

DEPARTMENT OF Mathematics

MSU College of Natural Science | Newsletter for Alumni and Friends

From the Department Chair...

Mathematics grows ever more important as the world grows increasingly digital, and the MSU Department of Mathematics is helping to lead the way. The past year has been one of tremendous growth for the department—growth that lays the foundation for future opportunities.

Our research activities have been bolstered by the hiring of six new tenure-track faculty since our last newsletter. Jun Kitagawa and Willie Wong, who work in optimization and mathematical physics, respectively, joined us in August. Igor Rapinchuck arrives in fall 2016 and will strengthen our world-class algebra group. Three additional faculty members who are joint with the new Department of Computational Mathematics, Science and Engineering also joined us in August—Matthew Hirn, Jose Perea and Ming Yan. These impressive individuals have research interests that range from optimization to the analytical and topological analysis of large data sets. In many measures, this new department reflects the growth in applications of mathematical ideas. See more about these new hires on page 5.

Our strength as a department was also recognized by the awarding of two MSU Foundation Professorships to our faculty—one this past spring to Professor Andrew Christlieb that recognizes his contributions in computational science, and one this fall to University Distinguished Professor Alexander Volberg for his work in analysis. In addition, Assistant Professor Yingda Cheng was the recipient of a prestigious NSF CAREER Award, the seventh CAREER award to a mathematics faculty member in the past five years.

Math's graduate program has also had an exceptional year under the leadership of Graduate Director Jon Wolfson. First-year

teaching duties for graduate students have been eliminated and first-year courses have been restructured so that students can complete the qualifying exams within one year and move directly to in-depth research. The incoming class of 18 Ph.D. students promises a tremendous start to the revamped program.

“Of course, all of this growth is possible only through the generous donations of our alumni and corporate sponsors ...”

The department's undergraduate degree program continues to grow, with the Advanced Track Program graduating 10 seniors this past summer who have gone on to graduate study at top universities around the country including Brown University, the University of Michigan, the University of Pittsburgh and the University of California, San Diego. The Actuarial Science Program has experienced tremendous growth, with almost 500 students enrolled, and also welcomed a new director, Kevin Clinton, in August. Kevin looks to build upon industrial contacts within Michigan to enhance internship and career prospects for our graduates. Read more about Kevin on page 5.

The Department of Mathematics is building upon its excellence in undergraduate instruction. We continue to innovate, seeking new ways to deliver outstanding

instruction and to assess our performance. In response to student requests, we have developed MTH 299, an “introduction to proofs” course that was recast by Assistant Professor Russell Schwab into a partially flipped class in which students work in teams to hone their proof skills. The combined business and biology-based calculus course, MTH 124, is being redesigned by Professors Teena Gerhardt and Ben Schmidt, both recipients of the 2014 MSU Teacher-Scholar Award, who are separating it into a business and a biology-based stream, and modifying the course content to match the interests and needs of each group. Another innovation is the introduction of a quantitative literacy sequence, MTH 101-102, which emphasizes the process of mathematical thinking and problem solving over the technical manipulation of symbols, and is designed to provide life-long skills to students in non-quantitative degree programs.

Of course, all of this growth is possible only through the generous donations of our alumni and corporate sponsors, who provide the support for our graduate and undergraduate entrance fellowships, as well as the funds that support MSU's Actuarial Science Program. The creation of an endowed professorship for mathematics is one of our major goals and a priority for us during MSU's current Empower Extraordinary capital campaign. We are confident that, with your help, we can make it happen! 🍎



Keith Promislow, Ph.D.
Chair
Department of
Mathematics



Marjorie (Premo Pickering) Gifford, mathematics, '54; Ph.D., education, '68, is a professor emerita of mathematics at San Jose University and owner of Metier Tax Consultant, LLC, in Princeville, Hawaii.

Dale Lick, mathematics, '58; masters, mathematics, '59, is president and professor emeritus at Florida State University. He is also a former president of Georgia Southern University and the University of Maine.

Jim Cheshire, mathematics, '63, retired from the Texas Education Agency in Austin in 1994 as director of programs, adult education. Prior to that, he served in the United States Air Force from 1963 to 1976 and was a USAF teacher/counselor and faculty member at Southwest Texas State University from 1980 to 1989.

Stanley Steinberg, mathematics, '63; masters, mathematics, '63, started an international meeting, Applications of Computer Algebra, in 1995. The meeting alternates between the United States and Europe, with one in Japan. The 2016 meeting will be in Kassel, Germany.

