

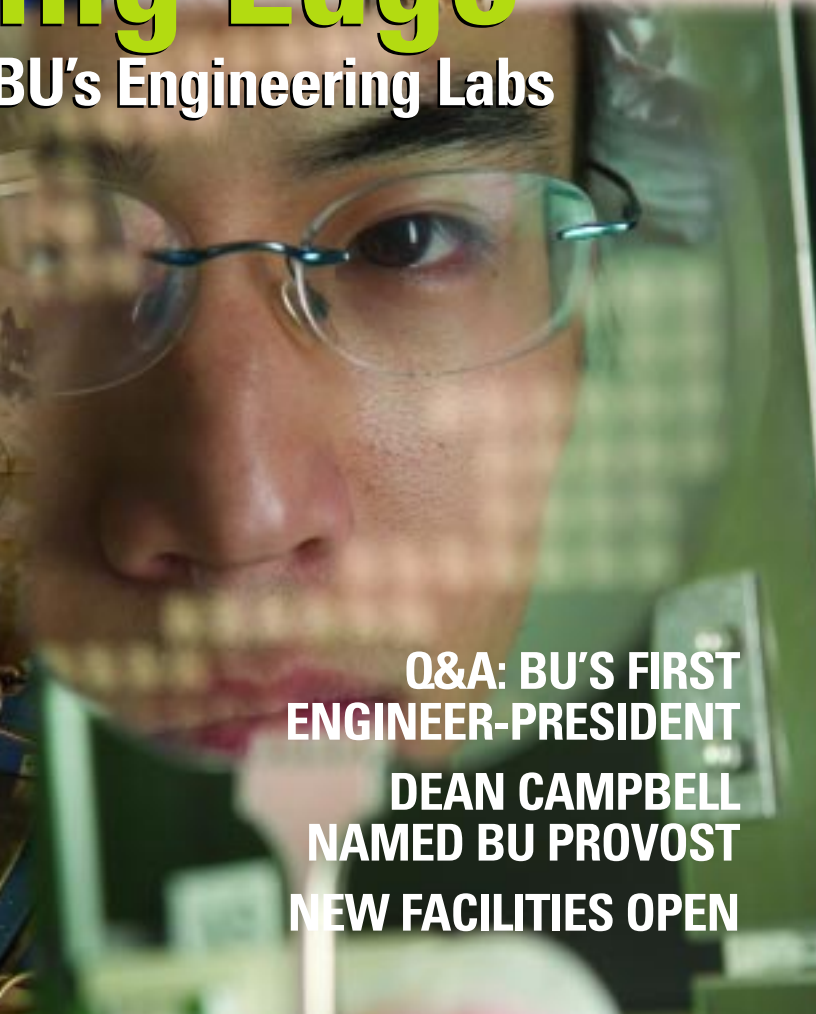
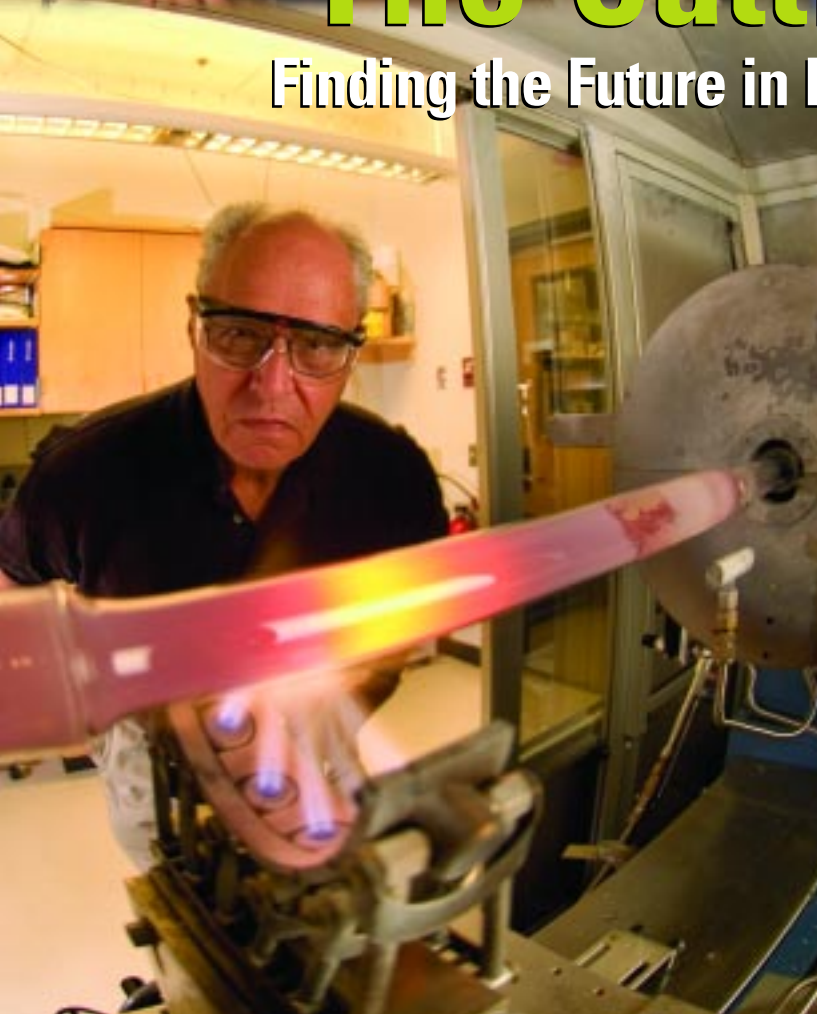
BU College of Engineering

F a l l 2 0 0 5 M A G A Z I N E



The Cutting Edge

Finding the Future in BU's Engineering Labs



Q&A: BU'S FIRST
ENGINEER-PRESIDENT
DEAN CAMPBELL
NAMED BU PROVOST
NEW FACILITIES OPEN

College of Engineering Upcoming Events



BU vs. Maine Hockey Game and Cocktail Reception

January 13, 2006

7 p.m.

Agganis Arena, Boston, MA

Join BU alumni and friends for cocktails and hors d'oeuvres at one of the best views on campus, 10 Buick Street, 18th Floor, followed by the BU vs. Maine hockey game. Tickets are \$15 per person.

College of Engineering Spring 2006 Career Fair

February 3, 2006

11 a.m.-4 p.m.

George Sherman Union at Boston University

Free event

Attention students and alumni — come network with local and national companies for full-time job placement or co-op and summer internship opportunities.

Free Ski Night at Nashoba Valley

March 2006 (exact date to be announced)

Nashoba Valley Ski Area, Westford, MA

Take advantage of the cold by skiing Nashoba Valley with your former classmates. If skiing isn't your sport, try tubing! For more details, send your e-mail address to engalum@bu.edu.

BBQ at the Dean's House

May 12, 2006 REUNION WEEKEND

5-7 p.m.

ENG Continental Breakfast and Tours

May 13, 2006 REUNION WEEKEND

10 a.m.

ENG Commencement Awards Ceremony

May 13, 2006 REUNION WEEKEND

3 p.m.

ENG Dean's Alumni Reception and Awards Dinner

May 13, 2006 REUNION WEEKEND

5-7 p.m.

Want to stay posted? Send us your e-mail address.

The ENG Alumni Office sends out invitations to upcoming events like Red Sox games, wine tastings and other happenings exclusively by e-mail. These events are open to all alumni — but you'll only find out about them by e-mail.

Be sure you don't miss out. Send your e-mail address to engalum@bu.edu.



page 8



page 12



page 16



page 20

Features

Innovation is happening every day in labs throughout the College of Engineering, where scores of faculty members are leading research projects. In this issue, we look at four labs, one in each of the College's academic departments, that are generating promising research with the potential to have substantial impacts on our lives.

AME Aerospace and Mechanical Engineering page **8**
Professor Ron Roy is working to harness the amazing power of little bubbles in applications ranging from medical to military.

BME Biomedical Engineering page **12**
Associate Professor John White is trying to unravel nature's most complex wiring system — the human brain.

ECE Electrical and Computer Engineering page **16**
Professor Ted Morse left Brown University for BU to develop new methods for producing optical fibers.

MFG Manufacturing Engineering page **20**
Assistant Professor Xin Zhang builds microscopic devices that have the potential to change the way we live.

Departments

Reaching Out to the Future page **2**
Record Fundraising page **24**
Alumni Events page **27**
Class Notes page **32**

News

Study Hall page **3**
Q&A With President Brown page **5**
New Dean page **7**
Life Science & Engineering Building page **25**
New Faculty page **26**
Young Engineers page **31**

BU College of Engineering
BOSTON UNIVERSITY

Magazine

Fall 2005

Editor: Michael Seele

Contributing Writer: Ryan Olson

Design and Production: Crocker & Company

Photography: Boston University Photo Services,
except page 7, 15, 22-23 (b&w), 26-29, 31.

The *BU College of Engineering Magazine* is produced for the alumni and friends of the Boston University College of Engineering. Please direct any questions or comments to: Michael Seele, Boston University College of Engineering, 44 Cummington Street, Boston, MA 02215. Phone: 617-353-2800, fax: 617-353-5929, e-mail: engalum@bu.edu, website: www.bu.edu/eng.

Boston University's policies provide for equal opportunity and affirmative action in employment and admission to all programs of the University.

