and Computation, brings UD's math department into an elite group of only eight U.S. universities housing experimental laboratories in mathematics departments. Our former quiet tutoring center has been transformed into a noisy, gooey place for faculty and students to make observations and measurements which generate mathematical knowledge and understanding. Ongoing projects in the lab focus on self-assembly of conducting materials, the foraging behavior of ants and random packings of beads and chains. Many of these projects were initiated over the summer months when a whole team of undergraduate and graduate researchers invaded the lab, spending their summer months doing hands-on mathematics.

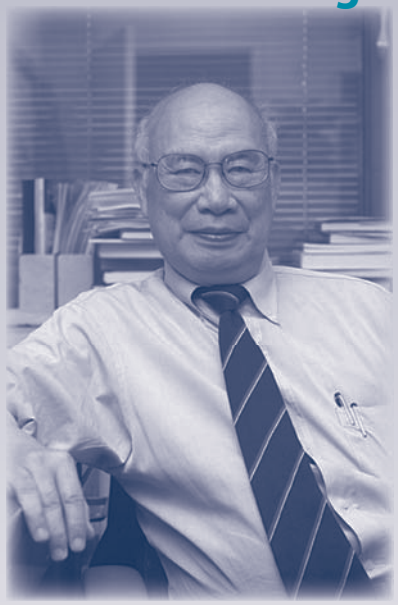
Facilities like the MEC Lab add a new capacity in mathematical teaching and

Mec Lab continued from page 1

research, much like improvements in computing changed university mathematics through the 80s and 90s. Just as the cost and quality of computing hardware and software made it feasible for large numbers of faculty and students to use them as tools to solve problems a decade ago, now we believe that we have come to a similar point in the experimental sciences. The cost and sophistication of data acquisition software and hardware has progressed to a point in many instances where mathematicians can easily design, equip and execute careful experiments without requiring assistance from technicians, specialists or engineers. The relative ease at which specialized materials and equipment can be found and acquired through the web has also accelerated the pace at which this experimental movement has grown in math departments. We hope the removal of this disciplinary barrier will continue to improve the education we offer our students and the pace of interdisciplinary research in our department.

From its inception, the MEC Lab was laid out as a flexible resource so that it would grow and evolve as needed. Since this time, the MEC Lab now serves as a focal point for our capstone modeling course, and instructors use it for enrichment projects in regular courses. We've also held workshops for high school math teachers in the MEC Lab featuring experiments to motivate mathematical thought. Finally, the MEC Lab itself "reaches out" with portable demonstrations that move in and out of classrooms to demonstrate ideas. Next summer, we hope to add a Delaware high school teacher to the MEC Lab research group. The lab web page, http://www.math.udel.edu/MECLAB, lists current projects and lab activities. Please visit the page and take a look at some of the lab's research projects, resources, and upcoming events. If you have any ideas, contributions or suggestions for the lab, please send us a note (meclab@math.udel.edu) .

Professor George Hsiao named Rees Professor of Mathematics



The Department of Mathematical Sciences is pleased to announce that Prof. George Hsiao has been named the first Rees Professor of Mathematics. The Rees Chair honors the memory of Carl John Rees (1896-1985), a distinguished member of the Department of Mathematical Sciences who served the University as a Chairman, Dean and Provost.

Prof. Hsiao recalls meeting Prof. Rees when he was first hired more than 30 years ago. "He was truly a gentleman and scholar. I was always encouraged by his kind words whenever I saw him. I still remember our profound conversations on his time in China during World War II. Therefore, my appointment to this endowed professorship in honor of him is particularly meaningful to me. Needless to say, I shall do my best to live up to Professor Rees' expectations."

Since joining the University of Delaware's Department of Mathematical Sciences in 1969, Dr. Hsiao has developed a vast mathematical research program, publishing over 150 refereed papers on mathematical topics with applications in ship hydrodynamics, wave scattering, data inversion, blood flow and fluid structure interactions. More fundamentally, his work is known throughout the world of applied analysis for establishing the existence, uniqueness/plurality and regularity properties of optimally smooth solutions to integral equations that occur in practical engineering problems. Indeed, he is one of a relatively small number of applied analysts who demands rigorous justifications as well as practical computability of solutions to applied boundary value problems.

Dr. Hsiao has also earned a reputation as a strong instructor. He was recipient of the 1996 College of Arts and Sciences Award for Outstanding Teacher, as well as of the 2000 Alison Medal. He has embraced new technologies and brought them to bear on classroom challenges, developing numerous handouts and supplements for his students. He has developed computer algebra projects for differential equations and is a joint author of a recent Prentice Hall text, "Maple Projects for Differential Equations". On top of all his other accomplishments, Professor Hsiao has been an exemplary instructor.

While research and teaching activities by necessity require introspection and inward focus, Prof. Hsiao is notable for directing his energy outward as well. While highly valued here in Newark, he has held visiting positions in Austria, Chile, Italy, Denmark and throughout Germany, and holds an honorary professorship in the People's Republic of China. He has delivered numerous keynote and invited lectures at conferences all around the world where he has represented both the University of Delaware and its Department of Mathematical Sciences with honor and distinction. Dr. Hsiao has been a wonderful ambassador for the University of Delaware. In Prof. Hsiao's own words, " I was very fortunate to have many good colleagues in this department who have always encouraged me during the years. We really have a great department..."

Mathematics and Electoral Systems

The Department of Mathematical Sciences is increasing its level of interaction with disciplines that are not traditional users of mathematics. This mini-symposium was conceived by Phil Broadbridge and organized with the assistance of Lou Rossi to coincide with the US presidential Election Campaign. Partly because of the timing, it may have been one of the best attended general lectures sponsored by this department. As many as 200 faculty and students filled the lecture hall to see one or more of this diverse collection of experts.

