High Performance Computing and Mathematics
Glenn Luecke checks in on a technician installing HPC equipment in the machine room in Durham.
Alumni feature: Saulo Orizaga

On choosing ISU for graduate study ...

While attending a Field of Dreams conference in Iowa City, I heard about the experiences of several graduate students. In particular, comments shared by Fernando Miranda about his arrival, hard work and success at Iowa State were memorable. That is one of the main reasons I chose ISU.

As a member of an underrepresented group, you received special funding ...

Funding for minorities is available at ISU. One key factor that makes this so beneficial is the support provided by faculty and staff members and other students. The initial funding allows one to begin graduate study, but it is up to the individual to maintain continued funding by rigorous review, keeping good grades, passing qualifying exams, preliminary exam, and eventually graduating within a time frame. It is a wonderful opportunity that the student must attend to on a semester to semester basis. I worked hard; I stopped thinking about the “minority concept” and focused on the mathematics, and the fact that I was in ISU because I had a desire to become a scientist. At the end of the day I was in ISU because of my mathematical passion. I finished in 4 years.

You started a SIAM student chapter at ISU and served as the first president ...

This speaks to my desire to improve and ignite the spirit of research among the students at ISU.

Attending a number of conferences made me aware that other schools have various student chapters. I became interested in forming a SIAM student chapter to get students more involved in presenting their research, attending national conferences and representing ISU in a more consistent way.

Faculty members Cliff Bergman and James Rossmanith each played key roles in supporting a local student chapter at ISU, which formed in May of 2013. Our first year was successful, offering opportunities for students to present their research, which in turn helped them prepare for their masters defense, prelim, and even final defenses. In addition, we had two post docs presenting and an invited PhD student from Kansas.

I believe being elected as president reflects peer awareness for the intense level of effort I bring to a task.

Talk about your current post doc at Arizona ...

I got a prestigious NSF Postdoctoral Fellowship administered through the Alliance for Building Minority Faculty. I work with phase separation applied to binary mixtures. This area is rich in theoretical, computational and experimental framework. I have been working on the efficient numerical implementation that is required to solve such models. These problems typically include severe limitations on the time steps due to the differential operators and nonlinearities of such PDEs. There is work to be done in the way molecular self-assembly is structured or altered by an external source. There are several open problems that we are considering in this fascinating area.

Other significant activities during your graduate studies ...

In addition to taking courses related to my main research area, I also took many courses that were in other areas. This opened up more research paths to investigate. The goal was always to continue exposing myself to new areas that I could possibly explore in the upcoming years.

A paper based on your dissertation research will appear in an international journal this year ...

The joint paper (dissertation research) that I wrote with Daniel N. Riahi and Steve Hou (My two advisors from UTPA and ISU) will be published in the International Journal of Non-Linear Mechanics (v 67, Dec 2014, pp 218-230).

Entitled Nonlinear spatio-temporal instability regime for electrically forced viscous jets, it looks at the applications of electrically driven jets as they relate to nano-technology.

This technology is used in air filters, bio-medical and engineering applications. To study the nonlinear regime of electrically induced viscous jets, we conducted computational methods, applied and theoretical fluid mechanics, electrostatic interactions and mathematical modeling. Our main goal was to contribute in the understanding of the problem at the nonlinear stage. We were able to detect the Rayleigh and Conducting flow instabilities for the case of axisymmetric wavelike disturbances evolving in time and space. The nonlinear wave interactions and modes of resonance of dyad-type uncovered new operating modes in which the flow dynamics were significantly enhanced by modifying the orientation and magnitude of the electric field in the jet. The nonlinear investigation also allowed for the jet radius to be reduced at higher rates and at much more smaller intervals of time and space when compared to the linear version of the problem. These are the desired mechanics in practical applications (a thinning viscous jet that stretches due to tangential stress). This work extended the current available understanding of electrically driven jets and provides a much realistic mathematical modeling of the problem.

http://math.arizona.edu/~sorizaga/
Greetings from Carver Hall

Clifford Bergman

Once again, Iowa State is experiencing record enrollment, and that means record enrollment in math classes. This Fall we are teaching well over 10,000 students. While the University has responded to the surge by hiring additional faculty, classroom space, office space, and student services are stretched to capacity, and beyond.

As you know, we are a participating institution in the Institute for Mathematics and Its Applications (IMA) in Minneapolis. The IMA is running a Thematic Year in Discrete Structures during 2014-15. Our department has a very strong cluster of researchers in this area, more precisely, in graph theory and combinatorics. Considering the great fit, and the proximity of Ames and Minneapolis, it is not surprising that many members of the group are taking up residence at the IMA for all or part of the academic year.

Steve Butler, Ryan Martin, and Leslie Hogben are spending the entire year there, while our two new assistant professors, Bernard Lidicky and Michael Young, are up there for just the first semester.

We have three faculty members on professional development leave this year (details, p. 7), and two on unpaid leave. In addition, former chair Wolfgang Kliemann has accepted the position of Associate Vice President for Research at ISU. Wolfgang can still be seen around the department, but now has new administrative duties.