Reaching Out to the Future

By David K. Campbell, Dean



Engineering has come a long way in the past generation. As working professionals and as educators, engineers have produced “quantum-leap” technological advances in many fields that have given rise to entirely new sectors of our economy. In the areas of semiconductors and photonics, the leap has quite literally been quantum mechanical, but advances in materials and in computation have been equally important to this progress. But while we

engineers have been busy solving problems, we, together with the rest of our society, have lagged in an area crucial to engineering’s (and our nation’s) future: getting youngsters excited about our field.

The senior leaders of our profession today came of age when recruitment of talented young engineers was not a big issue. The space race and other challenges of the 1960s and ’70s drew talented American minds to engineering. But somewhere along the way, while we were focused on other things, science and engineering acquired an image among young people, and it was not the image we wanted. The natural sciences became the “hard” sciences, and it became “uncool” for bright middle- and high-school students to imagine careers in science and engineering. Untold numbers of potential engineers looked for their futures in other professions, and we are feeling the impact today.

Although total enrollment, graduate and undergraduate, in engineering colleges — the harbinger of our profession’s future — has been stable, the number of undergraduate engineers has been declining and the overall number of American students has been on a downward trend for years. The quality of American engineering programs is renowned world-wide and bright young people from around the world are flocking to our engineering schools. They are completing their degrees and, increasingly, taking their talents back home and spreading the technological advances America has enjoyed throughout the world. They are doing much to improve the human condition in areas of our planet where improvement is most needed, and we are proud of them and of our contributions to their success. For them growing up, it was very cool to imagine a career in science and engineering.

Where does that leave American engineering? We have seen increasing global competition, as have many other sectors of our economy. We have seen a number of engineering jobs sent overseas, not because the work can be performed better there, but because there is often a paucity of qualified American engineers available to do the work here. That trend is likely to continue, at least in the short term, because the pipeline is not swelling with American engineering students at the moment.

What can we do to reverse this? Well, for starters, we need to get young people exciting about engineering again. As engineers, we have a profound impact on the young people in our familial and social networks. A workforce survey conducted in Silicon Valley by the consultants A.T. Kearney found that 83 percent of students rely on personal

connections when making career-related decisions and that students who have parents in high-tech careers are more likely to be interested in similar careers themselves. We need to reach out to young people before inaccurate stereotypes take hold and discourage them from a rewarding professional career. We need to show them that engineering is no more difficult than any other profession and, importantly, that it is professionally and personally rewarding, that it is valuable to society and, very importantly, that it is fun.

At the College of Engineering, during the last few years, we’ve been involved in several efforts intended to disseminate this message. Each summer, we run a design program for sixth- through ninth-graders from urban and suburban schools throughout the Greater Boston area. They learn the basics of electronics and mechanical engineering, then apply that to building gadgets and robotic vehicles of their own design. And they love it. The camp fills two sessions every summer. We also host a Design Competition in the spring that attracts high school students from throughout the Northeast to compete in designing and programming robotic vehicles.

For the past several years we have also sponsored a team in the FIRST (For Inspiration and Recognition of Science and Technology) robotics competition. This event, the brainchild of inventor Dean Kamen, pairs high school students with undergraduates, faculty and industrial experts to build robots to undertake a particular task. The FIRST competitions themselves take on an aura of a major sporting event, with cheering crowds and the glory of victory, together with the agony of defeat. Importantly, many FIRST competition students have gone on to study engineering and the sciences based on their experience at the event. We were delighted to learn this summer that Boston University was selected to host the 2006 Northeast regional competition at the newly dedicated Agganis Arena. Any of you who can be in the Boston area March 23-25 really should make a point of visiting the competition—it will be tremendous.

The purpose of all our outreach efforts is not student recruitment at BU, although we’d be delighted to have many of these young people enroll with us in a few years. The goal is to give these young students a more accurate picture of engineering, to let them experience the rush of making something that really works, and to get them thinking about it as a possible career choice. The issue is not which engineering college they choose; it’s that they choose an engineering college.

Those of us who train young engineers have an obvious stake in this issue, but so do all engineers. The health and vitality of our profession, and indeed of our nation, depend upon a steady stream of young, talented and diverse engineers rising through the ranks. We can all do our part by encouraging bright young people we know to give engineering a good look.

In this issue of the *BU College of Engineering Magazine*, you’ll read about the exciting research four of our professors are engaged in, research that has the potential to pay huge dividends in the future. It’s the kind of thing that can get young people excited. I hope that you will pass on your enthusiasm for engineering to the young people in your life.

Editor’s Note—As this magazine was going to press, David K. Campbell was named University Provost and relinquished his deanship at the College of Engineering. For more on the change in leadership, see our story on page 7.

Study Hall

NEW W. BRADFORD INGALLS ENGINEERING RESOURCE CENTER MEETS STUDENTS' NEED FOR STUDY SPACE

by Michael Seele



Boston University President Robert A. Brown (center) and University Provost and Engineering Dean David K. Campbell (left) presented W. Bradford Ingalls '51 with a framed photograph of the new center at its dedication on Sept. 6.

Aiming to meet a critical need for student study space, the College of Engineering has opened a facility that provides students with a place to do their reading and much more through a combination of high technology, and peace and quiet. The W. Bradford Ingalls Engineering Resource Center, named for one of the college's first alumni (Class of '51), debuted as students returned to campus on Sept. 6.

Although the need for a student resource center has been known for some time, the space didn't become available until earlier this year when bioinformatics researchers left their 48 Cummington St. quarters for the new Life Science and Engineering Building a few doors down [see story on page 25]. ENG's vision for the center became reality thanks to a \$300,000 gift

from Ingalls, which was supplemented by a \$150,000 gift from Boston University Trustee Chairman Alan Leventhal. The project was put on the fast track and construction proceeded at a rapid pace throughout the summer months so the facility would be ready for the start of the fall semester.

Speaking at the center's dedication on the first day of classes, Boston University President Robert A. Brown, himself an engineer, noted that much has changed on the education landscape. "We need to think about engineering in a larger, more complex way than we did 25 years ago," he told an audience of faculty, staff, students and others involved in the center's construction. "When you think about the way information is gathered in that context—through wireless technology and computer technol-

ogy—the need for spaces like this is paramount in the way we deliver education today. BU is grateful to Brad Ingalls and Alan Leventhal for stepping up and making this center a reality."

"The W. Bradford Ingalls Engineering Resource Center addresses a pressing need for student study space in the College of Engineering," said Engineering Dean David Campbell. "This state-of-the-art facility will be, in many ways, an extension of our engineering library. It will give students a place to study individually, to work on class projects in small groups, to research on-line journals and periodicals, or to just relax and catch up on their reading between classes."

The Ingalls Engineering Resource Center features seven small conference rooms where groups of four to eight stu-



W. Bradford Ingalls was assisted by his wife, Joan, President Brown and Dean Campbell in cutting the ribbon at the new center (above). Afterward, students, faculty and staff gathered to explore the facility.

