Dean’s message

Some exciting new initiatives are redefining undergraduate education in the Hajim School of Engineering and Applied Sciences. For instance, having completed a year of curriculum review and planning, we are introducing some changes to the freshman experience. Building upon a number of great course offerings, we are expanding opportunities for students to gain hands-on experience in the first semester of the freshman year, exploring the creative aspects of engineering with an eye toward providing a reason and motivation for pursuing a degree in engineering. We’re offering a wide variety of such courses. Students can select from topics such as Introduction to Biomedical Engineering, Green Engineering for a Sustainable Environment, Introduction to Digital Music, the Engineering of Bridges, Introduction of Optics, and Loudspeaker Design, depending upon what interests them. While these courses offer flavors of different disciplines, students are not constrained by any disciplinary requirements in their choice, offering some flexibility in their introduction to the field of engineering.

Also, working closely with the computer science department, a recent addition to the Hajim School, our faculty has been focusing on developing a freshman course that will provide an introduction to computational tools applied to engineering problems as well as exposure to data acquisition. Students will be taught how to use their computer as an interface to the physical world—acquiring data, bringing it into the computer, studying it, manipulating it, and then developing analog signals for communicating with the physical world. The objective is to demonstrate that beyond serving as an interface to commercially available software and a portal to the Internet, computers are tools that allow us to interact with the physical world, through measurement and control, to effect change. This introduction to the use of computational tools and data acquisition will enable our students early in their program of study by providing them with skill sets that can be used throughout their career.

We have further begun the initial design phase of a new Center for Engineering Education and Design. This will be a space...
dedicated to instruction in the use of tools required to unleash the creative aspects of engineering, and it will have sufficient flexibility for cross-disciplinary educational purposes. To afford our students the space and tools required to practice their art, we have also initiated design of the URInnovative Lab, equipped with all of the modern fabrication tools required for rapid prototyping and design. If we expect our students to be part of our nation’s innovation engine, we must provide them with a place and the tools to innovate.

Here in the Hajim School, we aim to enable our students to accept President Obama’s challenge to become “makers of things” as opposed to “consumers of things.” With every challenge faced comes opportunity. Engineers seek challenges and exploit them to create opportunities. As you peruse this newsletter, join me in celebrating the field of engineering and the young minds that accept the challenge of becoming engineers.

Sincerely,

Rob Clark
Professor and Dean
Edmund A. Hajim School of Engineering and Applied Sciences
In the past few years, the country’s oldest and most prestigious university optics program has built a new state-of-the-art optical design center, refurbished its undergraduate labs, and hired two new professors, in order to stay on the cutting edge of research and education in the field.

The Robert E. Hopkins Center for Optical Design and Engineering, located on the fourth floor of the Robert B. Goergen Hall for Biomedical Engineering and Optics, is a series of three adjacent labs totaling 1,200 square feet and filled with professional-grade optical instruments. Funded initially by a grant from the KLA-Tencor Foundation and subsequently by a $2 million gift from University trustee and former Tropel Corp. chief executive John Bruning, the center was dedicated last spring. Professor Thomas Brown directs the center.

The lab is already starting to build an impressive collection of tools, mostly donated by companies in the optics industry: a ZYGO interferometer, an Audio Dev thin film reflectometer, an Optikos Q/C (quality control) Bench, and several other instruments. The idea of the center is to provide students an opportunity to get acquainted with industrial-quality machinery that they will likely come across if they decide to pursue a career in the optics industry.

In addition to the creation of the Hopkins Center, the undergraduate laboratories on the fifth floor of the Wilmot Building were completely refurbished. Both projects focus on giving students a hands-on education to supplement their in-class training. Wayne Knox, the institute’s director, earned both his bachelor’s degree and doctorate at the University of Rochester and says that he is committed to educating engineers who “aren’t just very smart, but also are able to build complex things.”

“For me, the undergraduate research portion was really important to my education here. The process of learning something in class and then demonstrating it in the lab reinforce each other,” Knox said.