In response to the large number of faculty members on leave, combined with increased enrollment in undergraduate classes, this year we are awash in postdocs. It is great to have so many young mathematicians around. New ideas, new energy, and lots of seminar speakers. For senior faculty, it also represents a significant mentoring responsibility.

Learn more about the contribution our postdoctoral research associates make to the creative life of the Department by viewing our recent Research Highlights publication online (Department Publications link appears in the bottom red bar of our home page).

As a university of science and technology, virtually every student takes one or more mathematics courses at some point, putting our department center stage. While we like to think that we put out a great product at all levels of instruction, we are always in search of improvement. Tim McNicholl, our “precalculus czar,” has hosted a series of summer workshops for high school and community college instructors. The goal is to fine tune precalculus instruction at those institutions, so that when their students transfer to Iowa State, they are ready to hit the ground running and take calculus.

In May, we said goodbye to long-time faculty members Roger Alexander (left) and Gary Lieberman (right). Both gentlemen are looking forward to devoting more time to their musical activities, Gary as a clarinetist, and Roger, with the very successful Barn Owl Band. We wish them well.

Looking forward to another great year,

Cliff Bergman
On the Challenges of Mathematics
an essay by professor Jonathan D. H. Smith

The challenges of mathematics depend on one's relationship to the subject: For students — why, what, and how to learn; for educators — how to teach; for mathematicians — what to pursue; and for supporters — how to promote mathematics? These roles are often mixed and mashed. Graduate school in mathematics offers a progressive transition from student to educator and mathematician. For a student at any level, the best way to consolidate newly acquired knowledge is to try teaching it, say to fellow students. Good mathematicians continue to learn throughout their career, and should be ready to ensure the future of their discipline by teaching it. Academic mathematicians now encounter expectations to follow their colleagues from the experimental sciences, assuring financial support by applying for grants. In the other direction, administrators and politicians, whose traditional role was to lobby and legislate appropriations for the support of academic mathematics on behalf of their constituents, are now becoming more directly involved in the education process itself at a detailed level.

The challenge of research

In the twentieth century, major challenges for mathematics came from physics. As the crucial role of symmetry was recognized, group theory emerged as the mathematics of symmetry. Quantum physics drove the development of noncommutative mathematics, and functional analysis arose at least partly from the desire to understand physicists’ use of Dirac delta functions and other operators on a more rigorous basis.

The major new challenges to mathematics are coming from biology, with the need to understand truly complex systems, in which the parameters at the various levels do not relate directly by a mere scaling, however large the factor. The traditional reductionist, bottom-up methods are out of their depth here. Information-theory based, top-down approaches offer a better way to tailor the level of detail in the model to the level of knowledge available to the user. Barycentric algebras (defined by the laws of idempotence, skewcommutativity, and skew-associativity) offer a way to combine convex-set based optimization techniques at each level with the ordered structure of the set of levels [4].

The simplest non-trivial example is illustrated in Figure 1. Here, the closed interval from A1 to A2 represents the demographic level for a structured species A with two stages A1 and A2, say larva A1 and moth A2. The half-closed interval from the open circle to B represents the higher, ecological level, where individuals from species B compete with individuals from species A, regardless of the demographic stage of the latter. Barycentric combinations within the intervals behave like conventional, convex combinations, while any point from the A1–A2 interval combines with any point from the half-closed interval like a convex combination of that latter point with the A1–A2-midpoint represented by the open circle.

In complex systems, symmetry is rarely exact. Mammals exhibit an approximate external left-right symmetry about their plane of forward motion, but this symmetry breaks down internally, with the heart displaced to the left, for example. The challenge for mathematics is to develop an exact theory of approximate symmetry, as an extension of group theory. One component of such a theory is provided by quasigroups, “non-associative groups” whose multiplication tables are Latin squares (sudoku puzzles) [5]. Figure 2 (due to Jackie Chalmers [1]) illustrates some of the rich structure that emerges when the six-fold exact symmetry exhibited by the vertices of an equilateral triangle — mathematically: the action of the symmetric group S3 on the three cosets of a subgroup S2 — changes to the action of a quasigroup on the three cosets of a subquasigroup.

The challenge of education

Mathematics is a natural ability. Indeed, it has evolved to a certain level in many species. (Compare [2] for a recent discussion of pigeons’ understanding of the mathematical concept of transitivity: \(a \geq b \geq c\) implies \(a \geq c\).) Nevertheless, most adults appear to have an aversion to mathematics. In particular, a challenge to the development of serious mathematical biology is encountered when this aversion is found in a majority of the biological community. (On the other hand, it well behooves mathematicians to appreciate the many subtle insights into complex systems that biologists are...
able to offer.) Recent studies by the eminent Polish pedagogue Gruszczyk-Kolczyńska have shed light on how innate mathematical ability may be stunted by the education system [3]. While she found that more than half of pre-school children possessed clear mathematical talent, and one in four children in that group displayed exceptional mathematical skills, the latter proportion had already dropped to one in eight after less than a year of regular schooling. According to Gruszczyk-Kolczyńska, this was a result of the strong pressure for social conformity imposed by the teachers, and the reluctance to tailor the classroom program to the widely differing abilities of the students. When aversion to mathematics becomes the socially acceptable norm, it is readily adopted by all but the most determined pupils.