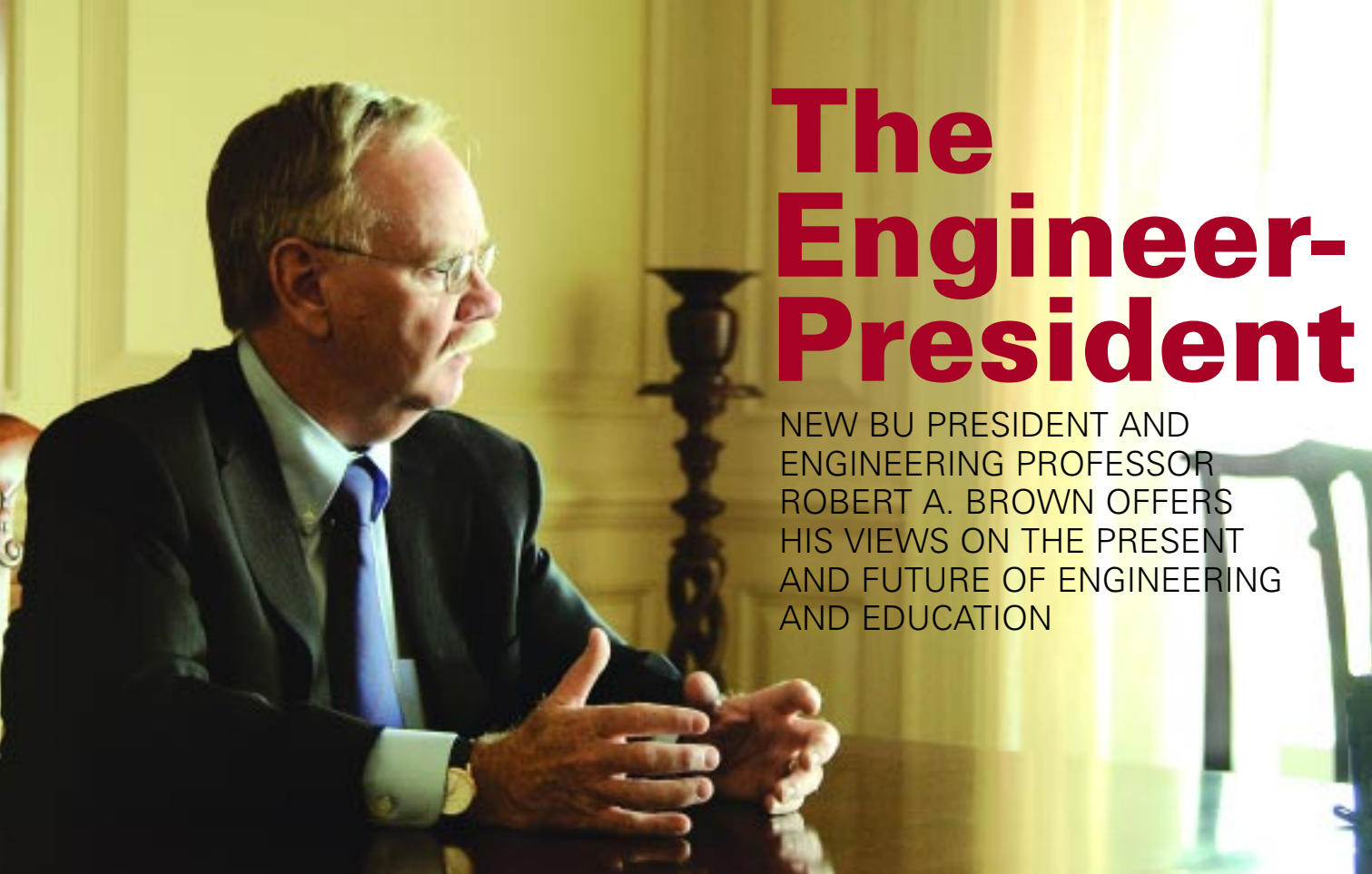


dents can gather to work on common projects. It also has a 16-person conference room with a video projector. In a spacious common area, students can use five computers to access library resources, or take advantage of wireless Internet access through their own laptop computers. Two large plasma television screens can be used for presentations, with audio available through laptop computers via Bluetooth technology so as not to disturb other students. Study carrels, lounge chairs and a staffed help desk round out the 3,750-square-foot area. The center's architects used large clear and colored glass panels to draw in natural light and lend a high-tech feel to the space.

Ingalls was finishing an associate's degree in engineering at the New England Aircraft School in 1951 when the school was acquired by Boston University, making him one of BU's first engineering alumni. He went on to earn bachelor's and master's degrees from BU during the 1950s, and taught project engineering in the nascent College of Engineering (then called the College of Industrial Technology). While taking evening classes for his bachelor's degree, Ingalls worked at a highly classified day job where he helped develop heat shields to protect space vehicles during re-entry. The heat-resistant tiles on today's space shuttles use a similar design.

Looking for a way to give something back to the College of Engineering, Ingalls asked Dean Campbell if the college had a project he could help with. It did. "It was a project that appealed to me because I think that helping the students is where it's at. I wanted to help current students, help attract new students, and help the college produce a better product," he said.

Dean Campbell says the center does just that. "The Ingalls Engineering Resource Center will be a magnet that will draw in our students today and will help us attract ever more talented engineers to Boston University well into the future."



The Engineer-President

NEW BU PRESIDENT AND ENGINEERING PROFESSOR ROBERT A. BROWN OFFERS HIS VIEWS ON THE PRESENT AND FUTURE OF ENGINEERING AND EDUCATION

Robert A. Brown is the first Boston University president to come from an engineering background.

Robert A. Brown became Boston University's first president to come from an engineering background when he assumed office on September 1, 2005. A distinguished chemical engineer with about 250 scholarly publications to his credit, Dr. Brown is a member of the National Academy of Sciences, the American Academy of Arts and Sciences, and the National Academy of Engineering. For 26 years, he spent his academic and administrative career at the Massachusetts Institute of Technology, beginning as an assistant professor and rising rapidly to the rank of full professor. Along the way, he cultivated an interest in administration, becoming a department chairman, then dean of engineering at MIT. In 1998, he was named provost of MIT, a position he held until the Boston University Board of Trustees named him as BU's 10th president.

In addition to his duties as the University's chief executive, Dr. Brown holds a faculty position in the College of Engineering as a professor-at-large. A few weeks after assuming the presidency, Dr. Brown sat down in his office with BU Engineering Magazine Editor Michael Seele to talk about his engineering background, his views on current and future issues in engineering and education, and areas that hold promise for the College of Engineering in the future.

BUE: You are the first member of your family to go to college and you settled on a career in engineering pretty quickly. Was there a key event or personal influence that steered you in that direction?

DR. BROWN: Actually, not, other than that my interest in chemistry was supported by people I knew in the profession, and by college professors I had early on who inspired me in chemistry. Chemical engineering just looked like a way of combining that

interest with the interest I had in math throughout my high school career. I actually would say I picked the profession without knowing what chemical engineers did.

BUE: What has Bob Brown the university administrator learned from Bob Brown the engineer?

DR. BROWN: Well, that one's pretty straightforward. Engineering as a profession is about relating a set of knowledge you have to everyday experiences, needs and technologies. It's about defining needs and technologies, and solving those problems, if you will, that you define. I think that Bob Brown the administrator spends a lot of his time defining the needs around different academic units, programs and intellectual needs, and then trying to bring the resources to bear to solve those "problems." I use the word problem, but you could substitute challenge.

BUE: The duties of a university president are many, and time for research and teaching will be short. Do you think you'll have time to contribute as a professor of engineering?

DR. BROWN: It's complicated. I very much enjoy doing research and teaching, but then I have to be cognizant of what people brought me here to do. Every minute I spend doing research and teaching is taking away from things I should do as the president of the University. My natural inclination would be to spend some time doing teaching and research, but I'm not sure that's the best use of my time for the University, so my presence in the College of Engineering will probably be pretty small.

BUE: What are the primary issues facing engineering education in the short term, and what do we need to do to address them?

DR. BROWN: Well, I think that engineering education today has to be parsed, depending on where a particular school of engineering sees itself in the development of young engineers. I'll divide the world into two different pots.

There are many large state universities and programs that produce the young bachelor's-level engineers. The majority of those engineers will become licensed engineers or engineers working in manufacturing and production facilities, and design facilities, and actually practicing engineering from the day they go to work. There's another set of schools that are usually tied to private research universities, in many cases strong liberal arts universities, where the schools of engineering produce graduates who use an engineering education as the background for professional life in many different disciplines, whether it be engineering, or finance, or real estate, or going into law or medicine, going on to a professional degree, or to management. The same explicit education is not right for these two different ends of the spectrum.

I think what BU has to decide is where it is on that spectrum as a school of engineering and how to tailor its education for its cohort of students and what those students do. My sense is that BU is close to the latter of those two — being a great private research university with strong liberal arts — and that engineering graduates at BU go on to a mix of engineering professional jobs and all these other things. Our engineering education has to be tailored to take into account this breadth in our students.

My sense about engineering education, if you think about it globally, is creating rank and file engineers who are not going to be leaders, but are actually going to be engineering workers in design and manufacturing, is going to be an incredibly competitive business with large countries overseas. India, China and other countries are going to be able to create large workforces of very highly trained — I use the word trained; maybe not educated, but trained — engineers who will be able to do things in design and manufacturing cheaper, faster, better than what we can do in the United States, and there's going to be keen competition along those lines. We have to continually move up the economic food chain, if you will, and create people who are leaders, can work in a global environment, can have very flexible careers to adapt and become the leaders internationally. That's got to be the focus of BU.

BUE: For many years, the proportion of American students in engineering programs has been on the decline at BU and throughout the country, and the proportion of foreign students, particularly from Asia and India, has been rising. Do you see this as an issue for higher education and the profession?

DR. BROWN: It is, but it's not clear how you reverse it. Engineering is a profession that supplies a social escalator. It's a profession, as it was for me, for students coming from backgrounds where there hasn't been a lot of higher education in their family. It's a degree that has at the end of it a professional career and a professional-level salary and economic benefit. So it's a social escalator. It's a natural profession for first generation college-edu-

cated people. It's not a profession that has today a lot of draw nationally for people coming from upper-middle-class and affluent families who are looking at other professions like law and medicine, and business and finance, as what they're interested in. These are generalizations; in detail they're wrong, but on average I think they're right. This is a natural progression within the discipline. To reverse it would be very difficult unless engineering becomes known as a profession from which, from the base of an undergraduate degree in engineering, you can do a whole variety of things; that it's not training, it's education, and I think that's what we have to strive for.

BUE: As someone who's been surveying the higher education landscape in engineering, where do you see areas of opportunity for places like BU?

DR. BROWN: I think there are two different ones. I think undergraduate education is the base of a great liberal arts university that is BU. Engineering education here should identify itself to be something really unique in integrating the principles of engineering and the professionalism of engineering on top of the liberal arts base. I'm interested in watching the College of Engineering and helping it evolve so it can fulfill that kind of vision and differentiate itself from many other places. We should be able to do that.

On the research side, the graduate side, I think we have to pick, because we're not a big school. We have to pick the fields very carefully that we want to be in and pick those fields where we have a competitive advantage or leverage. We have strong efforts going on in microelectronics and photonics. That's an example of us leveraging assets we have. We have a world-class biomedical engineering department. And that's, again, leveraging on the fact that we have a very highly rated medical school and medical research complex, so those are natural places. We have to pick the places that we put investments in, the areas in which we work research-wise, to leverage ourselves, because we are not one of the colleges of engineering with 350 or 400 faculty.

BUE: You've spent nearly your entire professional career at what is regarded by many as the world's premier engineering university. Given that BU's engineering college has a narrower focus, should it try to emulate MIT, or should it follow a different path?

DR. BROWN: Only in its excellence. MIT has one thing that everyone should emulate. MIT tries to be excellent in everything it does and if it can't be excellent in something it doesn't do it. That doesn't define the path; that defines the way you go down the path. BU should find its own path, but those principles should be the same.

BUE: Earlier this year, you gave a speech to a group of educators in Singapore, where you said that great research universities are like magnets that attract industry, as well as students and faculty. You cited five places worldwide where such magnets exist, one of them being across the river in Cambridge around MIT and Harvard. Do you see opportunities for BU to tap into that magnet in new ways?