Thomas Steinfatt, mathematics, '63; masters, speech and theater, '66; Ph.D., communication, '71, has been a professor at the University of Miami since 1987.

Joan (Peters VanDeventer) Ogden, masters, mathematics, '68, has been named to the Taxpayer Advocacy Panel (TAP) as representative for Utah. TAP is composed of citizen volunteers, representing every state and territory, who work with the IRS to help improve customer service and taxpayer satisfaction.

James Dimitry, mathematics, '72; computer science, '76, retired from Consumers Energy in Jackson, Mich., in September after working in the company's IT department for 39 years.

Bruce Morlan, mathematics, '73, retired from the Mayo Clinic in Rochester, Minn., in 2014. He had previously retired from the Air Force in 1993. He is now pursuing new opportunities in applied analytics as a volunteer for the Citizens' Climate Lobby.

Linda Deneen, M.A., mathematics, '75; M.S., statistics, '79; Ph.D., mathematics, '80, retired from the University of Minnesota Duluth in May 2014. Her career was in computer science and information technology.

Christine Vandervoort, Ph.D., chemistry, '81; mathematics, '89; M.S. entomology, '95; Ph.D., entomology, '00, is working at Michigan State as a research chemist.

Edward Aboufadel, mathematics, '86, a mathematics professor at Grand Valley State University, was included, along with Wisconsin cartographer Daniel P. Huffman, in a short list of "Runners Up" in a recent international competition in applied mathematics and statistics. Their submission involved representing water pollution data on maps.

Mohamed Elgindi, Ph.D., mathematics, '87, is a professor in the mathematics department at Texas A&M University at Qatar.

Brian Bury, M.S., applied mathematics, '90, was part of a six-member team to receive the Engineering Efficiency Award at the

annual 2015 Engineering Recognition Day at GE Aviation. The team earned this award by reducing cycle time for software deliveries by 50 percent.

Edward Hill, mathematics, '92, is starting his 24th year in secondary education. He is currently the principal at Alice M. Birney K-8 School in Southfield, Mich. His wife, Joila, is also an MSU graduate (social science, '93).

Jack S. Calcut, mathematics, '99, was awarded tenure at Oberlin College, Department of Mathematics, in July 2015. His wife, Margot, is also an MSU mathematics alumnus (M.A.T., mathematics, '00).

Dan Bouk, computational mathematics, '02, recently published a book, *How Our Days Became Numbered: Risk and the Rise of the Statistical Individual* (University of Chicago Press, May 2015).

David Hickling, mathematics, '04; D.O., '14, is a family medicine resident in Mt. Clemens, Mich. He will graduate residency in 2017 and likely stay in Michigan to practice medicine.

Eric Yskes, mathematics, '04, is an actuarial consultant for Amerisure Insurance Company, Farmington Hills, Mich., and recently attained the designation of Associate of the Casualty Actuarial Society.

Christopher Danielson, Ph.D., mathematics education, '05, is author of *Common Core Math for Parents for Dummies* (Wiley Publishing, April 2015). He is a math teacher at Normandale Community College in Bloomington, Minn., and is creator of the website, *Talking Math with Your Kids*.



Erin Stein, mathematics, '05, is director, global programs, for Bespoke Education, a tutoring company specializing in standardized test preparation in New York.

Holly Westerfield, M.S., industrial mathematics, '08, organized the Seattle Pi Day Dash and sold out the event with 2,000 participants. The event raised almost \$40,000 for the Leukemia & Lymphoma Society.

Justin Droba, Ph.D., applied mathematics, '14, began working in the Applied Aerosciences and Computational Fluid Dynamics Branch at NASA Johnson Space Center in Houston, Texas, in August 2014.

Jared Merlo, general management and mathematics, '14, has recently taken on a new job as an associate at Deloitte in the Washington, D.C., Metro Area doing applied machine learning on problems for large companies across the United States.

Maggie Mikus, mathematics, '14, received her master's degree in applied mathematics from Northwestern University in June and started a new job at Epic Systems Corp. in Madison, Wis., in July.

Toby Buckley, mechanical engineering and mathematics, '15, just started his M.S. in the aero/astro program at Stanford University.