The first speaker was the masterful Steven Brams, Professor of Politics at New York University, who was recommended to us by none other than John Nash. He spoke on the topic " Voter Sovereignty and Election Outcomes". In this talk, he spoke on various systems of voter preference casting, and on the variability of outcomes and the effect on voter sovereignty. This talk was rich in technical achievements, including many rigorous results, some of which were surprising. These included the two statements:

- sincere outcomes under all voting systems considered are approval voting (AV) outcomes, but not vice versa;
- a Condorcet winner's election, that is someone who would beat any other candidate in a one on one election, under AV is always a strong Nash-equilibrium outcome but not under other systems, including those that guarantee the election of Condorcet winners, if voters are sincere.

Brams is a proponent of approval voting (AV) in which a voter can assign preferences to any number of candidates that he or she deems to be acceptable. AV can lead to

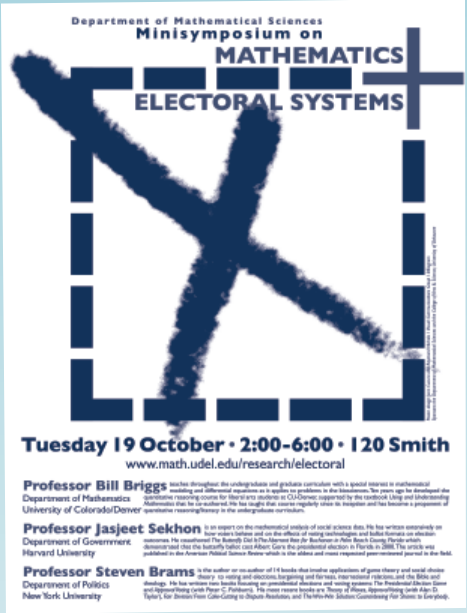
- a plethora of outcomes, depending on where voters draw the line between acceptable and unacceptable candidates; and
- Condorcet losers and other lesser candidates, even in equilibrium.

However he argued that voters' judgments about candidate acceptability should take precedence over standard social-choice criteria, such as electing a Condorcet or Borda winner.

Dr. Jas Sekhon, of the Department of Government at Harvard, spoke on "The Butterfly did it: Ballot Formats, Voting Technology and the Presidential Election."

This again was a masterful presentation. It was clear from the talk and from the answers to questions, that Dr. Sekhon was fully aware of the strengths, weaknesses and interpretations of every statistical study ever made on the effects of voting technology.

He explained why the early alarm-bell studies on the 2000 Florida presidential election were not as conclusive as they had claimed. However, he went on to describe statistical uses of more data on the ballot papers, by which one could more confidently divine the true voting intentions. This showed that at least 2000 Democratic voters voted by mistake for a Reform candidate. Other interesting data indicated some intentional race-motivated patterns of invalid voting. Dr. Sekhon was very careful not to display any political, racial or ethnic bias. Some of the most probable interpretations of his



analyses could have offended both major political parties, whites and minorities. Non-partisan discussion of such important topics is very difficult to achieve; Dr. Sekhon succeeded by using thorough scientific analysis and humor.

Following these two experts, Prof. Bill Briggs, from University of Colorado Denver, spoke as a generalist mathematical scientist. He succeeded in showing that one can ask relatively simple questions on social phenomena, then begin to accumulate relevant data from the world wide web, and to carry out useful analysis in a way that all can follow.

There was something of interest in this talk for everyone – undergraduates, mathematics teachers and even two of the world's experts on voting systems. It was an inspiring talk for those of us who think about mathematical science as an enabling tool for general intelligent enquiry.

Second Annual Mini-Symposium

The Second Annual Department of Mathematical Sciences Student Mini-Symposium was held on Tuesday, August 17, 2004. Eleven students, eight undergraduates and three graduate students, spoke in this day-long symposium about their summer research accomplishments. The undergraduate student speakers were Janine Janoski, Katie Johnson, Hudaa Neetoo, Kathryn Sharpe, Dan Cargill, Latonia Polk, Drew Marshall, and Andrew Seagraves. The graduate student speakers were Lauren Rossi, Tom Fleetman, and Patrick Zulkowski.

The Sigma Xi Honor Society sponsored an award for the best student presentation. Professors Pamela L. Cook, Annette Shine, and Associate Dean George H. Watson graciously agreed to serve as judges for this award. The award was shared jointly by Janine Janoski and Lauren Rossi for their back-to-back presentations on problems in random packing. This year's symposium will be held on August 16, 2005. All are invited to attend. For further information, check the department web page.

Featured Alumni

Phyllis Schott

A lifetime in education

Our featured alumni this issue is Phyllis Schott who completed her MA in Pure Mathematics at UD in 1970. Ms. Schott received her BA in mathematics from Towson State College (now Towson University) in 1966. After graduating, she worked at Western Electric for two years coding in COBOL and RPG. She desired the flexibility of academic life, so she entered our MS program in pure mathematics in 1968. She fondly remembers Profs. Sloyer for topology, Livingston for complex variables, her advisor Prof. Kearns as well as Bellamy and Libera from her time as a student. She remembers how Prof. Baxter, the chairman at the time, helped her when she had questions about core topics. Prof. Kearns supervised her master's thesis on commutator matrices. Her degree served her well as she pursued a career teaching mathematics at Catonsville Community College beginning in 1969 when she served as an Instructor. She was promoted to Assistant Professor in 1972 and Associate Professor in 1976. In 1991-1992, she completed an MS in Applied Mathematics at Johns Hopkins University. Though she "retired" from CCC in 1999, she actively tutors middle school students and high school students preparing for college. She began tutoring the son of a friend many years ago. Over time, her reputation grew to where she was tutoring as many as 12 students per week. To make time for other activities, she has cut back in recent years to a mere 8 students per week.