Engineering Change

DR. BROWN: Actually, I was being politically correct in that I talked about the Charles River Basin as being the magnet. BU is in the Charles River Basin and so we're part of the magnet. Part of the whole magnet in the area is the large health science research complex, which is all the hospitals, including Boston Medical Center and the BU Medical Campus. Part of it is the Harvard-affiliated hospitals and all the companies and industry that have built up around that. I think of the magnet as being the entire complex. Obviously, locally, we live with a little bit of an inferiority complex. We think of Harvard and MIT as having larger national and international reputations. One of my goals is for us not to feel that way. I think that when we get far enough away from Cambridge and Boston, people see Boston University as part of that whole draw to the Boston community. It's certainly true in terms of people located in Boston. It's certainly true in terms of people being educated in Boston, because we offer much more diversity in an educational environment than either of the other two universities. We are part of that magnet. We have to leverage ourselves as well as we can to both strengthen the draw to the Charles River Basin, and to get our share of the glory.

BUE: You've said that BU needs to do two things moving forward: boost the endowment and communicate its accomplishments better. What do you see as the alumni's role, and how critical is that role?

DR. BROWN: They have roles on both sides. We have almost 250,000 alumni. We have to learn to communicate with them about the quality and activity and excitement of their alma mater, their University. And they have to communicate with each other and with the rest of the world, being proud of and telling people about what BU is doing and accomplishing, and of what its goals are. And that's part of the communication. It's a very, very important part of the communication.

The second part is that the great universities in the world today are being supported philanthropically. If you look at all of them, the significant revenue stream that helps the university achieve its greatness, that provides the flexible support to do those things that differentiate it from everyday universities, is coming from the support of alumni, friends and foundations to the university, and we need our alumni to help us.



Dean *ad interim* Solomon R. Eisenberg.

Just three weeks after becoming Boston University's 10th president, Robert A. Brown named College of Engineering Dean David K. Campbell to the position of provost, the University's chief academic officer. Shortly thereafter, Solomon R. Eisenberg, the College's associate dean for undergraduate programs, was named dean *ad interim* and the process for identifying the College's next dean was set in motion.

"David Campbell is an outstanding physicist and proven academic leader who is committed to the educational and scholarly mission of Boston University," Brown, a chemical engineer and member of the ENG faculty, said in announcing the appointment. "I look forward to working closely with David to advance our University."

Campbell had been ENG dean since 2000 and presided over a period of rapid and dynamic growth. His tenure was characterized by expansion of the faculty ranks, record levels of sponsored research funding, and rising student quality marked this year by the most talented freshman class in the College's history.

"Obviously, I will miss the daily contact with my colleagues in the College of Engineering, but I'm confident that it is very well positioned for the future," said Campbell, who had been serving as ENG dean and University provost *ad interim* since 2004. "As we begin work on our plans for the next five years, this is an ideal time for a new dean to refocus our vision and to develop detailed plans to take us to the next level of excellence."

While a national search is conducted for Campbell's successor, Eisenberg will lead the College as dean *ad interim*. He joined the ENG faculty as an assistant professor upon completing his doctorate at the Massachusetts Institute of Technology in 1983, and now holds full-professor appointments in the Biomedical Engineering, and Electrical and Computer Engineering departments. In addition, he has led the College's undergraduate programs since 1998. He has played a leadership role in raising the quality of incoming students, and supervised the College's preparation for a highly positive review by the Accreditation Board for Engineering and Technology.

"In view of his intimate knowledge of all our programs, and in particular his leadership in our recent ABET accreditation review, Sol is ideally suited to keep us on track," Campbell said.

"The College will continue to move forward during the search for a permanent dean," Eisenberg said. "President Brown is tremendously supportive of the College, and David will obviously be a great resource to me during the coming months. We all agree that the College of Engineering cannot stand still while the search for the next dean is underway."

— Michael Seele



Prof. Ronald Roy is working to understand the power of bubbles.

“The noise you hear from breaking waves?” he asks. “Bubbles. Rain noise? Bubbles.” Even the near-silence of falling snow on a lake surface seems to be created by bubbles. Whether in microscopic surface cleaning, the promotion of intense chemical reactions and even the production of light from sound, bubbles are involved.

Hearing him list the ways in which we encounter bubbles every day, it’s easy to start thinking that they’re part of some great unifying force, albeit on an often microscopic scale. In some small way, at least for many of his research projects, such a claim carries a bit of truth.

Working closely with Aerospace and Mechanical Engineering colleagues Glynn Holt, Robin Cleveland and William Carey, Roy splits his time between a number of projects funded by agencies as diverse as the Office of Naval Research, the U.S. Army, the National Institutes of Health and the Center for Subsurface Sensing and Imaging Systems, an engineering research center at BU funded by the National Science Foundation.

Much of the work involves an in-depth understanding of the phenomenon known as acoustic cavitation. Generally, cavitation refers to the formation of a cavity in a liquid — a bubble. Roy describes acoustic cavitation as “the interaction of a sound wave with a gas cavity or a collection of cavities. Acoustically driven bubbles undergo violent pulsations, leading to a host of interesting physical effects. Alternately, pre-existing bubbles can radi-

Pop Science

MECHANICAL ENGINEER RONALD ROY WORKS TO BURST THE MYSTERIES OF THE UBIQUITOUS BUBBLE

By Ryan Olson

When Ronald Roy talks about his work the subject invariably seems to return to the same thing. “I still can’t get away from bubbles,” he says, jokingly. “They follow me wherever I go.” From biomedical acoustics used in therapeutic ultrasound to oceanic subsurface sensing and imaging in naval research, Roy finds himself working with bubbles again and again.

cally alter the physical characteristics of sound waves and how they travel through a medium.”

Military and Medical Applications

In his work for the Navy, the goal is, as Roy puts it, “finding the bad guys.” But bubbles can get in the way. Using sonar to search for mines buried in shallow-water sediments, for example, is made difficult by the presence of bubbles in the sediment that can scatter and absorb acoustic energy, in effect shielding the mine from detection. A similar argument applies to sound scattering from the sea surface, where bubbles entrained by wave action can congregate in layers and plumes, complicating sonar detection of surface ships, especially in rough seas.

Enter the idea of a resonance frequency and a reso-

nance response. Hit bubbles with bursts of sound and they will respond maximally at a unique frequency, which is based on their size. Generally, big bubbles have low resonance frequencies and small bubbles have high ones. Using these resonance responses, it’s possible to distinguish bubbles from other objects. Moreover, if one wants to monitor the flow of a bubbly fluid, one can select a frequency that maximizes acoustic scattering, rendering the bubble or bubbly region much easier to detect. This method is used in medicine to enhance blood flow imaging from diagnostic ultrasound.

But change the frequency of the sound hitting those bubbles, and the way bubbles respond begins to change. When excited below their resonance frequency, bubbles dramatically reduce the speed at which sound travels through water; a reduction of a factor of 10 is not uncommon. Now, increase the frequency to just above the bubble resonance frequency, and the opposite happens; the sound speed becomes supersonic relative to that of bubble-free water. Indeed, Roy has measured sound speeds in bubbly water three times greater than that of steel. Such a rapid transition from low to high speed with a relatively

small change in frequency, a phenomenon known as dispersion, is rarely found in nature. Sound speed dispersion, and related effects, affect sonar systems operating in shallow water, the operation of torpedoes designed to home in on ship wakes, and systems that employ microscopic bubbles to enhance cardiovascular imaging with ultrasound.

Hot Stuff

When a very small bubble is driven by a high-amplitude sound field, things get really interesting. The bubble can grow to 100,000 times its initial volume and collapse violently, resulting in an enormous concentration of energy in a very small region. Conditions in the cavity are more extreme than the surface of the sun, with estimates of collapse temperatures ranging from a few thousand to several hundred thousand degrees.

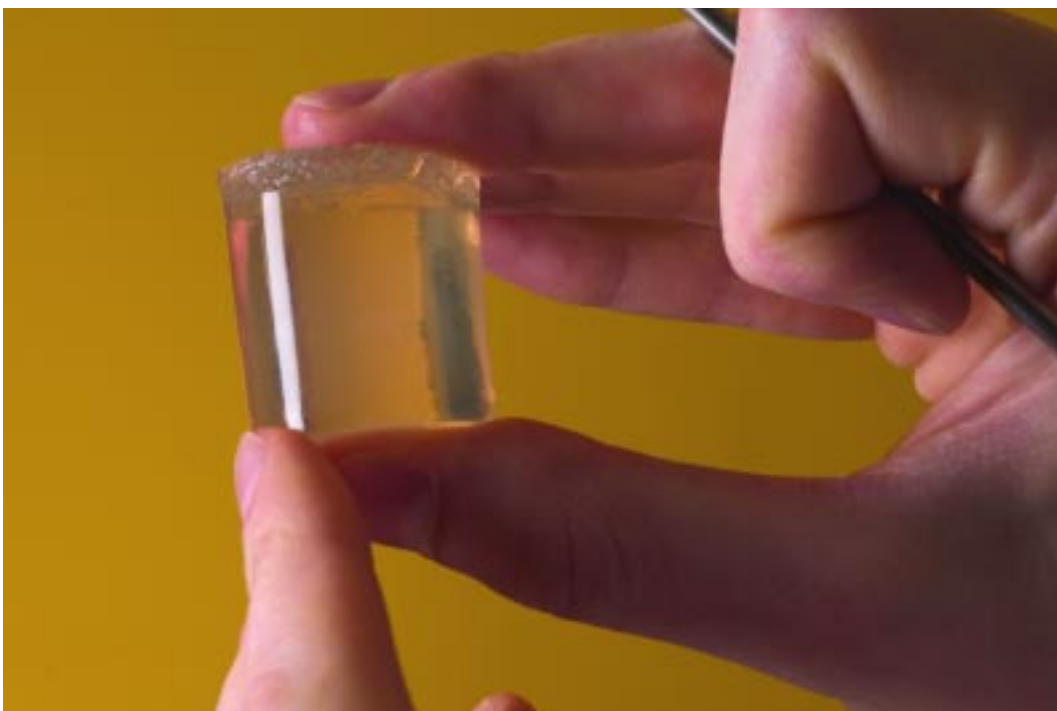
Molecules are torn asunder and recombine, resulting in chemical reactions and the production of light. The process, which is called sonoluminescence (light from sound), was the subject of Roy’s master’s thesis at the

University of Mississippi and has been an area of active research ever since. In the late 1980s Roy worked on the team that discovered how to generate stably repetitive SL from a single bubble. This discovery captured the imagination of acoustical physicists and spawned a worldwide surge of SL research activity that continues to this day. Industrial applications for this sort of extreme behavior range from sonochemical reactors to material processing and high-precision ultrasonic surface cleaning.