The biggest obstacle to improvement is inertia. Serious reform of the education system is unlikely to be achieved by the well-intentioned but limited programs that are currently being attempted. When schools are merely expected to deliver a population of docile consumers, inertia will block any change.

![Figure 3: Part of the binary tree of wrench sizes below one inch.](image)

One example of the effect of inertia is the perpetuation of the outdated system of English measures within the United States. While mathematicians may enjoy certain of its features, such as the proliferation of prime factors involved (3 feet to a yard, 5 fluid ounces to a gill, 7 pounds to a nail, . . .), or the binary tree of wrench sizes (Figure 3), the system obscures the understanding of basic physical relationships. If an inch of rain falls over a square mile, how many gallons of water are accumulated? But if a centimeter (10⁻²m) of rain falls over a square kilometer (10³m x 10³m), the quantity of water accumulated is 10⁻² x 10³ x 10³ = 10⁻²+3+3 = 10⁴ m³ — ten thousand cubic meters or tons, of the order of magnitude needed to displace a typical river barge consist (Figure 4). This is the kind of computation and comprehension that should be within the reach of the majority of the population, were it not for the current deficiencies of the educational system.

![Figure 4: A river barge consist.](image)

**The benefits of mathematics**

Given the many challenges presented by mathematics, it is worthwhile to conclude by reaffirming the diverse benefits the subject offers. As society faces increasingly complex problems, the need for a cadre of qualified professionals to solve these problems grows ever more acute, along with the need for an electorate that is well-informed enough to ensure the political implementation of the solutions. Mathematics offers professionals the means to find these solutions, and empowers an educated population to make sensible choices about how our limited resources are allocated.

**References**


**About the author**

The author of 11 books and hundreds of research articles spanning 40 years, Jonathan D. H. Smith has been a member of the graduate faculty at Iowa State University since 1984. Prior to joining ISU, Smith spent time at the University of Cambridge, the Technische Hochschule Darmstadt, and Temple University.

Upon being named a Fulbright Scholar Smith spent a semester lecturing on “twenty-first century algebra” at the Warsaw University of Technology in 2012-13. Previously he visited Chonnam National University (Korea), the Stefan Banach International Mathematical Center (Poland), North Dakota State University, the University of Rome, and the Institute of Mathematics and its Applications. Smith’s research interests include algebraic, combinatorial, geometric and information-theoretic methods with applications in physics, computer science, and biomathematics.
Info at a glance

Math Majors

Student Credit Hours

Degrees

Faculty Members

Total External Funding

Scholarship Award Total by Academic Year

Scholarship Recipients by Academic Year
Faculty member activity outside Department

Three faculty members received Faculty Professional Development Assignments (i.e., sabbaticals) from the University. Leslie Hogben is spending the year at the IMA. Hailiang Liu will be splitting the Fall semester between Tsinghua University in Beijing and Magdeburg University in Germany.

Zhijun Wu is organizing a workshop at the Mathematical Biosciences Institute in Columbus, Ohio.

Other faculty members at IMA for part or all of the academic year include Steve Butler, Bernard Lidicky, Ryan Martin and Michael Young.

Kliemann begins new role as Associate Vice President for Research

Former chair and professor of mathematics Wolfgang Kliemann joined the research office as an associate vice president for research earlier this year. Kliemann helps researchers across campus connect with funding opportunities and reach their research goals. In August, Kliemann also became ISU’s research integrity officer.

Kliemann, who came to Iowa State in 1983, is no stranger to research administration. He served as associate vice provost for research from 2001 to 2005, working on research development and compliance issues. He has served as chair of the Department of Mathematics (2008–2013) and as associate dean for research in the College of Liberal Arts and Sciences (2000–2001).

Leslie Hogben edited the second edition of the Handbook of Linear Algebra.

A new textbook coauthored by Fritz Colonius, Universität Augsburg, Germany, and our own Wolfgang Kliemann became available via AMS this fall.

Steve Butler edited a popular book on the life of Paul Erdos.
Teaching and Learning
Alejandro Andreotti, Cliff Bergman, Elgin Johnston and Justin Peters contributed to content.

Undergraduate Program

Service courses
As we work to improve undergraduate service courses, we continued the redesign of precalculus, offering Math 143x (Preparation for Calculus) and completed configuration of Math 145x (Trigonometry and Analytic Geometry) for students that will not be taking calculus. We also redesigned Math 160 (Survey of Calculus) to better address the needs of client departments.

We have been fine-tuning the placement process for the separate tracks of Math 10 (remedial). Wolfgang Kliewer and Chris Schultz collected data that shows that students who take the course graduate on time at a much higher rate than ISU students overall. Data collection is continuing to study the success rate of STEM majors in particular.