Retirements



Fintushel

University Distinguished Professor **Ronald Fintushel**, a world renowned researcher in the mathematical field of 4-dimensional topology and gauge theory, retired in August. He

received his Ph.D. from SUNY Binghamton in 1975 and came to MSU in 1987 after spending 10 years at Tulane University and two years at the Institute for Advanced Study in Princeton, New Jersey. Among his best-known works are the blow-up formula for Donaldson invariants and the Knot Surgery Theorem. Through mentoring and recruiting, Fintushel is credited with transforming the MSU mathematics Ph.D. program, making it one of the best graduate schools in topology.

Known internationally for her work in commutative algebra, Professor Emeritus **Christel Rotthaus** retired in August.

She received her Ph.D. in 1975 from the University of Münster in Germany and spent 10 years doing research on commutative algebra in Germany before coming to MSU in 1985. At MSU, Rotthaus continued her research in commutative algebra in the areas of excellent rings, Artine approximation and local cohomology. In addition to her research, Rotthaus enjoyed teaching and was involved in the department's ongoing program to improve the mathematics skills of future math teachers.



Rotthaus

Professor **Sharon Senk**, who retired in August, began her career at MSU as an associate math professor in 1990, having earlier been an assistant professor at Syracuse University

and a research associate at the University of Chicago. She was promoted to professor in 1997. Since 2005, Senk has held appointments in both the Program in Mathematics Education and the Department of Mathematics. Her research interests include curriculum, instruction and assessment in secondary schools, and mathematics teacher education. Senk received her Ph.D. from the University of Chicago in 1983.



Senk

In Memoriam

Dorothy Manderscheid died August 16, 2015. After raising her family in East Lansing, Manderscheid went back to school and obtained a master's degree in library science, and then headed the Mathematics Library at MSU for many years. Memorial donations may be made to the Lester and Dorothy Manderscheid Endowment for the Mathematics Library at MSU.

Retired Professor **Indranand Sinha** died August 17, 2015. He was a math professor for more than 40 years and was an active member of the Indian community of greater Lansing. Sinha

obtained his bachelor's degree in mathematics from Banaras Hindu University in Varanasi, Uttar Pradesh, India, and his Ph.D. in mathematics from the University of Wisconsin-Madison.

Katherine A. Trebilcott, an administrative assistant in the math department for 42 years, died January 19, 2014. She had retired from MSU in 2013. She loved her cats, her garden and flowers, and enjoyed traveling. Trebilcott is survived by her husband, Philip Richard, Jr.

New Faculty

The Department of Mathematics also welcomed five additional faculty members in August:



Hirn

Matthew J. Hirn is an assistant professor in mathematics and computational mathematics, science and engineering whose research focuses on harmonic analysis, applied mathematics and data analysis. Prior to coming to MSU he was a postdoctoral researcher at the École normale supérieure, Département d'Informatique in Paris, France. Hirn received his Ph.D. in mathematics from the University of Maryland.



Yan

Ming Yan is an assistant professor in mathematics and computational mathematics, science and engineering. His research interests include optimization methods and their applications in sparse recovery and regularized inverse problems. Ming received his Ph.D. in mathematics from UCLA. Prior to joining MSU, Ming was an assistant adjunct professor with the Department of Mathematics at UCLA.



Kitagawa

Jun Kitagawa is an assistant professor in mathematics whose research focuses on elliptic and parabolic partial differential equations, optimal transport and numerical methods. Kitagawa was a postdoctoral fellow at the Field Institute for Research in Mathematical Sciences and the University of Toronto before coming to MSU. He received a Ph.D. in mathematics from Princeton University.



Perea

Jose Perea is an assistant professor in mathematics and computational mathematics, science and engineering. His research focuses on the theoretical aspects and applications of topological methods for the analysis of data. He was a visiting assistant professor in the mathematics department at Duke University from 2011 to 2015. Perea received his Ph.D. in mathematics from Stanford University.



Wong

Willie Wai-Yeung Wong is an assistant professor in mathematics whose research interests lie in the interface of geometric analysis and hyperbolic partial differential equations. Prior to coming to MSU, Wong was a postdoctoral collaborator at École Polytechnique Fédérale de Lausanne in Lausanne, Switzerland. He received his Ph.D. in mathematics from Princeton University.

Actuarial Science Program names new director

R. Kevin Clinton is the new director of MSU's Actuarial Science Program.

Clinton has more than 35 years of financial and insurance industry experience. Most recently, he was the state's 45th treasurer. Prior to that he served as director of the Michigan Department of Insurance and Financial Services.