Two faculty members were hired in 2009. Jannick Rolland, the institute’s first Brian J. Thompson Professor of Optical Engineering, was installed in April; and Julie Bentley, who has taught here as an adjunct professor for more than 10 years, joined the faculty full time in September.

Rolland comes from the College of Optics and Photonics at the University of Central Florida. She specializes in optical instrumentation and systems engineering and is associate director of the Hopkins Center. Bentley is an expert in designing and manufacturing precision optical assemblies such as micro lithographic inspection systems, which she did while working for Corning Tropel Corp. for 12 years.

As the Institute of Optics expands, it will also add a new educational track this fall. A bachelor’s degree in optical engineering will complement the already available bachelor’s degree in optics. The optical engineering track will focus on practical applications of optical technology and fabrication of optical equipment, while the standard optics track will stress the theory and physics underlying those applications. The new engineering path will be geared toward those students who intend to go into industry.
At age 22, University of Rochester senior Brian MacMillin is already the president and owner of a profitable company, Outdoor Equipment Supplier LLC, but he hasn’t let the title go to his head. The affable entrepreneur also works on the assembly line as the company’s entire labor force.

MacMillin designs and manufactures ultra-lightweight, durable camping tarps for backpackers who don’t want to carry a full tent with them but need protection from rain, wind, and snow. In 2003, MacMillin built his first few rudimentary tarps—they were admittedly heavy and had some design flaws—and he sold them mostly to enthusiastic acquaintances, making about $1,000. Just six years later, in 2009, he sold roughly 425 tarps for a total of $40,000 ($26,500 of which was profit).

The design has evolved and improved along with the profits. Now, MacMillin sews his trademark MacCat series of tarps from sheets of high-tech synthetic fabrics like silicon-impregnated nylon—known for being extremely lightweight and waterproof—and cuts them into shapes that make use of structural engineering principles like catenary curves that allow them to remain taut when strung between two trees.

Depending on the size and fabric, the tarps run in price from $65 to $195.

MacMillin got the idea to build custom tarps from online hiking and camping forums that allowed him to frequently interact with other hikers and campers around the country. A lifelong outdoor recreation enthusiast and Eagle Scout, he realized there was a certain niche market of people who would be more than happy to spend a little money to cut down on the weight that they had to carry on their backs.

The market was ideally suited for him to tap because of its low barrier to entry: All the 15-year-old needed in order to start the process was some cheap fabric from local stores, his mother’s sewing machine, and a work space that he set up in the family’s garage in Campbell Hall, N.Y. His parents not only supported but also encouraged the endeavor with the mantra “what’s the worst that could happen?”

After he moved out to go to college and study mechanical engineering, he bought his own sewing machine and continued his company’s upward momentum. One might run into him sewing tarps, often into the late night hours, in the basement of the Hopeman Engineering Building or one of the dining halls on campus.

With his father’s help, he filed the paperwork to start an official limited liability corporation in 2007 and hired a Web designer in Virginia, whom he paid with two of his tarps to design a professional Web site for the company to take the place of his old homemade version. The Web site, located at www.outdoorequipmentsupplier.com, looks like that of a much larger corporation, featuring a straightforward interface where customers can simply click on items to purchase and pay with easy online tools like PayPal. Shipping his lightweight, easily compressible products in flat rate boxes from the U.S. Postal Service, he now has clients in more than a dozen countries, including Germany, Brazil, Taiwan, and Madagascar.

MacMillin has even woven his business interests into his mechanical engineering education at the Hajim School. For the research project in his solids and materials lab, he studied the degradation characteristics of the fabrics he uses when exposed to ultraviolet radiation. He hopes to study the fabrics’ water resistance properties as he continues his education with a master’s degree.
Lukas Novotny, professor of optics, has been elected a fellow of the American Association for the Advancement of Science (AAAS). Using the discoveries from his pioneering work on light-matter interactions, Novotny has taken the highest-resolution pictures on record, imaging individual carbon nanotubes and proteins in a cell membrane.

Paul Ampadu, assistant professor of electrical and computer engineering, has won the Black Engineer of the Year Special Recognition Award. Along with his research in reliable energy-efficient integrated nanoscale circuits, systems, and architectures, he has worked on several effective initiatives to help encourage low-income, first-generation, and underrepresented minority students to pursue careers in engineering and science.