For sponsors like the Army and NIH, Roy’s work with cavitation has a number of applications inside the human body. The rapid absorption of high intensity focused ultrasound (HIFU) by tissue results in localized deep tissue heating that can literally cook diseased tissue and congeal blood. This effect can be enhanced by the energy released in violent bubble collapse and the Army hopes to develop a system able to perform what is known as remote acoustic hemostasis. Roy and Holt (working with colleagues at the University of Mississippi and University of Washington) are refining technology that could one day use HIFU to cauterize broken blood vessels inside the body without invasive surgery.

For the NIH, cavitation may play a role

“The noise you hear from breaking waves?” he asks. “Bubbles. Rain noise? Bubbles.”



To learn more about how blasts of high intensity focused ultrasound might be used in medical applications, Roy’s lab uses a gel-like substance, such as the one shown above, to mimic human tissue.



similar to the one in hemostasis. Using HIFU, the BU team has developed a system that can heat targeted areas of simulated human tissue. The main clinical application for this technology is the destruction of tumors without surgical intervention. Right now Roy and his students are working on ways to better detect the location of cavitation fields and increase the accuracy and efficacy of the heating process [see accompanying story].

The list of applications goes on. Bubble collapses generate rapid fluid flow on a microscopic scale that can assist in the rapid diffusion of drug molecules in areas of need or the gradual dissolution of blood clots. Cavitation also is used in shock wave lithotripsy, which employs high-intensity acoustic energy to break down kidney stones inside the body. Microscopic bubbles produced on the surface of a stone can be made to collapse and send a high-speed jet of liquid crashing into the stone with enough force to cause cracks to form. But there's a flip side. Generate too much cavitation and the plan can backfire — the resulting cloud of bubbles surrounds the kidney stone and protects it from incoming shock waves.

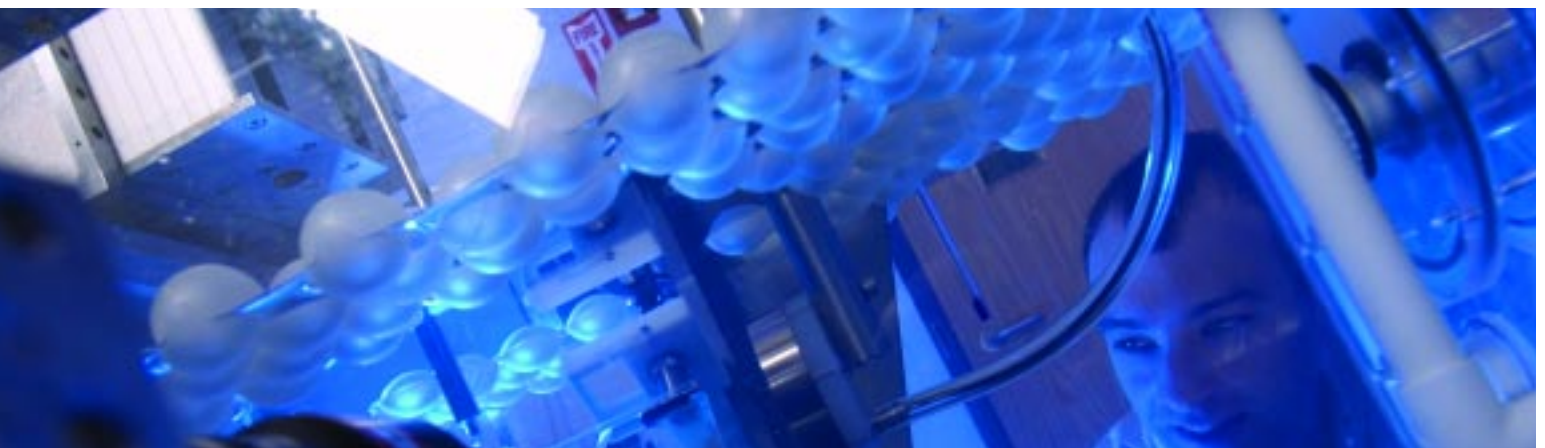
"There's a lot of art to cavitation physics and engineering, as much as I hate to admit it," Roy says, smiling. "Cavitation is three parts science and one part physical intuition." But he keeps at it. "It's funny that a simple phenomenon like a bubble could be so elusive and ubiquitous," he says. "So many things can take place." Whatever the role of intuition and art, he continues to excel.

Announced in January as the 65th recipient of Oxford University's prestigious George Eastman Visiting Professorship award, Roy will spend the 2006-07 academic year in England, giving a series of lectures while further enhancing his work at BU. Among the long list of distinguished scholars who have held the chair, Roy is the first engineer.

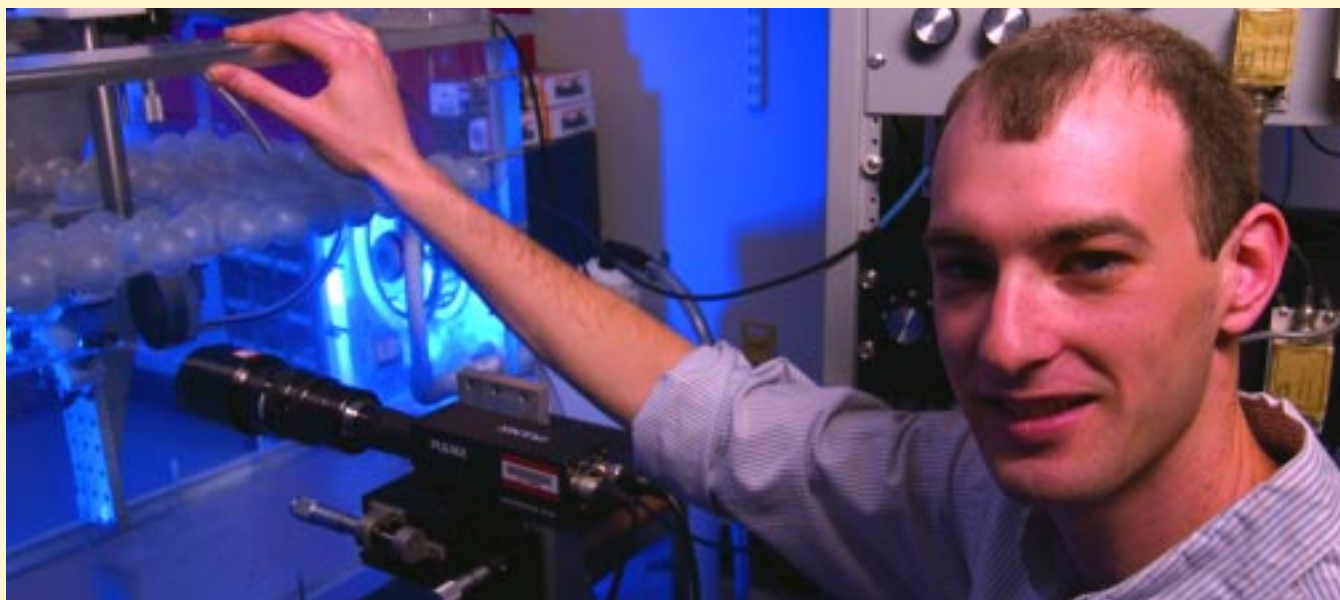
"I'm very excited," Roy says of the upcoming trip. He plans to spend his time enhancing his activities at BU involving biomedical ultrasound and ocean acoustics.

And maybe some more work with bubbles.

Roy uses tanks of degassed, distilled water in his work. The floating plastic spheres help keep water in and gas out. "There's a lot of art to cavitation physics and engineering, as much as I hate to admit it," he says. "Cavitation is three parts science and one part physical intuition."



Music, engineering interests lead to medical acoustics



Interests in music and engineering led Caleb Farny to pursue his doctorate in Roy's lab.

Surprisingly, the desire to combine his undergraduate interests (engineering, piano and double bass) led Caleb Farny to Boston University. A doctoral candidate in Prof. Ronald Roy's lab, Farny's passions converge in the work he does today — medical acoustics.