After CEUME obtained data on the correlation between ALEKS scores and success in downstream courses, the ALEKS placement test was adjusted as appropriate. Analysis is ongoing.

As we embrace the continuous improvement program, every multi-section course now has a course coordinator responsible for implementing a plan, as well as choosing textbooks and electronic support system, designing uniform exams and make-ups, and tuning the syllabus.

Glenn Luecke was appointed as director of High Performance Computing Education. He has designed a new course, Math 424x, intended for undergraduate and graduate students who need sufficient serial programming background to enable them to take Math 525, the existing high performance computing course. Luecke has also designed workshops intended for those researchers that need a quick on-ramp to the HPC system.

Mathematics majors
Math 101 has been redesigned and expanded to 3 sections. The expansion is partly a result of an increase in freshmen majors. It also allowed us to create a separate section for transfer students.

We are vigorously encouraging math majors to undertake an independent research project. Led by Steve Butler, this entails inducing faculty to supervise these projects. Support for this is coming from Janson funds. Students must undertake a reading and writing project and present the results orally and in writing. Several students have submitted their work for publication.

We are trying to expand faculty participation in our weekly “undergraduate teas”. This is an informal gathering of undergraduate majors in the Sprague Room. The intent is to encourage community building throughout the department.

With the new academic advisor on board, we are attempting to distribute advising responsibilities across more members of the faculty, rather than have a few members carry the entire load.

Center for Excellence in Undergraduate Mathematics Education (CEUME) activities
The Center was involved in several efforts to enhance undergraduate mathematics teaching and to reach out to aspiring pre-college mathematics students.

In Fall 2013 the Center organized a faculty and graduate student seminar based on the book How Learning Works by Susan A. Ambrose. The book focused on seven research based principles for smart teaching. Over 20 faculty and graduate students participated in the seminar. CEUME personnel ran each seminar twice each week to accommodate the large number of participants. Discussions were lively and interesting and led many of us to rethink elements of our own teaching.

CEUME personnel and associates Elgin Johnston, Heather Bolles, Hien Nguyen, and Adrian Jenkins continued their study of the effectiveness of personal response systems (clickers) in large lecture calculus. Though the study is continuing this year, the team presented preliminary findings at three professional meetings in Spring and Summer 2014, including the August MathFest meeting in Portland, Oregon.

In the Spring of 2014 the CEUME led a weekly workshop on clickers. This workshop provided a forum to discuss new ideas for clicker usage and was a way for interested faculty to learn about clickers prior to using them in the classroom. The first use of clickers in an ISU mathematics classroom was in Spring 2011 in a large lecture Math 165 class. This semester (Fall 2014) there are twelve faculty using clickers in at least 18 classes.

The Center also continued its efforts to reach out to pre-college students with an interest in Mathematics. The ISU Math Circle team grew last year: the team was led by faculty members Elgin Johnston, Steve Butler and Kristopher Lee, and graduate students Jolie Roat, and Nathan Warner. The Math Circle met several times during the year. Each meeting was attended by between 10 and 20 Middle School and High School math enthusiasts.

Grad students and faculty members often join undergraduate majors enjoy mathematical fun and community building at weekly teas.
During the two-and-a-half hour Saturday sessions students explored open ended questions in card shuffling, hat guessing, Gollum rulers, tiling, etc. In February 2014 the CEUME organized the Math League competition, where 150 high school students and teachers gathered on campus for a Saturday of mathematics competitions and camaraderie. Several of our mathematics majors are veterans of the contests and/or Math Circle.

Last year CEUME personnel teamed with faculty from other departments and other institutions in four grant proposals aimed at improving undergraduate instruction in precalculus and/or calculus. In Summer of 2014 ISU was awarded $1,400,000 by the Howard Hughes Medical Institute for a university wide effort to improve instruction and retention in STEM (science, technology, engineering and mathematics) fields. A sizable part of this grant will support our efforts to improve instruction in Calculus I and II for STEM students.

**Graduate Program**

We have imposed a minimum score of 20 on the TOEFL speaking portion. This has been very successful in ensuring that new foreign graduate students have sufficient English skills to pass the Oral English Certification Test in their first year at ISU.

Based on extensive discussions with the research faculty, we have a self-imposed limit of 2.5 graduate students per research-active faculty member. That limits us to about 85 students. The other limiting factor in the size of our graduate student population is office space.

We have created two graduate learning communities, called “co-edge”. They are intended to replicate the success of our edge@ISU mentoring cluster.

We have formed a SIAM Student Chapter. The group has met regularly this academic year.

A program of videorecording our teaching assistants as they conduct their classes has been instituted. Students do a self-analysis and discuss their observations with Mary Gichobi (Ph.D., C&I 2013). This work is supported by the Barbara J. Janson Professorship.

We have established an internship program with General Dynamics Information Technology Corp. in West Des Moines where 1-2 students per year (from Math and Stat) spend half time working on projects with their staff. We are now in the development stage on a similar agreement with another company.

**Professional development travel**

Our program encourages students to attend conferences and workshops relevant to their research areas. Students may receive funding from the Department as well as other sources at ISU; often students receive funding from the conference, as well.