Ben Ebenhack, a chemical engineering lecturer, was named a Distinguished Lecturer by the Society of Petroleum Engineers. In late fall, he went on an international speaking tour that took him to Europe, Asia, and the Middle East to talk to oil industry executives about the future of oil supply and demand. One of his interests is studying and designing methods of bringing energy to poor and developing countries, where a small amount can go a long way.

Diane Dalecki, an associate professor of biomedical engineering, was elected a fellow of the Acoustical Society of America. Dalecki is part of the Rochester Center for Biomedical Ultrasound (RCBU). With a dual appointment in biomedical engineering and electrical and computer engineering, she studies novel ways to use ultrasound in diagnosing and treating medical conditions.

Rick Waugh, chair of the biomedical engineering department, was elected president of the Biomedical Engineering Society (BES). The society is a highly respected international organization that serves as the lead society and professional home for biomedical engineering and bioengineering students, academics, and professionals. Waugh is serving a two-year term as the head of BES.

David Wu, a professor of chemical engineering was elected to the College of Fellows of the American Institute for Medical and Biological Engineering. Wu has been working on deriving usable energy out of biomass, like corn, wood, and grass by determining methods for more efficiently converting these products into ethanol and other fuels. His research focuses on the enzymes and genes contributing to biomass breakdown.

Michael Scott, a professor of computer science, has been elected a fellow of the Institute of Electrical and Electronics Engineers (IEEE), an international professional organization. He studies concurrency and synchronization, programming mechanisms that allow multiple possessors to coordinate in working toward a common goal.
New Introductory Courses Offer Hands-on Engineering Experience

A new series of courses designed for freshmen aims to show first-year students the fun side of engineering, from designing loudspeakers, to building bridges, to making more-energy-efficient devices. The courses aren’t mathematically rigorous, so they’re accessible to engineering majors and nonmajors alike.

Becoming a professional engineer these days often requires a certain level of sophistication with math, physics, and computer programming, but at its core, engineering is about designing and tinkering with things to get them to do what you want them to do.

Starting this fall, the EAS 10X (one-oh-x) sequence, known as the Introduction to Engineering and Applied Sciences, will feature six courses created to familiarize freshmen with some of the exciting challenges that engineers face.

“We’ve found that students come from high school with knowledge about math and science, but very few understand what engineering entails,” says Thomas Hsiang, associate dean of undergraduate studies at the Hajim School. “These courses will teach students what engineering is and expose them to the different disciplines within the field.”

Hsiang explains that the best way to spark interest and engage students is to put forth the strongest, most attractive aspects of the program. That means showing students the interdisciplinary nature of engineering while introducing them to the basic crux of the field: problem solving.
In each course, students will be presented with an engineering problem and learn how the professionals would analyze the situation and construct something to solve it. For example, in EAS 101: Introduction to Biomedical Engineering, students will receive an overview of the multidisciplinary field of biomedical engineering. Learning about topics such as the mechanics of a cell, organ systems, and medical instrumentation and imaging, freshmen will see the crucial role engineers play in the development of medical machinery.

In EAS 104: Engineering in Bridges, students will explore what causes a bridge to collapse. They will study bridge building from antiquity to modern day, researching a series of historical bridges selected for their major structural relevance, including the Roman Alcantara Bridge, Palladio’s wooden truss bridges, and the Roeblings’ Brooklyn Bridge, among others. Working in teams, students will use constructive experimental models as well as computer-aided programs to design, build, instrument, and test realistic bridge projects. In addition, students will learn about Rochester history as they explore bridges along the Erie Canal and Genesee River.

Freshmen enrolled in EAS 102: Green Engineering for a Sustainable Environment will have an early glimpse into research on sustainability with a strong engineering twist. Students will learn about the development of eco-friendly technology as well as renewable clean energy technologies. They also will discuss the global policy debates on issues such as global warming and the greenhouse effect.