Phyllis maintains broad interests outside of mathematics as well. She reflects, "Music has always been my second love after mathematics." She has been a member of numerous community voice and handbell choirs, and volunteers once a month as a piano accompanist at the Augsburg Lutheran Home. She and her husband Bob have raised three children, Christine, Laura and David. As a family, they have been to every state in the union save Oregon and Hawaii. UD has become a family tradition as Christine attended the Professional Theatre Training Program from 1996-1999, and now works as a stage manager in Pittsburgh. Ms. Schott looks forward to touring through Canada this summer, and hopes to visit Hawaii in the near future.

The Department wishes to express its gratitude to Phyllis Schott for her support of the University and the Department through her contributions to the Alumni Campaign and to the community who she has served so well. In future issues, we hope to feature other alumni like Phyllis Schott to highlight the role mathematics has played in their lives after graduation. If you have any suggestions or comments about similar features, please let us know.

Retiring Faculty

Since the last newsletter was published, no fewer than eight faculty members have retired from our department, leaving behind more than two centuries of accumulated knowledge and experience, several forests worth of graded problem sets and of course, the gratitude of those of us who inherited a department that is better for their hard work.

Those who have retired include **John Bergman** (36 years), **David Hallenbeck** (31 years of service), **Al Livingston** (33 years), **Walter Mallory** (22 years), **Zuhair Nashed** (26 years), **Robert Stark** (40 years), **Dick Weinacht** (40 years), and **Ron Wenger** (41 years). While Prof. Nashed has moved on to serve as the Math Department Chairman at the University of Central Florida, the rest have chosen to retire from academic life and focus on other pursuits. In this article, we list some of their achievements and their plans for the future. Some have chosen to share a few memories with us.

Prof. Ron Wenger's experiences at UD follow a less traditional path of research, service and teaching. His research interests were in semigroup algebras where he published several papers. In the fall 1966, his wife, Sherry, became director of Rodney E when it opened. At this time, the University was interested in having faculty members live in the residence halls. The Wengers' willingness to live in the residence halls attracted some interest from the Administration, and soon Prof. Wenger found himself Assistant Dean of the College of Arts and Science. After a few years of service to President Trabant, Prof. Wenger was made Vice Provost for Academic Planning. Later, he would return to the Dean's office. In the 1980's, he was drawn toward pedagogical issues and mathematics, and the role that computers would play in mathematics instruction.

Soon, he left semi-group theory behind and redirected his energies toward cognition and the learning of mathematics. Since this time, Prof. Wenger has been involved in several successful NSF grants both at UD and in consortiums with nearby institutions. Prof. Wenger has also been active with the Delaware Math Coalition where he served as director for many years, and the Steering Committee of the Mid-Atlantic Center for Mathematics Teaching and Learning. In more recent years, Prof. Wenger served as Math Club advisor, and his annual spring picnic for the students (with his famous homemade ice cream) will be sorely missed. He reflects, "Perhaps the most important perspective I have on my experience at Delaware is that I made a very fortunate choice in coming here. This university has been an excellent environment in which to live and work. I hope those who have joined the place more recently will appreciate its somewhat unique qualities as much as I do."

Prof. Dick Weinacht's experiences reach back to 1956 to a time when he was Ensign Weinacht (USN), Main St ran in both directions and the student population at UD was about 3500. He took several graduate mathematics courses at night, one of which was taught by Ed Pellicciaro who later became his colleague. He finished his tour with the Navy, completed his PhD at the University of Maryland, did a postdoc at the Courant Institute at NYU and

returned to the University of Delaware as an Assistant Professor of Mathematics in 1963. At this time, our department's predecessor, the Department of Mathematics and Astronomy, had only eight regular faculty members. Prof. Weinacht's service in the department played a role in the development and growth of our Ph.D program, and has seen the Department through substantial change and growth over the years.

Through all these changes, it was rare that everyone agreed upon the proper course of action. Prof. Weinacht recalls, "For me, it was rewarding to be involved in getting the Ph.D. Program underway. It was amazing that (despite the many different points of view and rivalries and disagreements that naturally arise) there was a spirit of cooperation to achieve the common good." One of the greatest pleasures of his service to our department was advising graduate students in their research. Many of his students went on to pursue academic careers at Clemson, Lafayette, SUNY-Oswego, Wright State and other institutions. Prof. Weinacht visits the Department regularly and is routinely sighted playing basketball at the gym.

Prof. Al Livingston joined the faculty in 1967. At the time, he was attracted to the department because of its nascent Ph.D program and the strength of its faculty, including Prof. Robertson, Unidel Professor of Mathematics. Also, he had a little inside information because a former classmate of his, Richard Libera, served on the faculty.

His research interests are in complex analysis, specifically univalent and multivalent functions. During his long career here, he was able to work with Profs. Libera and Hallenbeck as well as several outside investigators on a variety of problems. In addition to his research accomplishments, Prof. Livingston is known for his strong teaching abilities earning the College of Arts and Science Outstanding Teaching Award in 1997. His doctoral students include James Walbert and Laurellen Landau-Treisner. Through all this, he provided substantial service as well. He served as Graduate Committee Chair and College Promotion and Tenure Committee chair. He also served the Department as Associate Chair for three years. Looking back, he comments, "My greatest joy in teaching came through the sequences Math601-602 (advanced calculus) followed by Math807-808 (complex analysis). Many students took both sequences with me... I hope they all realize what a joy it was to teach them and watch them grow and mature mathematically." Prof. Livingston still visits the department when he is not pursuing his second passion which is golf.