In the private sector, Clinton was president of MEEMIC Insurance Company and was the chief financial officer at ProNational Insurance Company. In 2001, he joined American Physicians Capital, Inc., serving as the company's vice president and chief operating office before becoming its president and CEO. Clinton earned a bachelor's degree in business administration and a master's degree in actuarial science from the University of Michigan in Ann Arbor.

Clinton succeeds Emiliano Valdez, who was the first director of the program.



Clinton

RONALD H. AND MARY E. SIMON ACTUARIAL SCIENCE LECTURE

KEYNOTE ADDRESS BY
STEPHEN MILDENHALL
Global CEO of Analytics for Aon

NOVEMBER 13TH
5:30 PM
EAST LANSING, MICHIGAN



R.S.V.P. by October 30, 2015
natsci.msu.edu/simonlecture

Math department fosters the birth of MSU's newest academic department

The newest academic department at Michigan State University is intended to position the university as a world leader in scientific discovery through large-scale computation, and the Department of Mathematics has played a critical role in its launch.

Jointly administered by the College of Natural Science and the College of Engineering, the Department of Computational Mathematics, Science and Engineering (CMSE) was approved by the MSU Board of Trustees at its April 17 meeting. It brings together researchers from a variety of disciplines and will serve to advance cutting-edge interdisciplinary science and the training of undergraduate and graduate students.

Computational science focuses on the construction of mathematical models and quantitative analysis techniques, using computational tools to analyze and solve any number of scientific problems.

"It shouldn't be a surprise that math plays a critical role in this new department because the idea of developing robust approximations is a mathematical topic," said Andrew Christlieb, MSU Foundation Professor and inaugural chair of CMSE. "We're looking beyond traditional disciplinary boundaries to bring together people who are focused on algorithms to solve problems."

"I view the new department as an emblem of the success of mathematics," said Keith Promislow, professor and chair of MSU's Department of Mathematics. "As the world becomes increasingly digitally driven and cyber-enabled, we are confronted with huge data sets that are beyond anything people can understand.

"It's sort of the 'mathification' of many different fields of study," Promislow



Andrew Christlieb is an MSU Foundation Professor of Mathematics and the inaugural chair of the Department of Computational Mathematics, Science and Engineering.

"In the modern world, the role of computation in almost all of science is growing exponentially ..."

added. "In the modern world, the role of computation in almost all of science is growing exponentially."

CMSE will offer its first two classes in January. The five-year Ph.D. program will

launch in fall 2016, by which time the department expects to be in its new space on the first floor of the Engineering Building.

"We're also in the process of getting the CMSE minor through the university system; that will be official by fall 2016," Christlieb said. "And we're starting to work with other departments on campus to develop undergraduate degrees jointly."

"Almost all aspects of human endeavor will be impacted by the desire to take these data sets that are beyond human comprehension and extract meaningful information from them," Promislow said. This includes fields as diverse as plasma physics, informatics, neuroscience, polymer chemistry, entomology, materials science, image recognition and processing, health science and astrophysics.

"The new department will leverage the existing strengths of the math department and allow us to grow into new fields in ways that we couldn't otherwise," Promislow said.

The new program will train students to be cross-disciplinary and help them develop new tools for solving problems.

"This is the next generation of scientists," Christlieb said. "We're aiming to turn our students into a 21st-century student body. They will be ready to step into positions at other academic institutions, as well as in national labs and industry."

"After these students get their Ph.D.s, they will be able to look for their future not only in academic departments, but also in hybrid positions, which I think will be increasingly popular in the future," Promislow added. 🍎



Bob Rietz: Giving back because “it’s the right thing to do”

During a recent visit to campus, Bob Rietz (B.S., mathematics, '70; Honors College) had the opportunity to meet with R. Kevin Clinton, the new director of the math department's Actuarial Science Program, and three of the NatSci Dean's Research Scholars.

He couldn't have been more impressed with the college's programs and its students.

“Two of the students I met are majoring in neuroscience; they were telling me about the projects that they themselves are managing,” Rietz said. “The third, an astrophysics major, told me she has discovered seven new stars—using a radio microwave telescope. Seven new stars are now in the astronomical catalog!”

“I am positive that I wouldn't be where I am today if it weren't for Michigan State. I want to give back; it's the right thing to do.”

He is also pleased with the progress of the Actuarial Science Program, which graduated its first cohort of students in 2013.