From digital music to DVD data storage, two courses will expose students to the practical applications of engineering. In EAS 103: Introduction to Digital Music, students get a taste of computer programming while learning how software can create sounds like those produced by a pipe or a string instrument.

Students looking to learn about DVD data storage or quantum encryption might find EAS 105: Introduction to Optics an intriguing choice. While covering the fundamentals of optics, this course also explores how optics interweaves with other disciplines like electrical and mechanical engineering. In addition, freshmen will hear about career paths and professions in the field of optics.

In EAS 107: Loudspeaker Design, students will learn how to design an acoustic loudspeaker and by the end of the semester will be able to build a speaker that can be tested. Rob Clark, dean of the Hajim School and the course’s instructor, explains that these classes not only introduce students to the basic design principles of engineering, but also convey a way of thinking that extends well beyond the field. Because many of the courses introduce concepts with a nonmathematical approach, non-engineering students also are welcome to enroll in the classes. For these students, the courses can serve as a “technology literacy” experience.

“We’ve created these courses so freshmen will have a rich, informed idea of what engineers do,” adds Hsiang. “And by the end of the semester, we hope they’ll be hooked and we’ll be able to keep good engineers in the program.”

Intro to EAS Courses at a Glance

EAS 101: Introduction to Biomedical Engineering
EAS 102: Green Engineering for a Sustainable Environment
EAS 103: Introduction to Digital Music
EAS 104: The Engineering of Bridges
EAS 105: Introduction to Optics
EAS 107: Loudspeaker Design
Local students tested their engineering prowess by slinging pumpkins with catapults and trebuchets of their own design on the day before Halloween in what has come to be one of the campus's most entertaining and anticipated rituals.

The eighth annual Pumpkin Launch, hosted by the University of Rochester chapter of the American Society of Mechanical Engineers (ASME), took place on the University’s Wilson Quad last October.

For the event, teams made up of students from area colleges, high schools, and middle schools designed and constructed launching devices with the goal of hurling a pumpkin as far as possible (within reason) without sacrificing accuracy.

The home team, University of Rochester’s Baja Blasters, took first place, with Rochester Institute of Technology’s ASME team coming in a close second. Both top finishers brought powerful air cannons, capable of shooting their gourds all the way to the end of the Quad and beyond.

Because hollowed-out pumpkins tend to explode when flung hundreds of feet in the air, there can be some discrepancies about where exactly a given pumpkin came to rest. For this reason, each team stuck a bag of Skittles in each projectile it launched, and the landing spot of the Skittles was the point from which all distances were measured.

The teams were allowed four launches in which to prove their machines’ ranges and accuracies. Targets were set up at 75, 125, and 250 feet from the launch site, and each team’s score was calculated by taking the distance of the farthest shot (up to 400 feet), and subtracting two times the distance from one of the targets of the most accurate shot.

Small cash prizes were given to the winners—$50, $25, and $10, for the top three finishers, respectively.

Link to video of the event: www.youtube.com/watch?v=KV7pgCZZeKY

Smashing Pumpkins for an Educational Purpose
In August, a team of University of Rochester biomedical engineering students noticed some recurring problems as they walked through several hospitals in Peru.

The lighting was dim and made it difficult to examine a patient or perform an operation. Patients restricted to bed rest developed painful sores because of rigid, poorly contoured beds. There weren’t adequate tests to detect nerve damage in patients’ extremities caused by diabetes.

These were just three of the things that stuck out in the students’ minds as challenges that would be perfect for their senior design project. When they got back to Rochester, they got to work.

Founded 10 years ago and coordinated by professors Amy Lerner and Scott Seidman, Biomedical Engineering Senior Design is a yearlong class that’s required of all biomedical engineering majors. It serves as both a test of the skills and knowledge that students have accumulated over the term of their education as well as an introduction to work environments and client interactions they likely will have in industry.

“Having had this experience, students will be less hesitant to go out into the world and take on these types of projects,” Seidman said.

The course is divided into two parts. Students spend the first semester examining existing medical devices and analyzing their designs. During that time, they also cull through a list of possible projects to work on in the second semester.