In a tank of distilled and degassed water topped with floating clear plastic spheres the size of ping pong balls (they reduce evaporation and help to keep the water degassed), Farny uses a transducer to fire beams of high intensity focused ultrasound, or HIFU, into volumes of simulated tissue. The sound waves cause a rapid increase in temperature, heating a target area the size of a grain of rice from room temperature to more than 140 degrees Fahrenheit (the point at which human tissue is destroyed) in just a few seconds. Immediate applications for HIFU include tumor destruction without invasive surgery and stopping internal bleeding by cauterizing blood vessels. Anyone who has seen the 2001 war film "Black Hawk Down" should remember the scene exemplifying the real-world application for remote cauterization; a soldier bleeds to death from a leg wound in which a ruptured femoral artery retracts back into the leg before it can be clamped shut.

Using tissue phantoms — surrogate materials that mimic the acoustical and thermal properties of real tissues — Farny experiments with variations in his exposure conditions. While the phantoms have their own limitations, notably their uniformity in contrast to the heterogeneous nature of human tissue, they allow Farny to refine his work in something approximating the real thing.

Two main mechanisms are believed to cause an increase in temperature as sound waves hit the area targeted by HIFU: attenuation (similar to friction) and inertial cavitation (large-amplitude fluctuations in the sizes of small gas bubbles produced by

the oncoming sound waves). Farny is looking closely at cavitation's role in this process, because he and Roy believe these bubbles can greatly enhance heating rates and, in the process, reduce the time needed to treat large volumes.

A HIFU wave consists of a series of high pressure and low pressure regions traveling through tissue at the speed of sound. When a low pressure zone reaches the targeted area, bubbles are created and expand rapidly. When the ensuing high pressure zone arrives, the bubbles are squashed by the acoustic wave and subsequently collapse violently, radiating acoustic shock waves that release energy into the surrounding area. This energy release is manifested as a temperature elevation — the bubbles convert acoustical energy into highly localized mechanical energy, and ultimately into thermal energy.

But problems remain. Bubbles are good reflectors of sound, some of which bounces back towards the transducer, causing unwanted heating in areas in front of the targeted area. The key is to create and sustain just the right amount of cavitation activity: too little cavitation is ineffective and too much shields the target region. Roy, Holt and Farny believe improved precision and control is around the corner. The two use a second system of transducers, called a passive cavitation detector, or PCD, to more accurately measure when and where the bubble collapses are taking place by monitoring acoustic emissions from bubble activity. This allows one to non-invasively monitor cavitation activity and use that information in a feedback loop to optimize HIFU exposure conditions in real time.

"If we understand our feedback well enough then perhaps we can control the cavitation field and obtain the correct lesion shapes in a time-efficient manner," Farny says. With more effective focusing techniques, real-world treatment schemes might not be far off.

Standing in associate professor John White's Neuronal Dynamics lab on the second floor of Boston University's new Life Sciences and Engineering Building, you can't help but notice the black curtains. Spanning one entire wall of the spacious lab, they run from the floor to the ceiling and form three separate rooms, or bays, each with a microscope, computers and rack-mounted electrical current converters, amplifiers, signal processors and other equipment. Walking through the lab, White stops inside one of the bays, standing next to the table holding the microscope.

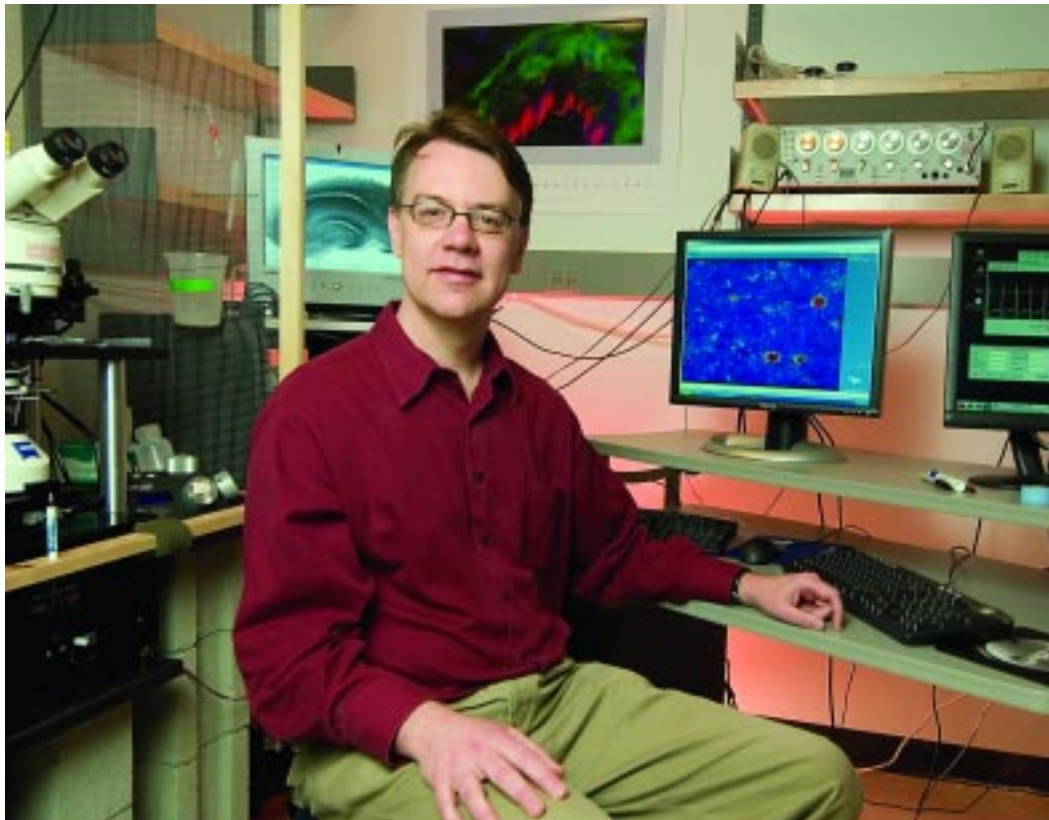
"We're close enough to the loading dock that we can sometimes feel the whole building shake," he says, kneeling down to reach underneath the table. In a few seconds the whirr of compressed air turns to a louder "thunk" as the table suddenly rises a short distance, now on a cushion of air.

"These vibration isolation tables float on pistons that isolate them from building noise," White says, jabbing one with his foot

Brain Game

BIOMEDICAL ENGINEER JOHN WHITE IS TRYING TO UNRAVEL THE BRAIN'S WIRING

By Ryan Olson



Assoc. Prof. John White's research could have implications for Parkinson's and Alzheimer's Disease patients.

to illustrate. Nothing on the table's top moves. Each of the four microscopes in the main lab sits on one of these tables, and save the front is surrounded by what looks like a box frame made of plywood and wire mesh. The screens act as Faraday cages, blocking potential interference caused by outside electromagnetic waves. Coupled with the thick, black curtains capable of shutting out nearly all light and air-cush-

ioned tabletops, it's easy to surmise that White spends his time working with very small, very sensitive things.

"We're studying how spatial and temporal activity arises in the brain," White says. More specifically, that means working with neurons — individually and in populations — and studying how they function in learning and memory. Studies of rat neurons (similar in size to human neurons)

have demonstrated that the brains of these animals show patterns of activity when they are confronted with a new environment they want to learn about.

For White, one of the most important aspects of these patterns is their organization. Building computer models based on observations of living neurons in the lab, they are learning that there is a set of rules governing this type of synchronous activity in the brain. With thousands and even millions of nerve cells communicating with one another at the same time during specific types of activity, a better understanding of how this takes place creates obvious applications for drug makers interested in stopping or changing certain types of cellular communication.

For people with movement disorders such as Parkinson's disease or essential tremor, the ability to alter the transmission of electrical signals in the brain can bring relief. A more complete study of brain interconnectivity could lead to more effective pharmacological treatments for those with epilepsy or Alzheimer's Disease.

Connectivity is the Key

The neocortex, also known as the telencephalon or cerebrum, is the part of the

brain commonly believed to set humans apart from other animals. "Because of the neocortex we have culture, language and the ability to invent," White says. While we are far from understanding how this region of the brain works, it is clear that massive inter-connectivity is key.

"If you take the human cortex and lay it out, it's about the size of a pizza," White says, and about a millimeter thick. Massively wired, it turns out that the wires take up much of the volume of the brain. In order to maximize the number of possible connections, each wire needs to be as small as possible. With some 100 billion cells in the brain and each one connected to an average of 10,000 other cells, the sheer number of signals being sent at any given time is staggering.

For White, understanding the smallest possible size of each connection means understanding the role of noise — the tendency of small wires to accidentally send a signal. With smaller wires the sensitivity of each one increases, to the point where the opening of a single molecular ion channel

has the power to unintentionally cause a nerve cell to fire. Because of this, noise effectively limits the ability of neurons to be below a specific size. With co-authors from the University of Cambridge, White recently published work on this subject in the journal *Current Biology*.

Perhaps surprisingly, it appears that humans and other organisms have evolved

to function with a certain amount of constant noise in the system. In the case of cochlear implants, in which a listening device is connected directly to a person's auditory nerve, humans appear to hear better if the implants induce a certain degree of

noise. If all of a person's auditory neurons were conditioned to fire at the exact same time, hearing would become an all-or-nothing response. White describes this "steady trickle" of information to be a much more effective way of transmitting information.

The Neural Net

The next step beyond interconnectivity of the billions of cells in the human brain is the creation of a computerized brain — a sort of "virtual reality" for neurons. By recording the way living neurons respond to stimuli, White and his fellow researchers and students have been creating a system able to independently interact with living cells. Connecting living neurons to this artificial network designed to mimic a real brain, they can then observe how effectively the living cell communicates with the artificial network. Using the open-source operating system Linux, members of the lab first helped create software capable of stimulating and detecting the responses from neurons as quickly as possible.