Prof. Walter Mallory joined the Department as a Visiting Lecturer in 1980. His field of research was mathematical logic. He taught a broad spectrum of undergraduate mathematics courses in our department, and served as an ex-officio member of the Undergraduate Studies Committee for most of this time at UD. He particularly enjoyed working with his colleagues Profs. Baker, Bellamy, Bergman, Kleinman, Pelliciaro, Sloyer, Weinacht, and especially the late Henry Tingey who was his close friend. Looking back, Prof. Mallory comments on his forty year career teaching mathematics, "The last twenty-two years working at the University of Delaware was a wonderful experience."

New Faculty

Over the past five years, the Department of Mathematical Sciences has been hiring new faculty to replace retirements and grow in new areas. In this newsletter, we are pleased to introduce our three newest hires who joined us in the Fall of 2004.

Dr. Constantin Bacuta received his Ph.D. from Texas A&M University, having Dr. James H. Bramble as an advisor, in 2000. Before becoming a faculty member at the University of Delaware, he was a Chowla Research Assistant Professor at The Pennsylvania State University, and a faculty scholar at the Lawrence Livermore National Laboratory.

Dr. Bacuta's research interests focus on numerical analysis, especially on the study of finite element methods for partial differential equations (PDEs). His recent research is in the development and the analysis of multiscale methods as main tools for solving elliptic boundary value problems. The multiscale theory is based on modern results in functional analysis and approximation theory. Dr. Bacuta is also interested in applications of multiscale theory in qualitative studies of PDEs regarding regularity, the approximation properties of the solutions, and the construction of efficient algorithms.

Constantin first fell in love with mathematics in first grade. He went on to graduate Magna Cum Laude with a Bachelor of Science degree in Mathematics from the Al. I. Cuza University of Iasi, Romania, where he met his wife, Cristina, also a Mathematician. They are proud parents of two teenage daughters who love mathematics among other things. In his free time, Constantin enjoys spending time with his family in the Upper New York state.

Dr. Russell Luke, Assistant Professor of Mathematical Sciences, received his M.Sc. and Ph.D. from the University of Washington in Seattle.

His undergraduate alma mater is the University of California, Berkeley, where he graduated with honors in Applied Mathematics. Between his undergraduate and graduate careers, he spent a few years making documentary films -- "The Ride to Wounded Knee" (1992), "29 and 7 Strong" (1995). He also did social work in rural Washington State where he helped run a self-help housing program modeled after an old Quaker idea for community development. Upon his return to mathematics at the University of Washington, Dr. Luke quickly became interested in numerical optimization with applications to image processing. His thesis work centered on the theory and practice of numerical algorithms for adaptive optics to be used with the James Webb Space Telescope, Hubble's replacement. After completing his Ph.D. he moved to the Institute for Numerical and Applied

Mathematics at the University of Göttingen in Germany where he worked on inverse scattering theory. He moved next to the Pacific Institue for the Mathematical Sciences and the Center for Experimental and Constructive Mathematics at Simon Fraser University, near Vancouver Canada, where he worked on variational and convex analysis, in addition to a more recent forray into number theory. Dr. Luke is a recipient of a NASA Graduate Student Research Fellowship, National Research Council Postdoctoral Fellowship, a Pacific Institute for the Mathematical Sciences Fellowship and is a member of the AMS, SIAM and IEEE.

Dr. Luke's personal interests were deeply shaped by growing up in the Cartesian cornscape of central Ohio. He loves running over mountains, travelling and eating any food whose name he can't pronounce.

Dr. Anja Sturm, Assistant Professor of Probability, received her Ph.D. from the University of Oxford, England, in 2002, where she was supported by a Rhodes Scholarship and an EPSRC award. Dr. Sturm started her undergraduate work at the University of Tübingen, Germany, in Mathematics and Physics. She then received a Master of Science in Applied Mathematics from the University of Washington. Before joining the University of Delaware, she was a postdoctoral fellow at the Weierstrass Institute of Applied Mathematics and Stochastics in Berlin and at the University of British Columbia, Vancouver, as well as a Junior Professor of Applied Probability at the Technical University Berlin.

Dr. Sturm's research interests center on probability theory, particularly on stochastic processes arising from branching and interacting particle systems. Depending on the focus, which may be particle mass or genealogy, the objects of interest may be described by measure valued processes, stochastic (partial) differential equations or coalescent processes. Dr. Sturm is especially interested in applications of the Mathematical theory to population genetics.

Dr. Anja Sturm is originally from Germany and grew up in the South-Western part of the country close to Stuttgart and Tübingen. Apart from Mathematics, she enjoys reading, running, hiking, and traveling, and she is looking forward to exploring the cities and outdoors of the East Coast.

Awards

The Department of Mathematical Sciences offers several awards and scholarships to its undergraduate and graduate students. The Baxter-Sloyer Graduate Teaching Award is given to the graduate teaching assistants who have demonstrated superior effectiveness in classroom instruction. The William D. Clark prize is a $150 award that is only presented when a graduating senior demonstrates unusual ability in an area of mathematics. Carl J. Rees and Eleanor K. Rees Scholarships are awarded to full-time undergraduate math majors based on academic performance. The Stephen J. Wolf Memorial Scholarship is awarded to a math major entering their senior year who has demonstrated both love and talent for mathematics. We express our gratitude to our alumni who help support these awards and scholarships, and we are pleased to acknowledge our students for their exceptional achievements at the University of Delaware.

Jon R. Beckham - 2004 Pyrros Memorial Teaching Award

Jessica L. Belden - 2003, 2004 Carl J. Rees Scholarship

Kenneth J. Bell - 2003, 2004 Carl J. Rees Scholarship

Maria G. Capursi - 2003 Baxter/ Sloyer Graduate Teaching Prize

Michael P. Casey - 2003 Carl J. Rees Scholarship, 2004 S. J. Wolfe Memorial Scholarship.