Events attended by our graduate students during the past year include:

- SAMS (Statistical and Applied Mathematical Sciences Institute) (1);
- SACNAS (Society for Advancing Hispanics/Chicanos & Native Americans in Science) (4);
- Midwest Probability Conference (4);
- Mathematical Association of America (3);
- Iowa Project NEXT (3);
- Field of Dreams Conference (4);
- Joint Mathematics Meetings (4);
- Combinatorics, Graph Theory and Computing Conference (4); and the Hot Topics workshop on careers in industry, held at the Institute for Mathematics and its Applications at the University of Minnesota (9).

**Graduate student workshop**

Graduate students organized their own conference, *Where are they Now*, in which former Ph.D. students who are now employed in different professions returned to Iowa State to talk about their work.

**New policy on research advisors**

This year the graduate program began a new policy of assigning temporary research advisors to students in their second year of graduate study to help students become better informed about the research area of interest to them. The advisor can help them plan which elective courses they should be considering, which seminars to attend, and make them aware of conferences outside of ISU.

**Master of School Mathematics**

The Master of School Mathematics (MSM) program blends face-to-face courses with distance learning technologies to further the mathematical background of secondary math teacher across Iowa and the country.

The program had 15 teachers taking courses during the summer of 2013, including Intermediate Calculus, Algorithms in Analysis, and a Mathematics Education Seminar.

Five teachers successfully completed the program, while five new teachers enrolled in it.

To complete the MSM degree, teachers take six core courses, two elective courses, and a creative component. The goal of the creative component is to encourage teachers to investigate mathematics that is new to them while connecting that investigation to the secondary mathematics classroom.

Completed creative components investigated the following topics:

- Statistical Applications of Auto Insurance,
- The Mathematics of Games, Statistical Analysis of ITED Scores, the Mathematics of Voting, and a Proof of Euclid’s Theorem.

After shepherding the MSM program very successfully for a decade, this year Heather Bolles turned the directorship over to Alejandro Andreotti.
Research and Scholarship

Research conference hosting

After so successfully hosting the regional meeting of the American Mathematical Society (450 participants) last year, we have now been selected to host the 2017 annual meeting of the International Linear Algebra Society (estimate 500 participants in July 2017).

Chair Leslie Hogben is joined by committee members Cliff Bergman, Steve Butler, Wolfgang Kliemann, Ryan Martin, Y.T. Poon, Sung-Yell Song, Derrick Stolee and Michael Young. Butler designed the logo shown below for the meeting.

We hosted the NSF-funded KI-Net workshop in May (photo upper right).

We will host the 2015 Rocky Mountain-Great Plains Graduate Research Workshop in Combinatorics, funded by the Institute for Mathematics and Its Applications.

Hosting post docs

Last Spring we hosted seven postdocs who are at least partially externally funded.

Chi-Jen Wang (PhD 2013) published a paper as first author in which he successfully models a novel process wherein rectangular islands on an anistropic surface decay maintaining constant width. The citation is as follows: Chi-Jen Wang, Y. Han, H. Walen, S.M. Russell, P.A. Thiel, and J.W. Evans, Analytic formulations for onedimensional decay of rectangular homoepitaxial islands during coarsening on anisotropic fcc(110) surfaces, Phys. Rev. B, 88 (2013) 155434.

Wang writes, “This behavior is quite distinct from conventional Ostwald ripening processes wherein islands maintain fixed equilibrium shape. Analysis required solving an unconventional boundary value problem for an anisotropic diffusion equation in a complex many-island environment.”

Cross-campus research

Numerous faculty engaged in cross-campus research. Partial list:

- Leslie Hogben, Fritz Keinert with Namrata Vaswani (EE)
- Jennifer (Davidson) Newman with Yong Guan (EE), Johnny Wong (ComS), Jennifer Margrett (HD FS), Debra Satterfield (ARTGR)
- Zhijun Wu with Robert Jernigan (BBMB)
- Michael Smiley with Jeffrey Essner (GDCB).

New interdisciplinary colloquium and seminar series

Leslie Hogben and Namrata Vaswani co-chaired the newly formed Mathematics, Electrical and Computer Engineering, Computer science, Statistics (MECS) interdisciplinary seminar last fall. The goals of MECS include:

- Stimulating interdisciplinary research collaborations among the departments of Computer Science, Electrical and Computer Engineering, Mathematics, Statistics, and other interested parties
- Raising awareness of research going on in these departments, particularly highlighting interdisciplinary research that may be of interest to the other participating departments.
- Hosting outside speakers who appeal to a broad audience.

MECS hosted both ISU faculty and outside speakers. ISU faculty members normally gave talks in two successive weeks; the first as a colloquium for a general audience, including an overview of problems s/he works on, and possible areas of expertise s/he can offer to others or is seeking in collaborators, and the second as a research seminar. Outside speakers typically gave a colloquium.