“It's growing extremely well. There are more than 100 students in the program right now. These students are passing exams, getting jobs,” Rietz said.

There are about 20,000 credentialed actuaries in the United States today, he said.

Born in Chicago, Rietz was “recruited to MSU by a wonderful gentleman named



Bob Rietz lives in the mountains in Old Fort, N.C., with his wife, Nancy. Together, they have five children and nine grandchildren.

Russell Wentworth, the MSU recruiter for the Chicagoland area.”

“During my time as a student at MSU, I was able to pass three of the five exams required by the Society of Actuaries to become an associate of the society. That was unheard of in those days; employers were impressed,” Rietz said. “Maybe I'm bragging . . . but what I'm really bragging about is the strength of MSU's math program!”

Immediately after receiving his degree from MSU in 1970, he went to work for Lincoln National Life Insurance Company in Fort Wayne, Indiana. After four years there, he joined the Wyatt Company in Detroit, where he worked for 25 years—first as an actuary, and then as a team leader. After three years at Blue Cross/Blue Shield of Michigan in the human resources department, he spent nine years at Deloitte Consulting LLP in Detroit before retiring as chief pension actuary.

In the 1990s, he was appointed by Michigan Gov. John Engler to the

Michigan Public School Employees Retirement System; he served for about seven years. Last fall, he was named to the Investment Committee of the Detroit General Employees Retirement System by Gov. Rick Snyder. He also just completed six years of service on the Actuarial Board for Counseling and Discipline, the last two as chair.

Rietz feels it's especially important to give back to his alma mater. He has been supporting the Actuarial Science Program both financially and through serving on the Actuarial Science Advisory Board, which is composed of people from industry—as well as faculty. He is also on the College of Natural Science Campaign Advisory Board.

“I am positive that I wouldn't be where I am today if it weren't for Michigan State. I want to give back; it's the right thing to do. I want others to have the same advantage that I did. I want to help keep the math program strong. I want to help the actuarial program be one of the nation's best.”

Summer math program bridges students to higher level

For 52 MSU freshmen, what they did during their summer vacation has added up to an advantage when it comes to their mathematics studies.

They were participants in MSU's Dow Hybrid Bridge Summer Mathematics Program, a seven-week program targeted at students from underrepresented groups—the majority from the Detroit and Lansing areas—who are struggling with math. It consists of online coursework and three face-to-face sessions.

“... ‘higher placement’ is just one step; the ultimate goal is for these students to be successful.”

“A big challenge for students transitioning from high school to college is to see mathematics as a coherent subject rather than a bunch of pieces to memorize,” said Pavel Sikorskii, senior teaching specialist and co-director of undergraduate studies in the Department of Mathematics. “An underlying reason why these students are struggling is because they don’t understand the value of math and they’re not motivated about it.”

All freshmen admitted to MSU are required to take a math placement test; a significant number of them place into intermediate algebra, about three levels below the target for a STEM college student.

“This is something that we take very seriously, and we’re trying to do everything we can to address national challenges—such as STEM recruitment and retention, time to degree, and graduation rates,” Sikorskii said.



Caleb Conley and Emily Butler (foreground), MTH 103 (College Algebra) students, with Pavel Sikorskii, senior teaching specialist and co-director of undergraduate studies in the MSU Department of Mathematics.

“Placing into intermediate algebra presents serious challenges for these students. For example, a student working toward a degree in engineering should start with calculus in the freshman year. Testing into intermediate algebra is telling them that they’re underprepared. The question is, what do we do to address that?” said Sikorskii, who has been involved with the math bridge program since it began three summers ago.

In addition to Sikorskii, Brian Chadwick, advising specialist, manages the online operations and logistics; and Susan Allen, mathematics instructor, helped develop the curriculum. This team identifies and recruits the students who are potential targets for the program.

The goal of the non-credit summer hybrid course is to help these students “catch up” in their math studies so they will be able to place into college algebra, the next higher course, by fall. Data from the past two years reveals that more than 70 percent of the students in the program advanced into this next level.

“But ‘higher placement’ is just one step; the ultimate goal is for these students to be

successful,” Sikorskii said. “We don’t want them to ‘just make it’ into college algebra in the fall, we want them to do well in college algebra.”

For the first two years, the program was funded through MSU’s Office of Supportive Services. This year, the program received support from the math component of a three-year, \$5 million grant from the Dow Foundation to MSU. It is expected that the summer math program will grow to support 100 students next summer and 150 the following year.