Amanda M. Crouse- 2004 Carl J. Rees Scholarship

Claire E. Czekaj - 2003, 2004 Carl J. Rees Scholarship

Gregory J. Deveney - 2003 Carl J. Rees Scholarship

Clifford B. Farmer - 2004 Carl J. Rees Scholarship

Leah Gemgnani - 2003 Carl J. Rees Scholarship, 2004 Outstanding Student Teacher Prize

Todd Gutekunst - 2004 Pyrros Memorial Teaching Award

Janine Janoski - 2004 Carl J. Rees Scholarship

Jennifer D. Joyce - 2003 Carl J. Rees Scholarship, 2004 Faculty Recognition of a Graduating Senior

David A. Juliano - 2004 Carl J. Rees Scholarship

Matthew J. Kistler -
- 2003, 2004 Carl J. Rees Scholarship

Jacob E. Lehr -2004 Carl J. Rees Scholarship

Stephanie E. Merkler - 2004 Carl J. Rees Scholarship

George R. Mitesser - 2004 Carl J. Rees Scholarship

Derek E. Moulton - 2004 Baxter/ Sloyer Graduate Teaching Prize.

Lauren G. Roberts - 2003 Carl J. Rees Scholarship

Vanessa T. Robinson - 2003 Faculty Recognition of a Graduating Senior

Daniel S. Roche - 2004 Carl J. Rees Scholarship

Lauren M. Rossi - 2003 Carl J. Rees Scholarship, 2004 Faculty Recognition of a Graduating Senior

Andrew N. Seagraves - 2004 Carl J. Rees Scholarship

Richard J. Seagraves - 2004 S. J. Wolfe Memorial Scholarship.

Matthew Searles - 2003 William Clark Prize.

Matthew W. Seiders - 2003 Carl J. Rees Scholarship

Kathryn E. Sharpe - 2004 Carl J. Rees Scholarship

Hye-Sun Sin - 2004 Carl J. Rees Scholarship

Jarod C. Staub - 2003 Outstanding Student Teacher Prize

Jeff S. Stehlgens - 2003 Carl J. Rees Scholarship

Bonard B. Timmons - 2004 Carl J. Rees Scholarship

Catalina O. Tudor - 2003 Carl J. Rees Scholarship

Matthew B. Wells - 2004 Carl J. Rees Scholarship

Jason S. Williford - 2003 Baxter/ Sloyer Graduate Teaching Prize.

Patrick Zulkowski - 2003 S. J. Wolfe Memorial Scholarship, 2004 William Clark Prize.

Combinatorial Designs and Algebraic Codes

My name is Qing Xiang. I am an associate professor in the department of mathematical sciences, working in the field of discrete mathematics. Our department has a strong group in discrete mathematics. Currently, the discrete mathematics group consists of four faculty members: Robert Coulter, Gary Ebert, Felix Lazebnik and myself. Robert is working on polynomials over finite fields, Gary is working on finite geometries, Felix is working on extremal graphs, and I am working on combinatorial designs and algebraic codes.

Combinatorial design theory deals with the problem of arranging objects according to certain rules. For example, thirty-six officers are given, belonging to six regiments and holding six ranks. Can the officers be paraded in a 6x6 array so that, in any line (row or column) of the array, each regiment and each rank occurs exactly once? This is the 36 officers problem, posed by Euler in 1782. This is considered as the beginning of design theory. In the mid-19th century, Kirkman, Steiner, and Cayley worked on such topics as triple systems, Room squares, and other combinatorial objects that are still of interest to modern researchers. Statistical planning of experiments motivated the study of combinatorial designs in the 1940s. During the past several decades, combinatorial design theory has undergone explosive growth, mainly because its applications in computer science, statistics, digital communication and cryptography. Closely related to design theory is the theory of error-correcting codes. Compared with design theory, coding theory has a rather short history. The whole subject was born with Shannon's seminal 1948 paper. The practical gain due to coding, demonstrated there and elsewhere since, has provided motivation for much of coding theory. Nowadays, we see the use of error-correcting codes everywhere in our daily life; for example, in CD players, high speed modems, cellular phones, etc.

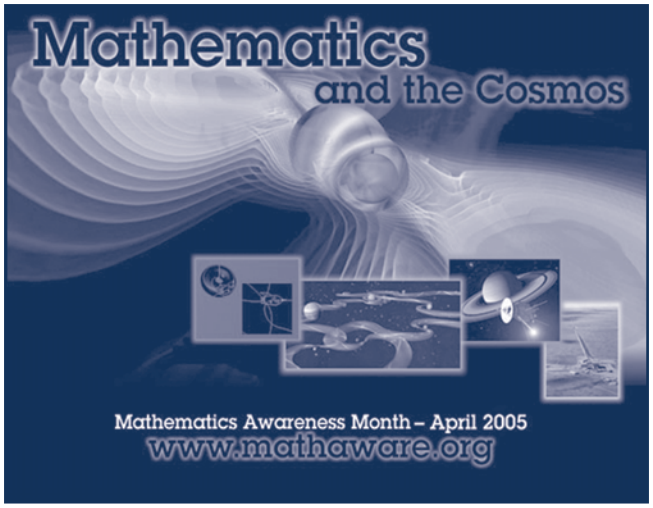
A large part of my research is related to the theory of difference sets, a branch of design theory. Roughly speaking, a (v, k, λ) difference set is a very special subset of size k in a finite group G of order v. Its importance lies in the fact that it can produce v subsets of the group G, each of size k, such that the pair-wise intersections of these v subsets all have the same size λ.