A highlight of the series was hosting ISU alum/IBM Storage Solutions Strategy and Project Manager Sondra Ashmore in a presentation on Watson.
Engagement and Outreach

National and international roles
Several faculty members have national and international roles:
• Sung-Yell Song is editor-in-chief of the Journal of Applied Mathematics and Computing (Springer-Verlag).
• Leslie Hogben is director of diversity for the American Institute of Mathematics (NSF funded) and secretary of the International Linear Algebra Society.
• Paul Sacks is division editor for Journal of Mathematical Analysis and Applications.
• Ryan Martin serves as vice chair of the Society for Industrial and Applied Mathematics (SIAM) Activity Group on Discrete Mathematics.

Best Practices conference
We hosted a workshop entitled Teaching Precalculus Mathematics Meaningfully in July 2013 and a follow-up workshop this summer with support from the Simons Foundation. More than 90 Iowa teachers, counselors and community college instructors participated in these gatherings.

Transition issues
We hosted Diana Gonzales, Chief Academic Officer of the Iowa Board of Regents, who discussed the Iowa Common Core, the Smarter Balanced program, and issues facing high school students as they make the transition from high school to community colleges and the universities.
Today, more and more people use high performance computing (HPC) to solve an array of problems, making it a critical technology for science, engineering and financial research and development. Specifically, it is used throughout the world for vehicle (land/water/air) structural design, engine design, financial modeling, crash testing, drug development, genome mapping, weather forecasting and scientific research, to name a few.

Exactly what is high performance computing, and why is it so widely used?

Simply put, HPC utilizes many (thousands or hundreds of thousands) interconnected processors simultaneously to allow large calculations to be done fast. Each processor does one portion of a more massive calculation. For example, in crash simulation, individual processors may independently calculate engine performance, structural considerations, brake response. These processors communicate with one another, sharing their results back and forth, allowing fast results for complex questions. The speed and complexity of HPC allows companies to remain competitive in today’s markets.

Mathematics professor Glenn Luecke directs the Education and Training for HPC at Iowa State University. The program provides instruction and training in high performance computing to students, P&S employees and faculty members using online material, workshops and university courses. Workshops are held periodically throughout the year.

The Colleges of Engineering, Liberal Arts and Sciences, and Life Sciences recently pooled around $1.1 million dollars to update processors in the HPC Lab. The new fiber optic machines, which reduce bottlenecks, allow researchers to reserve as much as 1600 processors for as long as three weeks at a time.

Current campus research projects utilizing HPC include those designed to create new data tools for plant breeders; look at molecular systems to create new materials and adapt existing ones; look at the ways tiny particles affect our everyday lives; find efficient ways to raise animals so they are more nutritious and healthier; model, design and control real-world physical phenomena; solve problems relevant to society; and project global climate change.

Writing programs for HPC machines is complicated and requires training. “Part of what complicates the task,” Luecke explained, “is being able to write the application so all of the processors are doing calculations simultaneously and not having any be idle. This is called load balancing.”

In response to the need for special training, Luecke has developed two courses in HPC: Introduction to HPC (math 424X fall semesters) and High Performance Computing (math 525 spring semesters). Both of these courses are cross-listed with Computer Science and Computer Engineering.

Luecke also directs a research group in HPC performing research for the Cray computer company as well as other research topics in HPC. “The projects and makeup of my HPC research group is constantly changing,” said Luecke. “Currently I have three graduate students and two P&S HPC experts in my group.”

Over the years Luecke’s group has conducted function and performance testing of MPI and OpenMP as well as designed debugging tools for Cray, and error detection capabilities for compilers and tools for the NSA. For Oak Ridge National Lab, they developed run-time error detection software for Unified Parallel C (UPC). Their work has included Fortran performance and function testing for IBM and Cray as well as a paper for NASA making recommendations on future system software requirements for future HPC machines.
Two new Co-EDGE clusters began meeting monthly during Spring semester. The informal gatherings offered the opportunity to address issues relevant to graduate students as well as interact with other graduate students in different stages of their mathematical careers. Clusters were open to all graduate students, as well as post-docs. Vertical integration and mentoring among graduate students was encouraged.

Each cluster was led by a core leadership team consisting of one senior faculty member, one junior faculty member, and one upper-level graduate student.

In general, Clusters met monthly to share dinner and discuss a MathGSO supplied or approved topic relevant to graduate students such as expectations, time management, teaching issues, qualifying and preliminary exams, major professors, internships, job search, etc.
Meet our new academic advisor

Dawn Walker joined our staff to advise first-year mathematics and statistics majors as well as join the recruiting efforts in the Departments of Mathematics, Statistics, and Computer Science. Walker is housed in room 171 Carver Hall.

Walker works with first and second year mathematics students and is in the process of preparing to lead a learning community.
Welcome new faculty members

Two assistant professors, eight post docs

Currently at IMA with other faculty members, Bernard Lidicky and Michael Young will assume their official teaching duties in January.

Lidický received his doctorate from Charles University in Prague in 2011. Before joining our department, he was a J.L. Doob Research Assistant Professor at the University of Illinois, Urbana-Champaign. His research interests include combinatorics and graph theory.