Starting in November, teams of four set to work on their individual challenges. Some of this year’s projects are a portable, cost-effective E. coli detector, a dynamic brace to extend chronically contracted arm and wrist muscles in patients with traumatic brain injuries, and a rapid radiation detection system for the populations of major urban areas.

The three Peruvian hospital projects, funded by a $25,000 grant from the National Collegiate Inventors and Innovators Alliance, are being addressed by three teams of Rochester students working with a group of students from Pontificia Universidad Católica del Perú in Lima. Two Peruvian students, David Gavilan and Hazel Díaz, along with their advisor Ben Castañeda (who earned his PhD from the University of Rochester in 2009) visited Rochester in January to tour American hospitals and work with their American colleagues.

Here in the United States, “our students were exposed to many pieces of equipment that we don’t have in Peru. It’s easier to design new equipment when you can see an example, rather than having to start from scratch,” Castañeda said.

Most of the time, the students are thousands of miles apart, collaborating through e-mail and teleconferences.

In March, a group of Hajim School students will head back to Peru to present their design proposals to the hospitals.

During their first visit to the country in August, the Rochester students said they were surprised at how much creativity Peruvian medical professionals use in treating patients as opposed to the American system, in which “protocol dictates everything.”

Lacking access to state-of-the-art equipment used at most U.S. hospitals forces doctors in many parts of Latin America and other less developed areas to be resourceful every day in order to make a difference in patients’ lives.

After 10 years of continued growth and success, the Biomedical Engineering Senior Design course, itself, has become a key feature of the student experience in the Hajim School. Many students look forward to the chance to work on a real-world project from the moment they decide to join the department, Lerner said. The projects not only teach students the business end of engineering—like how to cope with deadlines, interact with clients, and create a workable product from scratch—but also, several of the products that are created each year develop into invention disclosures through the Office of Technology Transfer.

“Design is ‘where the rubber meets the road’ in common vernacular,” said Dean Robert Clark. “Students must identify a customer and work to meet the customer’s objectives for the design while juggling constraints associated with ease of assembly and cost. The approach taken in the BME Senior Design course provides undergraduates with an experience rich in such challenges.”
In November, the University of Rochester became the first school in six years to beat MIT in the regional finals of the oldest, largest, and most prestigious computer programming competition in the world, popularly dubbed the “Battle of the Brains.”

Following the victory, University President Joel Seligman called the whole team into his office to congratulate the three team members—Ian Christopher, Dennis Huo, and Xiaoqing Tang, and their advisor Daniel Stefankovic for winning the Northeastern North America region in the Association of Computing Machinery’s International Collegiate Programming Contest.

In order to win the competition, the University of Rochester’s team outscored all of their closest competitors—MIT, Harvard, Brown, and McGill—in the five-hour battle, which took place over the weekend at Rochester Institute of Technology.

After winning the region, the three flew to Harbin, China—a city in the northeastern part of the country with such extreme winter weather that it makes Rochester look like a tropical paradise—for the international finals. It was the first time a team from the University made it to the big event. The team took home an honorable mention, finishing roughly in the middle of the pack among the other 20 elite U.S. teams that qualified.

They solved three of the 11 questions correctly. The first place team from Shanghai Jiaotong University answered seven, and the top U.S. finisher, Stanford, answered five.

Although the team members said that they could have done better in the finals if they hadn’t gotten bogged down with a few small bugs in their codes, their performance in the regional was an accomplishment in and of itself.

“It’s rare that someone other than MIT comes out on top in our region, so it’s really a feather in Rochester’s cap that they beat them,” said Paul Tymann, the regional contest director. “It was remarkable how quickly they could solve the problems, and really, in the end, that’s what allowed them to win.”

In the finals, the University of Rochester was one of 103 teams that qualified out of a pool of 7,109 teams from 1,838 universities in 88 countries.

The regional contest comprised eight tasks in which the teams were asked to write computer code that would solve particular problems. For instance, teams were asked to write a code that could take two words of the same length from the dictionary and transform one of the words into the other by choosing the shortest possible set of intermediary words in which each word differs from the previous word by only one letter (e.g., blood, brood, brook, etc.).