Such a structure is called a symmetric design, which plays an important role in design theory. Also difference sets can be viewed as binary sequences or arrays with two-level autocorrelations, hence they have coding theoretical applications. The history of difference sets goes back to Singer's famous paper in 1938. However, the systematic study of difference sets only started with the fundamental papers of M. Hall Jr. in 1947 and R. H. Bruck in 1955. The central research problem in difference sets is: for each positive integer v, which groups of order v contain a nontrivial (v,k,λ) difference set? This is an extremely difficult problem. Despite a large literature spanning more than half a century, the problem is far from being solved. In order to attack this problem, M. Hall Jr. in 1947 introduced a concept called multiplier which is very useful in both construction and nonexistence proofs of difference sets when v and $k-\lambda$ are relatively prime. But Hall's multiplier theorem has a hypothesis "$p > \lambda$", where p is a prime dividing $k-\lambda$. It was conjectured more than 40 years ago that this hypothesis is unnecessary. This is the so-called multiplier conjecture, which by now has acquired the status of a classical unsolved problem in the theory of combinatorial designs. The method of multipliers is not robust. For example, in the case of Hadamard difference sets, where v and $k-\lambda$ are not relatively prime, Hall's multiplier theorem does not provide any multipliers at all. So in this case we need new techniques to construct difference sets, and here is a place where we see a very interesting interplay of ideas from finite geometry (spread, two-intersection sets) and number theory (cyclotomy) which produces new difference sets in abelian groups of order $4p^4$ with an elementary abelian Sylow p-subgroup. This immediately leads to new Hadamard matrices of order $4m^4$ by a certain composition procedure due to R. J. Turyn.

As a whole, the theory of difference sets is still a very young subject. It has many outstanding open problems waiting to be solved; the multiplier conjecture mentioned above is one example, Ryser's conjecture on the nonexistence of circulant Hadamard matrices of order greater than 4 is another. Therefore difference sets will continue to be fertile ground for research and future breakthroughs in design theory.

April is Math Awareness Month

Every April is Math Awareness Month (MAM), and we like to celebrate by hosting a special lecture series focusing on the year's theme. High profile leaders both from within and outside the University of Delaware provide lectures for the general public that raise general understanding and appreciation for mathematics in diverse contexts. Last year's theme was "Mathematics of Networks," and this year's theme is "Math and the Cosmos." We invite our alumni community to attend our series. More information on MAM can be found at http://www.mathaware.org. This year's UD Math Awareness lecture schedule is posted at http://www.math.udel.edu/news/mam_05/calendar.html. The general public and especially our alumni are invited to attend this series.



Active Grants in the Mathematical Sciences

The Mathematical Sciences faculty maintains a wide range of teaching and research interests. One sign of teaching and research activity are projects that have attracted external or internal funding. Often these projects are intensely focused activities to advance mathematical knowledge or knowledge of the teaching of mathematics in a specific area. In this article, we survey some of these exciting endeavors.

Profs. Richard Braun, Tobin Driscoll, Peter Monk and Louis Rossi:

"Scientific Computing and Research Environments in the Mathematical Sciences (SCREMS)"

This National Science Foundation grant supported the purchase of a 24 node, 48 CPU istributed memory parallel computer which will be dedicated to the support of research in the mathematical sciences. The supercomputer is being used for several research projects, including electromagnetic, fluid dyanmics and materials science applications as well as computational mathematics research. These projects all involve the numerical solution of complex partial differential equations in applied mathematics.

Prof. Jinfa Cai:

"What is effective teaching: East meets West in the mathematics classroom."

This Spencer Foundation Grant supports cross-national research on mathematics education. A number of cross-national studies have shown that in mathematics East Asian students have generally outperformed their U.S. counterparts in mathematics on tasks routinely learned in schools. Surprisingly, many scholars and observers have found that mathematics teaching in East Asian countries is very traditional, content-based, examination-driven, and teacher-centered. The purpose of this study is to explore why East Asian countries with seemingly poor instructional practices produce higher achievers in mathematics.

Prof. Jinfa Cai (subcontract):

"The Greater Philadelphia secondary math National Science Foundation project research supplement and math and science partnership of Greater Philadelphia"

The purpose of this project is to present empirical evidence about the impact of four NSF-funded curricula on students' learning from ten school districts in New Jersey and Pennsylvania. This project will focus on how the curricula affects student performance, and whether or not it helps close the acheivement gap between minority and non-minority students.

Prof. Fiorabla Cakoni:

"Electromagnetic Imagining of Buried Objects"

Prof. Cakoni has received a Humboldt fellowship supporting one month of research at the University of Goettingen.

Profs. Fioralba Cakoni, David Colton and Peter Monk:

"The Detection of Hostile Structures"

This Air Force Office of Scientific Research Grant supports research on linear sampling method to investigate a number of problems in target identification of interest to the Air Force, in particular the detection of decoys under foliage, the detection of objects partially coated by a radar absorbing material and the detection of objects buried in the earth. In addition, Profs. Cakoni, Colton and Monk will investigate mathematical problems that arise in the numerical implementation of the linear sampling method.

Profs. L. Pamela Cook, Louis Rossi, Gareth McKinley (MIT) and Jonathan Rothstein (UMass Amherst):

"Theoretical and Experimental Analysis of Micellar and of Polymer Fluids"

This National Science Foundation grant supports joint experimental and theoretical research aimed at characterizing micellar solutions. Dilute micelles in solution can form long wormlike structures that drastically change the fluid properties. Common examples include body lotions and soaps, but they play a central role in oil recovery and have been shown to drastically reduce the drag of projectiles as well.

Profs. Cathy Davies (Agriculture and Food Sciences), John Pelesko and Louis Rossi:

"Collaborative Learning Between Food Chemistry and Mathematics"

This grant from the University of Delaware Center for Teaching Excellence supports the development of linked courses in Food Chemistry and Mathematical Sciences that foster interdisciplinary learning as students investigate large scale, open questions.