“Each semester, we teach 12,000 students in what we refer to as the ‘gateway math courses’—intermediate algebra, college algebra, pre-calculus, calculus, and others. We’re working very hard to improve these classes by taking advantage of the latest technology and customizing the courses so that they serve the needs of the students in those classes. We’ve been putting a lot of effort into this,” Sikorskii said.

“It’s a comprehensive effort to make what we do in these classes exceptional. The overarching goal is to improve student outcomes.” 🌱

MSIM Program: 15+ years of sponsorships and recognition

MSU's Master of Science in Industrial Mathematics (MSIM) program has blossomed since its inception 15 years ago. With initial support from the Alfred P. Sloan Foundation, the program continues to receive national recognition as one of the oldest continuously running Professional Science Master's (PSM) nationwide. More importantly, the program is achieving its primary goal of producing problem solvers capable of moving within an organization from task to task. MSIM graduates have studied not only the standard mathematical and statistical tools, but also the basic ideas of business and engineering with training in project management and industrial communication.

One key to the success of the program, under the direction of Peiru Wu, has been its use of an industrial advisory board.

"These advisors have made recommendations such as professional training, emphasis on writing and presentations, exposure to industrial problem solving and other disciplines," explained Wu, who is the director of PSM in Industrial Mathematics at MSU. "All of these recommendations have been met by the program curriculum."

In addition, there is an annual Industrial Advisor Contact Day, where students have mock interviews with advisors from such companies as Auto-Owners, Chrysler,



Keith Promislow (front row, center) and Peiru Wu (front row, second from right) with industrial advisors during an Industrial Advisor Contact Day event last fall at MSU.

Consumers Energy, Ford Motor Credit, Herman Miller, Jackson National Life, Loan Science and Steelcase.

"An essential pillar of the program requires students to work on real-world problems solicited from local industries during each spring semester," Wu said.

Teams of three to four students attack problems proposed by a company. Each team is assisted by a faculty manager and an industrial liaison from the company. Student teams subsequently deliver a formal technical report, computer deliverables and a

presentation of their results to the proposing companies. Since 2000, students have successfully completed 84 projects.

The program's success is ultimately measured by its graduates, all of whom have found placements, with many receiving salaries in excess of \$70,000.

"This 15-year track record is very gratifying and validates the program's effectiveness in preparing its students for a rewarding career," Wu said.

For more information on MSIM, visit <https://www.math.msu.edu/msim/>.

MSU establishes Center for Mathematical Molecular Biosciences

Biological sciences in the 21st century will be defined by the transition from the phenomenological and the descriptive to the quantitative and predictive. This transition will be driven by mathematical advances in biological sciences, in particular, molecular biosciences. Molecular structure, function, dynamics and transport are the ultimate basis for all living things, from viruses, bacteria, plants and animals to humans.

The Center for Mathematical Molecular Biosciences (CMMB) at MSU, headed by Mathematics Professor Guowei Wei, is the first entity of its kind established to catalyze the century transition in biological sciences.

"A key goal of CMMB is to position MSU as a national leader in mathematical biophysics and molecular biosciences through outstanding research, exceptional collaborations and national partnerships," Wei said.

Under the guidance of its scientific advisory committee (Andrew McCammon, University of California, San Diego; Gunnar Carlsson, Stanford University; and Avner Friedman, The Ohio State University), the CMMB is establishing interdisciplinary research collaborations across MSU that involve researchers in mathematics (Peter Bates, Chichia Chiu, Moxun Tong and Wei), biochemistry and molecular biology,

chemistry, entomology and computer science and engineering. Research topics include solvation prediction, drug binding and design, ion channel transport, RNA polymerase, systems biology, complex biological data and the origin of life.

The center has also established a national network of academic partnerships with faculty at Pacific Northwest National Laboratory, the University of Wisconsin-Madison, Pennsylvania State University, Rutgers and The Ohio State University.

"Our future goal is to broaden the center's impact beyond mathematics and establish an externally funded CMMB," Wei said.

Collaborative work could lead to new field of research

One bad apple won't spoil the whole bunch. Certainly not if one MSU research duo is successful.

Jeffrey Schenker, associate professor of mathematics, is working on a research project with a professor of entomology—something that is “not at all typical.”