Many of the puzzles, like the one above, seem simple on the surface but require significant facility with higher mathematics and creativity in designing code.

The team that succeeded in accomplishing the greatest number of tasks in the smallest amount of time won.

The University of Rochester and MIT were the only two schools that solved all eight problems correctly in the regional final (third- and fourth-place teams Harvard and McGill, respectively, each answered seven correctly, and fifth-place Brown answered five). Rochester beat MIT on speed, though, finishing with a combined time of 16 hours and 10 minutes—almost three hours shorter than MIT’s 18 hours and 51 minutes.

“They practiced a substantial amount, and I think that showed,” Stefankovic said of his team.

*The time for each problem is calculated from the beginning of the competition. For example, if a team gets the first problem at the one-hour mark, the second at the two-hour mark, and the third at the three-hour mark, its combined time for those three problems is six hours, even though it only took three hours to solve the set.
The preceding pages tell the compelling and wonderful story of the Edmund A. Hajim School of Engineering and Applied Sciences. Through these efforts and others, we are developing the Hajim Community, a network of alumni and friends who are dedicated to building upon the strengths of the Hajim School so that future generations will be able to reap the many benefits of a world-class engineering and applied science education.

Whether working in a research lab, starting a new company, navigating intellectual property law, or analyzing market strengths and weaknesses on Wall Street, the fundamental ability to think as an engineer is a critical asset. Being an active member of the Hajim Community further demonstrates your commitment to help solve not only the problems we face today but also those yet-unknown problems that our society will inevitably face in the future.

Your gift to the Hajim School Annual Fund will
- Provide much-needed financial aid for undergraduate and graduate students
- Provide much-needed resources for infrastructure and laboratory upgrades that afford our students opportunities to gain “hands-on” experience
- Enable our undergraduates, like the recent computer science students, to apply their knowledge in problem solving and design competitions nationally and internationally
- Support our undergraduate students as they explore research opportunities in laboratories with faculty and graduate students through our research scholars program
- Provide seed funding to support the development of new initiatives in response to the many issues we face today, such as a newly developed M.S. degree program in alternative energy or the undergraduate program in archeology, engineering, and architecture

Please join with other Hajim School alumni and friends who have made their gifts and are actively engaged with the Hajim Community. Your support is extremely important to our students, our faculty, and staff. Kindly take a moment to enclose your gift in the envelope provided and to include your current home and business contact information.

Should you wish to discuss specific giving opportunities or talk about including the Hajim School in your will or other planned giving opportunities, please contact Eric Brandt, senior director of advancement for the Hajim School (ebrandt@alumni.rochester.edu or 585-273-5901).

**Internship and Recruitment**

Might your company/firm be in a position to offer internships for Hajim School students? Perhaps your organization would be interested in speaking with Hajim students regarding career opportunities. Please let us know by contacting Eric Brandt (ebrandt@alumni.rochester.edu).
HAJIM SCHOOL BY THE NUMBERS

FAST FACTS

- Percentage of bachelor’s degrees awarded to women by school: Ranked 7th @ 34.7%
- Percentage of doctoral degrees awarded to women by school: Ranked 2nd @ 38.7%
- Research expenditures by school: Ranked 27th @ $79.9 million
- Computer science research expenditures located outside of engineering by school: Ranked 13th @ $2.6 million
- Home to the Institute of Optics: founded as the first optics education program in the United States in 1929 through a grant from Kodak and Bausch & Lomb
- Highest faculty to student ratio by school: Ranked 11th

AWARD COUNTS

- 11 NSF CAREER Awards
- 1 PECASE Award (from Department of Defense)
- 4 National Academy memberships
- 91 Fellows
- 59 Fellowships accepted
- 5 Presidential Young Investigator Awards
- 2 Alexander von Humboldt fellows
- 3 Fulbright Fellowships
- 5 IBM Fellowships
- 1 Willis E. Lamb Award for Laser Science and Quantum Optics
- 1 ONR (Office of Naval Research) Young Investigator Award

Research Expenditures per Year

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Research Expenditures per Faculty Member per Year

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