Young held a National Alliance Postdoctoral Fellowship in our department for the past 3 years. His research interests include combinatorics, extremal graph theory, Ramsey theory, algebraic graph theory, zero forcing, combinatorial matrix theory.

Jonathan Axtell
UConn 2009 (mathematics)
Representation theory, strict polynomial functors, symmetric functions, combinatorics of standard Young tableaux.

Marcus Bishop
National University of Ireland at Galway 2010 (mathematics)
Representation theory of algebras associated with Coxeter groups.

Zheng Chen
Brown 2014 (applied math)
Numerical analysis and scientific computing, including high order methods, singular problems, computational fluid dynamics, high performance computing.

William DeMeo
U of Hawaii at Manoa 2012 (mathematics)
Universal algebra, lattice theory, logic, computability, proof theory, category theory, type theory, functional programming.

Jyy-I Hong
ISU 2011 (math/stat)
Probability theory and stochastic processes; branching processes and branching random walks; coalescence theory; analysis; and statistics.

Yeansu Kim
Purdue 2013 (mathematics)
Automorphic forms and representation theory.

Mohit Kumbhat
U of Illinois, Urbana-Champaign 2012 (mathematics)
Combinatorics and graph theory, extremal problems.

Thanh Nguyen
Vrije Universiteit Brussel 2007 (engineering science)
Inverse problems for PDEs and applications in engineering problems.
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Pi-Chun Chuang
John & Teressa Clark
James & Martha Claypool
Lillian & Curtis Cooper
Pamela & Paul Crawford
John & Janet Craychee
Luz Dealba
Mary & Lowell Doerder
Jean & Frederick Dyer
K. James & Ruetta Dykstra
David & Adele Erbeck
Robert Erwin
Thomas & Joyce Eveland
Jack Girollo
Charles & Lucille Grosch
Robert & Linda Hansen

Philip Hanson
Susan & Gary Harrison
James & Sue Heerema
Arthur Hilsinger & Barbara Janson
Laura & Michael Hobart
Bruce & Dianne Huddleston
Hailong Jin
Neal & Teresa Kaloupek
Jessica Keough
Tamra Kirkpatrick
Gary & Verdeen Knox
Lois Kockler
Gary & Sarah Krenz
Larry & Marian Krummel
Carl Langenhop
Laura & Shawn Lewis
Brenda & Mark Lewis
Karen & Kirby Lidman
Phyllis Lowrey
Susan & Terry Lueders
Kathryn Mack
Larry & Judith McCool
Christine & Michael McElmeel
Sharon & Raymond McKimpson
George & Sara Melton
Bruce & Gael Mericle
Miriam Miller
R. Dennis Miner
Walter & Ursula Morris
Dirk & Darlene Muyskens

Lloyd & Janice Nyhus
Douglas Obye
Timothy & Rachael Oltrogge
Robert & Cheryl Ooten
James & Victoria Pedersen
Mary Petrick
Thomas & Sandra Robinson
Maryn & Thomas Rogge
Fred & Sara Rudolph
Edgar Rutter
Daniel Sarasio Meyer
Marjorie & Jerry Sedlacek
John & Lisa Seidel
Robert & Lynda Shive
Sherwin Skar & Kathryn Jones
Keith & Virginia Smith
Dennis Stanton
Charlotte & Tommy Streeter
Marie & John Stroup
Kathy & Lyle Van Buer
Richard & Gayle Ver Steeg
David Voss & Mary Walker-Voss
William & Kathyrn Wagner
Duane Winkler
Lonny Winrich & Sandra Donaldson

Undergraduates enjoy Antol print installed in Sprague Room.

Undergraduates and Math GSO (graduate students) cooperate to offer Pi(e) Day.
A sampling of 2013-14 colloquia

Kurt Bryan (Rose-Hulman University) Making do with less: An introduction to compressed sensing

Jim Cannon (BYU) Does every set have a size?

Marilyn Carlson (ASU) A research-based approach for improving precalculus teaching and learning

Mike Ferrara (UC Denver) Realization problems for degree sequences

Diana Gonzalez (Iowa Board of Regents) Transition issues in early college mathematics

Stephen Kleene (MIT) Logarithmically spiralling helicoids

Kyle Mandli (University of Texas at Austin) Approaches to forecasting storm surge more quickly and accurately

Joe Mileti (Grinell College) (Non)computable algebra

Misun Min (Argonne National Lab) Scalable high-order algorithms and simulations for electromagnetics and fluids

Wei Wang, (Florida International Univ) Multiscale discontinuous Galerkin methods for second order elliptic equations

Misun Min, computational scientist with the Mathematics and Computer Science Research Division at Argonne National Lab is one of many colloquium speakers we hosted.

To explore different ways to offer support, including cash gifts, non-cash gifts, matching gifts, planned gifts, and corporate and foundation gifts, visit www.foundation.iastate.edu/

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You may designate your contribution to one or more of these established funds:

___ Dio Lewis Holl Chair in Applied Mathematics Fund (2700481) to recruit and retain the brightest and best faculty members.