"Think about cell phones," White explains. "An imperfect system, you [often] end up talking over one another because of imperfect synchronicity." Using Linux meant that the researchers could write software able to do exactly what they wanted and nothing more, a problem they faced when they had to use Microsoft's Windows. Interestingly, the Linux project has grown as a result of the BU team making it available

"If you take the human cortex and lay it out, it's about the size of a pizza."



Graduate student Tilman Kispersky (left) and post-doctoral fellow Theoden Netoff are among the students working in White's lab.



to the general public. White believes it has reached a worldwide market that could be in the tens of thousands, as other groups doing similar work build on what BU has already done.

Other Projects

In addition to his work studying the organization of neurons, the role of noise and the creation of artificial neural networks, White is trying to study large populations of neurons and learn more about how brain cells create new connections with one another. Using fluorescent dye that emits light based on certain types of activity, White and his group use microscopes to observe how living cells react to different stimuli, often for hours or even weeks at a time. One of the hallmarks of the brain is its plasticity — the ability to make new connections as we learn new things, while simultaneously preserving the old. When two neurons fire signals in rapid succession, chances are that the strength of the connection between the two will change.

“These changes in synaptic strength are the basis for learning and memory,” White says. But the rules governing how and when they fire are not well understood. Another of the projects in White’s lab involves specifying the rules of synaptic plasticity, and the mechanisms by which the rules are implemented.

From epilepsy and memory disorders to the potential for predicting the onset of cardiac problems, a more complete understanding of the body’s most complex organ will undoubtedly lead the way to an entire realm of treatments and preventive care for a large number of debilitating conditions. With help from researchers like White and his colleagues, the next generation of techniques may very well give us specific types of treatment that can figure out when problems are going to happen and stop them before they do.

Graduate student Tara Keck uses a microscope mounted on one of the lab’s isolation tables. The photograph was shot through the wire mesh screen that protects the table from electromagnetic interference.

Research: It's not just for graduate students anymore

Cutting-edge engineering labs are places typically reserved for graduate students, postdoctoral researchers and professors, but John White's Neuronal Dynamics Laboratory places a priority on including aspiring undergraduates, too.

"We always get great applicants," White says, referring to the fact that the program commonly brings in applications from hundreds of students, far more than can be accommodated. Ira Mabel, a senior in BU's electrical engineering program, joined White's lab this past summer as part of BU's research experience for undergraduates. In its 11th consecutive year, the National Science Foundation-funded program provides aspiring neuroscience students with stipends and on-campus housing for a 10-week period during the summer.

For Mabel, the summer involved working on equipment used to study live rats, specifically ways to increase the functionality of the electrodes used. Working out of White's lab in close collaboration with Psychology Department Chairman Professor Howard Eichenbaum, the goal of his project is to stimulate the rats in a way that affects their spatial awareness and behavior in a maze. The work increases understanding of the fundamentals of how brain neurons interact with one another.

In the case of the rats, successful brain stimulation demonstrates the validity, and ultimately effectiveness, of techniques other than long-term behavioral conditioning. Two main approaches are commonly used: either stimulating pleasure centers in their brains after animals perform a desired task, or by stimulating areas of the brain involved in episodic memory, or memory of personal experiences. Mabel is using the unconventional technique of stimulating memory centers in the brain, an approach which, if successful, might offer hope to Alzheimer's patients and others with memory disorders.



Senior Ira Mabel is among the undergraduates working in research laboratories at ENG, a realm typically reserved for graduate students.

In these cases, rats can be prompted to remember certain responses, like which direction to turn in a maze, based on the type of brain stimulation. Typically, one electrode is used to stimulate and another to record the responses, but Mabel worked on the development of a single electrode capable of doing both jobs. He had to work on several problems along the way, such as minimizing weight, grounding, and developing circuitry that could handle a wide range of signal strengths using tiny wires in close proximity to one another.

While Mabel isn't sure about where he'll head after his final year as an undergraduate, the summer proved to be a great experience. "It really helped me get an idea of what a future academic career might look like," he said.

—R.O.



Prof. Ted Morse in his Laboratory for Lightwave Technology.

Leading Light

TED MORSE'S LIGHTWAVE TECHNOLOGY LAB DEVELOPS NOVEL FIBER OPTICS FOR LASERS AND SENSORS

By Ryan Olson

June marked the six-year anniversary of Professor Ted Morse's arrival at BU after 36 years at Brown University, and a single trip through his sprawling Laboratory for Lightwave Technology is all it takes to make you believe him when he says he'll never move again. Each of the series of rooms on the fifth floor of the Photonics Center is filled with progressively bigger pieces of equipment; the spacious isolation tables festooned with clamps, microscopes and prototype sensors seem compact when you are standing next to the industrial-grade lathes used to make the glass for optical fibers. Tucked away in the farthest corner of the lab is the most physically imposing piece of equipment: an eight-meter-tall draw tower used to make optical fibers. Researchers in the lab work on new types of fiber-based sensors, fiber optic lasers and even transparent ceramics for use in military applications like aircraft windows and radar domes.

One reason Morse pulled up stakes in Providence and moved to Boston was the prospect of an expansive, state-of-the-art lab in the new Photonics Center at BU. The view of Boston and Cambridge from his fifth-floor lab hints at another reason: location, location, location. “Oliver Wendell Holmes said that Boston was the hub of the universe,” he says. “There is certainly a difference in who walks through the halls here: venture capitalists, scientists from startup companies ... if you are going to pick three or four great centers of science and technology in the United States, Boston is certainly one of them.”

Sensors Abound

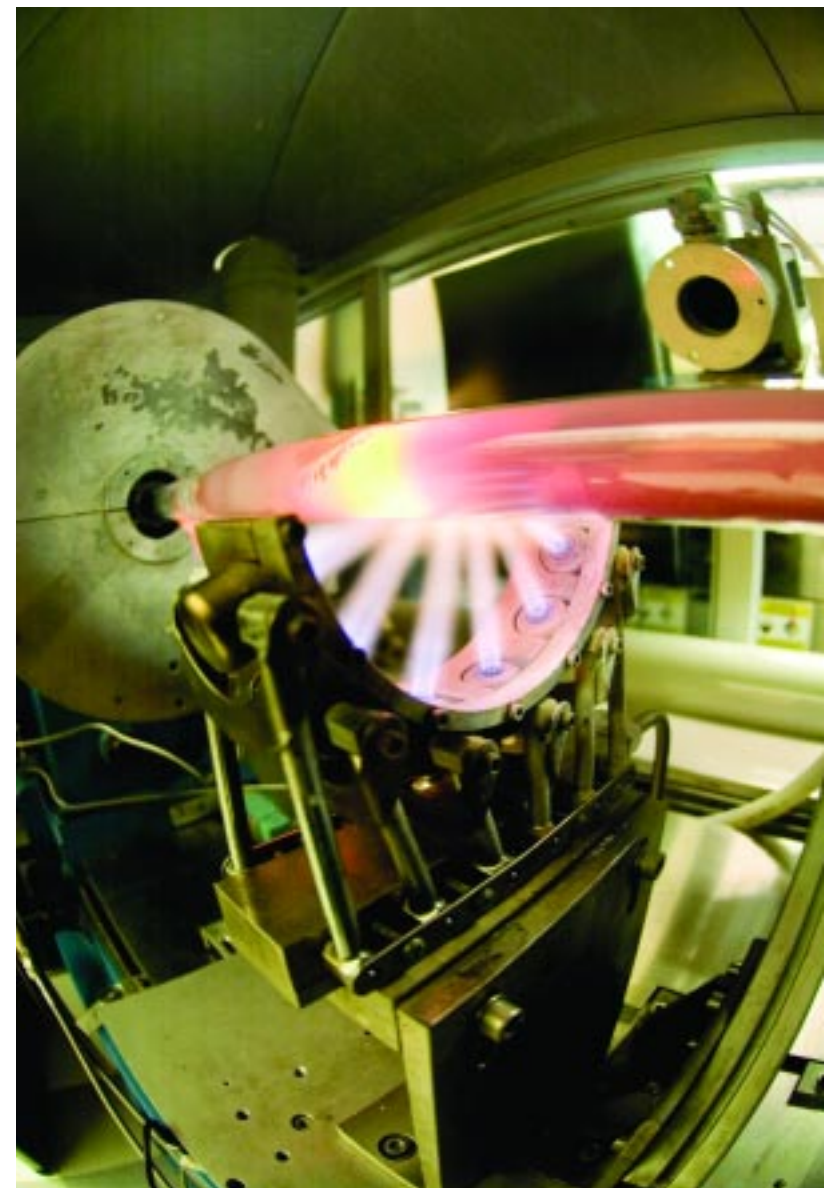
One of Morse’s projects is a new type of high temperature sensor that he has developed with Research Professor Fei Luo. Made by depositing temperature-sensitive layers at the end of a piece of optical fiber, the technique uses a variety of materials able to withstand heat upwards of 1,000 degrees Celsius. The secret to the sensors lies in the way these layers interact with light coming down the fiber. Different temperatures cause the layers to change, and when this happens light hitting the sensor is reflected in a narrow range of wavelengths. This reflected light moves back up the fiber, where it can be monitored by a miniature, solid-state spectrometer and used to calculate temperature.