“My collaboration with Professor Jim Miller in the entomology department is a very interesting one,” said Schenker, who is also director of MSU’s new Institute for Mathematical and Theoretical Physics. “I was raised as a mathematical physicist; I work on problems related to quantum mechanics, which is pretty far removed from insects.”

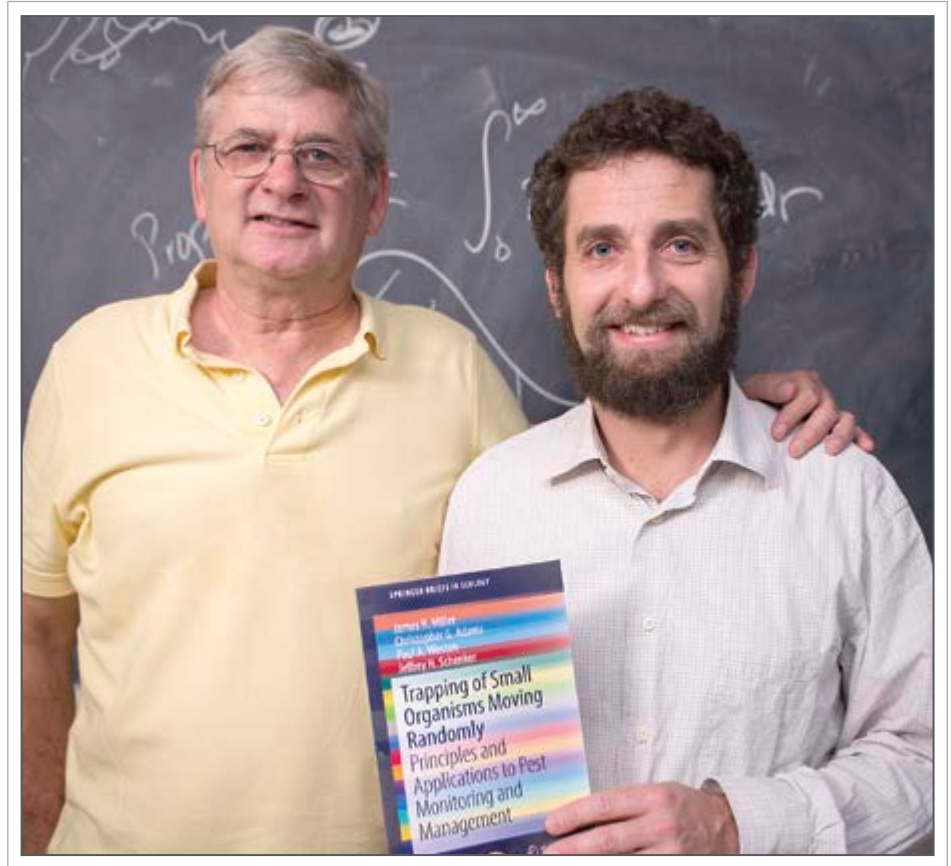
About three years ago, Miller and entomology graduate student Chris Adams approached Schenker with some probability questions. The entomologists wanted to use random walks to model insect motion—and in particular, to understand how to interpret the data their lab had already collected.

One of the insects they’re studying is the codling moth—whose larva is the proverbial “worm in the apple.” To find out if the moths are active in a particular orchard, the entomologists hang pheromone-baited traps in trees to attract and trap the male moths.

“But the trouble is, if they catch five moths in the trap, they don’t know whether that’s five moths per acre, or five moths per 20 acres. How do we turn absolute catch into population density?” Schenker said.

This collaborative project between mathematics and entomology has led to interesting new results, for the field of ecology as well as for mathematics.

“We found that the rate of convergence of these models to Brownian motion depends upon the parameters. And we now know that some of the parameters in the model need to be renormalized. This is a very recent finding,” Schenker said. “It’s been fascinating to learn how to go back and forth between math and biology and learn to talk to these



James Miller, professor of entomology (left) and Jeffrey Schenker, associate professor of mathematics, pose with their recently published book, *Trapping of Small Organisms Moving Randomly* (Springer, 2015). Chris Adams, a Ph.D. entomology student in Miller’s lab, also shared in the book’s authorship.

“I think we’ve . . . opened up a new field of research.”

biologists and understand the problems from the standpoint of experimental science, as opposed to mathematics.”

The end goal of the project is to optimize the use of pesticides.