Profs. David Edwards and Paul Milewski (University of Wisconsin Madison):

"Transport and Heterogeneity in Surface-Volume Biochemical Reactions: Modeling and Experiment, with Applications to Immunocolloid Labeling and Surface Plasmon Resonance Devices"

This National Institutes of Health supports Prof. Edwards' study of the BIAcore, which is a device biologists use to measure the speed of chemical reactions. Such measurements are crucial to understanding biological processes. By creating more sophisticated mathematical models for the dynamics in the device, Prof. Edwards enables scientists to achieve better rate constant estimates from the same data.

Prof. Robert Gilbert:

"Senior Scientist Award"

Prof. Gilbert will use this award to support three months of research on ultrasound acoustics in bone structures at the University of Bochum, University of Heidelberg and Martin Luther University Halle-Wittenberg.

Prof. Mary Ann Huntley:

"Examining the Issue of 'Fidelity of Implementation' for Two Middle-Grades Reform Mathematics Curricula"

This National Academy of Education, Spencer Postdoctoral Fellowship permits Prof. Huntley investigate the impact that textbooks have on what and how mathematics is taught. The way a textbook is implemented affects students' opportunities to learn substantial and worthwhile mathematics, and also teachers' opportunities to learn through the use of their textbook. However, experience indicates that implementation of a new

mathematics textbook is an uneven process within and across schools. Classrooms in which the same textbook and teaching practices are purportedly being used may be quite differently from one another. In this research, Prof. Huntley is investigating what it means to implement a reform middle-grades mathematics curriculum consistent with the authors' intents.

Prof. Mary Ann Huntley:

"Middle Grades Algebra: Textbook Presentations and Teachers' Knowledge"

The purpose of this University of Delaware Research Foundation study is twofold. First, Prof. Huntley seeks to understand the presentation of algebra in several middle-grades mathematics textbooks. Second, she seeks to understand the knowledge of curriculum and knowledge of algebra that middle-grades teachers bring to their instructional practice, and how they draw upon this knowledge as they engage in the practice of teaching.

Prof. Wenbo Li:

"Gaussian Methods and Probability Estimates of Rare Events"

The primary focus of this National Science Foundation funded research is a better understanding of rare random phenomena related to Gaussian processes and others which serve as models in many applications.

Prof. John Pelesko:

"Mathematical Modeling of Micro- and Nanoelectromechanical Systems"

This grant from the National Science Foundation supports research in the design and optimization of electrostatically actuated micro- and nanoscale systems. At the micro- and nanoscale, electrostatic forces dominate and control the behavior of many devices and systems. Understanding the interaction of electrostatic forces with the entire system allows for improved device design and optimization.

Prof Qing Xiang:

"Topics in Algebraic Design Theory"

Science Foundation grant supports Prof. Xiang's research on algebraic designs, codes and association schemes. Prof. Xiang has written an expository article on this topic for this newsletter.

MPI Workshops

The Mathematical Problems in Industry (MPI) Workshops are now in their 21st year. The 15th, 16th and 20th MPI workshops were held at UD and hosted by the Department of Mathematical Sciences. The MPI Workshop is a problem-solving workshop that attracts leading applied mathematicians and scientists from universities, industry, and national laboratories. During the workshop, engineers and scientists from industry interact closely with the academic participants on problems of interest to their companies. The result is a lively 5-day research collaboration on these industrial problems. This research is of a truly interdisciplinary nature, linking mathematics of the highest caliber with important scientific and technological problems from industry.

On the first day, the industry representatives present their problems to the whole group. For the rest of the week, the workshop participants break up into small working groups consisting of senior faculty and attending scientists, graduate students, and the industrial representatives to discuss and tackle the problems in an informal setting. On the last day of the workshop, an academic representative from each group presents the results obtained and discusses possible future directions. A written report detailing the progress made during the workshop is prepared subsequently and sent to the industry representatives.

The website for last year's workshop, including lots of photos, is at http://www.math.udel.edu/MPI. This year's MPI workshop will be held at Worcester Polytechnic Institute in Massachusetts. If you have a problem that needs some new ideas, please contact Prof. Braun (braun@math.udel.edu, (302) 831-1869). We would be happy to help!

Generating results and having fun in one of our computer classrooms. Left to right: Ravi Srinivasan (WPI), Mike McGratton (Duke), Bob Wilson (Urban Affairs, UD) and Andrew Feist (Duke).

Inaugural Hollowell Professor of Secondary Mathematics Education

During the Fall 2004 semester, Drs. Kathy and David Hollowell announced that they were providing support for a newly endowed, named full professorship in secondary mathematics education. At present there is an active search for the Hollowell Professor of Secondary Mathematics Education. This person must already be a nationally recognized leader in mathematics education research, and will be expected to take a major leadership role in strengthening secondary mathematics education at the university and across the State of Delaware.

The person who fills this position will join the dynamic group of mathematics education faculty in the Department of Mathematical Sciences, the School of Education, and the Mathematics and Science Education Resource Center (MSERC). There are three math education groups on campus with important distinctions between them. Prospective secondary mathematics teachers are prepared in the Department of Mathematical Sciences, while prospective middle-grades mathematics teachers and elementary teachers are prepared in the School of Education. Master's and doctoral programs in mathematics education are housed in the School of Education, with active participation by faculty from the Department of Mathematical Sciences, the School of Education, and MSERC. The Department of Mathematical Sciences plans to develop a doctoral program in secondary/undergraduate mathematics education. Professional development programs designed specifically for in-service teachers are offered by MSERC.