___ Janson Professorship in Mathematics (2702279) to support an eminent research mathematician with a commitment to undergraduate education.

___ Dr. Richard Sprague Memorial Fund (2701594) to furnish space and provide resource materials for upper level math majors.

___ Marian Daniells Scholarship Fund (0711566) for outstanding undergraduate math majors.

___ Robert & Marion (Betty) Lambert Award Fund (1900008) to support and reward teaching and research excellence by a graduate student.

___ Mathematics Graduate Student Scholarship Endowment (1900058) to support graduate study.

___ Dio Lewis Holl Award Fund (1909241) for an outstanding junior and an outstanding senior math major.

___ Herta & H.T. David Scholarship in Mathematics Fund (2700486) for an undergraduate math major with financial need and challenging family background.

___ Fred Wright Mathematics Endowed Scholarship Fund (2702071) for an undergraduate student that shows exemplary leadership in extracurricular activities.

___ Mathematics Department Development Fund (2700704) to support the teaching and research efforts of the Math Department.

___ Mathematics Department Scholarship Fund (1900057) to support math students at the graduate and the undergraduate level.

___ Mathematics Department Lectureship Fund (1922512) to finance lectures by outstanding mathematicians and their visit to Iowa State.

Thank you for supporting the activities of the Mathematics Department at ISU.
Honors & Awards

Undergraduate

Marian Daniells Scholarship
Adam Abbott
Baoyue Bi
Zaynab Diallo
Alexander Doser
James Klimavicz
Christian Lopez
Shannon McClintock
Andrew Smith
Fengxing Zhu

Herta & H.T. David Scholarship
Alphonso Lucero

Alan Heckenbach Award for Student Seeking Secondary Certification
Rebecca Ehlers

Gertrude Herr Adamson Award
Tyler Chenhall
Rochelle Starrett

Dio Lewis Holl Awards
Outstanding SR: Rebecca Ehlers
Outstanding JR: Joshua Thompson

Fred Wright Mathematics Endowed Scholarship
Stephanie De Graaf
Elizabeth Doebel
Alec Filak
Kathleen Roberts

Goldwater Scholar
William “Robin” Lindemann

LAS Academic Merit and Academic Excellence Scholarships
4 Merit and 1 Excellence scholarships have been offered to incoming new and transfer mathematics majors.

Outstanding Problem Solvers
Tyler Chenhall
Jaleb Jay
Rochelle Starrett

Iowa Collegiate Mathematics Competition winners
First place team:
Tyler Chenhall
Michael Dixon
Benjamin Sheller

ISU Putnam team 64th/557 teams
Tyler Chenhall (high scorer)
Shenzhi Wang
Joshua Thompson

Midwest Undergraduate Data Analysis Competition
Second place team:
Hillary Chaney
Bronson Recker
Han Wang

Phi Beta Kappa Initiates
Jordan Barr
Baoyue Bi
Stephanie De Graaf
Alec Filak
Drew Fullerton
James Klimavicz
Diego Useche Reyes
Kathleen Roberts
Joshua Thompson
Miracle-Rose Toppar
Elizabeth Veldboom

Graduate

Lambert Applied Math Research Award
Yongki Lee

Lambert Teaching Award
Steven Osborne

Lambert Graduate Assistantship
Brian Lois
Saulo Orizaga

Graduate students honor Hailiang Liu with Vinograde Award

Marion Daniells Scholarship recipients.
Master of School Mathematics


Master of Science

Juan Brandi, MS (2013) Parallel implementation of the quasi-steady wave propagation method for the shallow water equations. J. Rossmanith
Jacqueline Chalmers, MS (2013) Quasigroups and their fractals. J.D.H. Smith
Nuwan DeSilva, MS (2013) Coppersmith's attack on low public exponent RSA. C. Bergman
Dong McDanel, MS (2013) Mathematical models for population evolution in ecology, enzyme reaction kinetics and infectious diseases dynamics. J.Yan
Jeongmin Shon, MS (2013) Modular categories and invariants of 3-manifolds. T.Basak
Chelsey Uherka, MS (2013) An introduction to Ramsey theory and anti-Ramsey theory on the integers. S. Butler & M. Young

Doctor of Philosophy

Man Basnet, PhD (2013) On modified $l_1$ minimization problems in compressed sensing. F. Keinert & N. Vaswani
David Failing, PhD (2013) Commutative, idempotent groupoids and the constraint satisfaction problem. C. Bergman
Yiping Hao, PhD (2013) Computation and analysis of evolutionary game dynamics. Z. Wu
Steven Osborne, PhD (2013) Cospectral bipartite graphs for the normalized Laplacian. S. Butler & L. Hogben
Maksym Pryporov, PhD (2013) Gaussian beam methods for the Schrodinger equation with periodic potentials and strictly hyperbolic systems. H. Liu
Youngsoo Seol, PhD (2013) Random walks in a sparse random environment. A.Roitershtein
Jing Wang, PhD(2013) Modeling of the interplay between single-file diffusion and conversion reaction in mesoporous systems. J. Evans