“We’re not opposed to the use of pesticides; we’re interested in providing a sound, scientific basis for the decision making,” Schenker said. “At the moment, the decision relies upon expert opinion, based upon years of experience; there is nothing quantitative, nothing in the literature

to back it up. So while our research could lead to reduced pesticide use, the most important thing is to provide a sound basis for decision makers.”

The project recently received a three-year, \$300,000 NSF grant.

“There’s been this coming together of ideas, and I feel we’re making good progress,” Schenker said. “I think we’ve also opened up a new field of research. If we’re successful with this—and I think we will be—then it’s going to be natural to take these ideas and apply them to other things.”

Research results: Much deeper than the tip of the iceberg

An MSU mathematics professor and his team were recently identified as the first ever to develop a computational method to solve a 100-year-old problem related to gravity inversion.

Until now, no one had been able to come up with a computational approach that actually produced results on the benchmark problems of interest to the intelligence community. Using a level-set method, Jianliang Qian, professor of mathematics, along with his research team, came up with a computational method to solve a century-old benchmark problem of gravity inversion—one related to tunnels under the U.S. border. It took Qian's team about seven years to accomplish this.

"It was Dr. Qian's ability to identify the proper mathematical framework for the gravity problem that enabled him to make such dramatic progress on this difficult and important problem," noted Keith Promislow, professor and chair of MSU's Department of Mathematics.

"By making some mathematical assumptions, we can come up with a unique solution," Qian said. "That's the beauty of mathematics. When we understand the problem in terms of uniqueness, existence and stability, we can develop good numerical methods to solve the problem."

Qian, who is also director of MSU's Michigan Center for Industrial and Applied Mathematics (MCIAM), focuses on using inverse gravimetry—in this case, measuring the gravity in the soil to figure out what lies underneath—to develop computational methods that have applications in the areas of homeland security, global warming, and oil discovery and recovery.

Oil companies have a growing interest in the exploration of salt-related structures, because salt serves as an effective agent for trapping oil and gas in nature. Thus, salt basins worldwide have become lucrative places to look for prospective hydrocarbon reserves.

Qian's team has proposed a level-set



Mathematics Ph.D. students Qinfeng Gao (right) and Chao Song (left) discuss gravity inversion results with Jianliang Qian, professor of mathematics and director of MSU's Michigan Center for Industrial and Applied Mathematics.

algorithm for finding large salt regions.

"Salt is relatively incompressible and retains a low density, even after burial. Surrounding sediments are compact and have densities that increase with respect to depth. So this gravity inversion method is utilized to determine the shape and location of a salt body from the known background density contrast," Qian said. "The goal is to find the salt regions; the oil is underneath that."

The alternative to these methods would be to drill exploratory wells—which would entail enormous amounts of time and money.

"We could also use such a method to monitor global warming," he said.

For example, Qian is studying icebergs—specifically, the approximately 90 percent of the iceberg that is below the water's surface.

"We don't know what's happening at the bottom of the iceberg, but by flying an airplane over it or using satellite, we can collect the gravity data and try to figure out the shape of the bottom of the

iceberg, monitoring how it's changing," Qian said.

Qian's work is supported by a four-year, \$387,000 NSF grant that runs through next year. 📌

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Professor honored for helping student develop math intuition

Calculus III can be daunting even for math majors. In this course, sketches are essential to describing the shape of a surface given the equations that define it. For Jordyn Castor, understanding the course work had another hurdle. She is blind. However, she took the course from Assistant Professor Ben Schmidt, who worked with her to help her understand the mathematical problems even without being able to see them.

“Jordyn and I worked hard to figure out how to describe the shape of a surface given the equations that define it,” Schmidt said. “It was challenging at times, but we had a lot of fun. The real prize was what I learned as a teacher.”

For his efforts, Castor nominated Schmidt for the 2015 Spirit of Ability Award given by the



Ben Schmidt, MSU assistant professor of mathematics, with MSU senior Jordyn Castor, who nominated Schmidt for the award.

MSU Resource Center for Persons with Disabilities (RCPD). Schmidt received the

award in April during RCPD’s annual awards and appreciation reception. The Spirit of Ability Award commemorates the empowering heritage of several individuals from the MSU community who were dedicated to helping those with disabilities fulfill their dreams.

Keith Promislow, professor and chair of the Department of Mathematics, called Schmidt one of the most gifted instructors that he knows.

“Ben has a unique intuition for what students know, the context in which they know it and what they need to understand in order to take the next step in the journey,” Promislow said. “MSU is blessed to have faculty like Ben.” 🌱