We are honored that the Hollowells have chosen the Department of Mathematical Sciences as the recipient of their generous gift. Dr. Kathy Hollowell is the director of MSERC, and holds a joint appointment in the Department of Mathematical Sciences. Her husband, Dr. David Hollowell, is the university's executive vice president and treasurer. For additional information, please see the related article on UDaily at: http://www.udel.edu/PR/UDaily/2005/oct/named100404.html.

UD Math Sciences hosts Spring Eastern Section Meeting of AMS

The Department of Mathematical Sciences is honored to be hosting the Spring Eastern Section Meeting of the American Mathematical Society on April 2 and 3. We are expecting over 200 mathematicians from the region. The section meeting will include 14 special sessions in addition to plenary speakers and a student poster session. Hosting this meeting is one of many ways our department serves the professional community. More information on the section meeting can be found at http://www.math.udel.edu/amssect/index.html.

EPADEL

The Fall meeting of the EPADEL (Eastern and Delaware Section of the Mathematical Association of America), took place on November 6, 2004, at the University of Delaware. About two hundred faculty and students attended the meeting.

President Roselle, himself a mathematician, delivered the opening remarks. There were four invited speakers giving lectures: Maria Klawe (Princeton) spoke on new ways of teaching calculus, Andrew Woldar (Villanova) on group theory and its relevance to other branches of Mathematics, John McCammond (University of California, Santa Barbara) on non crossing partitions and connections to combinatorics, probability and group theory, and Marjorie Senechal (Smith College) spoke on tilings. Organizers of the Student Papers sessions received more submissions this time then in the past. As a result, three one-hour sessions were run this time instead of the regular two, and they were well attended. Three of the talks at these sessions were given by our undergraduates: Daniel Cargill, Janine Janovski and Katherine Johnson. A panel discussion "How to get a job" was directed to graduate students.

From the Editors

Dear Math Department Alumni, Students and Friends,

We're back! The last Newsletter for the Department of Mathematical Sciences was published seven years ago. Since that time, a lot has changed around the department. Many faculty have retired, and many have been hired. Scores of students have been admitted, earned their degrees and moved on. Conferences have come and gone. Our programs have changed with the times. New grants and initiatives have taken root. Other projects have concluded. As a department, we have many associations with individual alumni, but we have developed this newsletter as a systematic way of bringing the entire alumni community together, and you can expect to receive a newsletter every year. We want to be more involved with our alumni, and we hope our alumni will be more involved with us as we grow and change in the coming years.

This newsletter is a summary of the dynamic enterprise that is the Department of Mathematical Sciences. The editors would like to thank all of the contributors including Constantine Bacuta, Rich Braun, Phil Broadbridge, Jan Burns, Jinfa Cai, David Colton, David Edwards, Mary Ann Huntley, Felix Lazebnik, Wenbo Li, Al Livingston, Russell Luke, John Pelesko, Dick Weinacht, Ron Wenger and Qing Xiang. For a more complete picture of department activities, I hope you will take a look at our department web page (www.math.udel.edu). There, you will find more information about the activities of our faculty and students.

As a final note, over 1500 copies of this newsletter have been printed and mailed to our alumni. If you are willing to accept future issues of the newsletter in electronic form, please send a note with your preferred email address to alumni@math.udel.edu. Electronic distribution will reduce the burden on the department's budget.

Regardless of the form, we look forward to staying in touch.

Yours truly,

Lou Rossi

Anja Sturm

Chair's Message continued from front page

work in multidisciplinary teams. There is a need for continuous improvement of our course offerings. We need to provide a supportive social and learning environment

Thirdly, we need a strong graduate program to turn out masters and doctoral graduates who can make a major impact in our profession. Included among our PhD graduates, are SIAM's current Vice-President for industrial mathematics, and the current president of the Portuguese Mathematical Society. I know of some other Delaware PhD graduates who have tenure-track positions in major research universities. As usual, this has required some prior postdoctoral experience. A large number of our graduates have taken positions in departments with no doctoral program. Some have found employment in government or private industry. In order to maintain two separate doctoral programs (possibly being extended to three, including math education), we must improve completion rates and obtain other sources of funding for graduate student stipends. Around half of our graduate students arrive with a bachelor's degree from a small university or college with no mathematics PhD program. All of them have high grades but their prior training varies greatly in breadth and depth.

Fourthly (a word rarely used, because most people cannot remember more than three points), we need to enhance the discipline of mathematics within our local community. We need to cultivate a stronger mathematics culture in this state. There is such a shortfall of well trained math teachers, that national education associations generally believe that university mathematicians must be directly involved if secondary school students are to reach the states' declared standards of learning outcomes. UD has funding through the Math and Science Partnership Program to improve the professional development of practicing math teachers. We have worked hard to enhance our national profile within our discipline. This will have many spin-offs.

Lastly, but by no means least, we have to make big impacts in research. Grant income is not a goal in itself but it should be viewed as a means of supporting our activities through additional personnel, equipment, travel and devoted time. Usually, it is research and the spirit of inquiry that attracts us to this profession. Outside of elite 4-year colleges, it is research rather than teaching that will make the world take notice. As a medium sized department, we cannot be research leaders spread thinly across the broad spectrum of mathematical fields. This department has twin foci in mathematical analysis and industrial modeling, which makes sense to me. I support maintaining these foci as our main concentrations. While maintaining this focus, we continue to support other areas where there is considerable student demand and research accomplishments.

Any enumeration of our department's major activities will be somewhat artificial. In my opinion, there is a strong nexus between teaching and research. We have a number of recent hires who are capable of achieving the status enjoyed by our most senior professors. The outcome of a great department is much greater than the sum of its parts. If mathematics is an enabling science for other disciplines, we should be receptive to other sub-disciplines of mathematical sciences that might be enabling for our own.

I have seen many value-adding contributions by our faculty, staff and students. Space limits prevent me from acknowledging them by name.

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