Morse’s current probe can measure temperatures as low as liquid nitrogen (-196 C) and as high as 1,200 C. It is accurate to within two degrees. But NASA wants a sensor that can measure the temperature of the tiles on the space shuttle during re-entry, which can reach 1,400 C. Morse hopes to accomplish this by attaching a sapphire fiber to the silica fiber, because of sapphire’s ability to withstand temperatures much higher than 1,400 C.

In addition to the temperature sensor, Morse is working on a sensor designed to detect specific biolog-

ical molecules with great sensitivity. This works on the concept of a “whispering gallery,” such as is found in St. Paul’s Cathedral in London or Statuary Hall in the United States Capitol building. The unique shape of whispering galleries allow them to reflect sound along the perimeter in a way that permits two people standing on directly opposite ends of the gallery to hear one another perfectly. An integral number of sound waves must “fit into” this path, and this occurs only for a specific sound wave, or frequency. This is the resonance condition.

Since light waves behave in a similar manner, Morse is experimenting with a similar design. Using a fiber laser cavity with a built-in resonant ring like those found in whispering galleries, the sensor can detect certain biological molecules



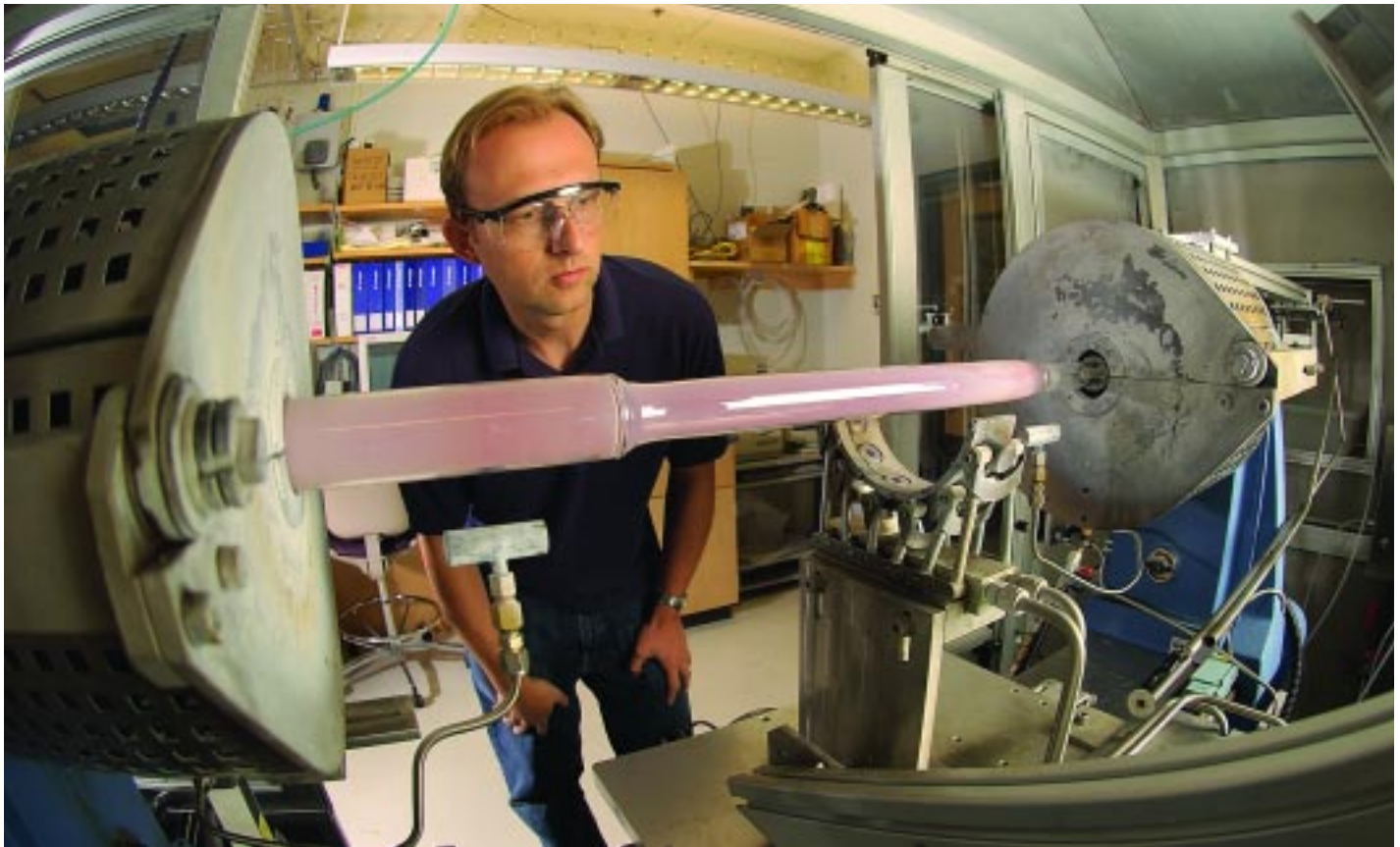
The lathes in Morse’s lab heat glass tubes to 2,000 degrees Celsius until they collapse to form rods. A single rod can produce hundreds of kilometers of optical fiber.

“Oliver Wendell Holmes said that Boston was the hub of the universe. There is certainly a difference in who walks through the halls here...”

that change the path of light within the ring. Similar to the way in which Morse’s temperature sensor causes detectable changes in light sent back through the fiber, molecules on the surface of the biosensor change the resonant condition of the small micro-ring. With this micro-ring placed inside a laser

cavity, it is possible to measure changes in frequency rather than wavelength, resulting in a big improvement in sensitivity. This technique has the potential of providing new levels of sensitivity in the detection of biological material.

Under a grant from the Air Force to work with the Wellman Center for Photomedicine at Massachusetts General Hospital, specialty fibers are being developed for enhanced sensitivity of confocal microscopy, a technique used to create images of thick specimens. In Morse’s case, it’s being used in clinical applications for the detection of subcutaneous cancer cells.



“As far as I know, this lab is the only one in the U.S.” using this process, says postdoctoral researcher Roman Shubochkin.

Competing With Industry

It is difficult for a university laboratory to compete with highly developed industrial laboratories, but the equipment available in the Laboratory for Lightwave Technology makes this possible. Roman Shubochkin, a postdoctoral researcher in Morse’s lab, spends much time using the glass lathes to produce specialty fiber. One of his projects is creating specialty fibers using an aerosol process developed by Morse and his students.

This aerosol process is important in the fabrication of fiber lasers. Only the rare earth elements (erbium, ytterbium, neodymium, praeosodimium, etc.) can form a laser in a silica glass fiber, and processing techniques usually require that the precursors that form these oxides be transported in a stream of gas. Because the rare earth oxide precursors have a low vapor pressure, they are solids and can’t be transported using a carrier gas. But Morse and his students developed an alternate process that bypasses this problem. The solid rare earth liquid precursors (referred to as dopants) are dissolved in a liquid solvent containing silica, which is then nebulized into tiny

droplets, in much the same way that a room humidifier works. In each of these microdroplets is a dissolved solid, and these droplets are small enough so that they can be transported just like the smoke of a cigarette. When these droplets react with oxygen in a heated zone, the desired oxide particles are formed.

“As far as I know, this lab is the only one in the U.S. doing it,” Shubochkin says. “For us it’s almost perfect because it allows us to put whatever ions [or] dopants we want in the glass pretty easily.” The technique deposits these dopants on the inside wall of a glass tube held by one of the lab’s lathes, and once the process is complete, the glass tube is gradually heated with an oxy-hydrogen torch that can reach temperatures over 2,000 C. As this happens, the tube collapses to form a solid glass rod, known as a pre-form, with the dopants at the center. Looking at one of the many pre-forms in Morse’s lab, it is possible to see them in the form of a thin clear line running through the center of the glass, visible because of the way the rare earth elements and other core components change its refractive index.

Standing in the shadow of the lab’s

draw tower, Shubochkin explains how the pre-forms become optical fiber. The pre-form rod is mounted vertically near the top of the tower and slowly fed into a furnace that typically reaches 2,200 C. At this point, the superheated glass begins to drip — as a droplet falls away from the pre-form, it becomes cool enough to handle. Like a piece of gum or taffy, the glass is pulled until it reaches the desired thickness, typically 125 microns. Once a uniform diameter has been established, the fiber is coated with a polymer that becomes a hard protective coating after it is hit with ultraviolet light, making it suitable for handling. Using this approach, a single glass pre-form only a few feet long can be used to make hundreds of kilometers of fiber.

“This is pretty much the same equipment as is used in industry,” Shubochkin says, referring to large companies making telecommunications fiber. “It’s nice to have access to this type of equipment at this university. Being in academia gives you a certain freedom ... Ted is very relaxed. As long as you do your part on the projects, it’s pretty much up to you to pursue your own interests.”

Doctoral candidate working on his third BU degree

Boston University is a place Bob Chivas knows well. After earning his bachelor's degree in physics from BU, he spent several years working in industry, but by 1999 the self-described "research junkie" decided to return to school. With contacts at BU and admiration for the opportunities presented by the Photonics Center, Chivas came back and earned his master's degree. Since 2001 he's been working in Morse's lab toward his doctorate.

"I know people don't usually stay in one place for all three degrees, but BU was just perfect for me and the circumstances of my life at each juncture," he says. He did not plan on completing a PhD, but after speaking with Morse the idea just seemed right.

"Working with Professor Morse has been a treat," Chivas says. "He is a giant in the fiber optics field." With Morse's previous grad students now the technical heads of high tech companies like OFS Laboratories (formerly part of Lucent Technologies/Bell Laboratories), spending time in his lab seems a wise move for anyone hoping to pursue work in the field.

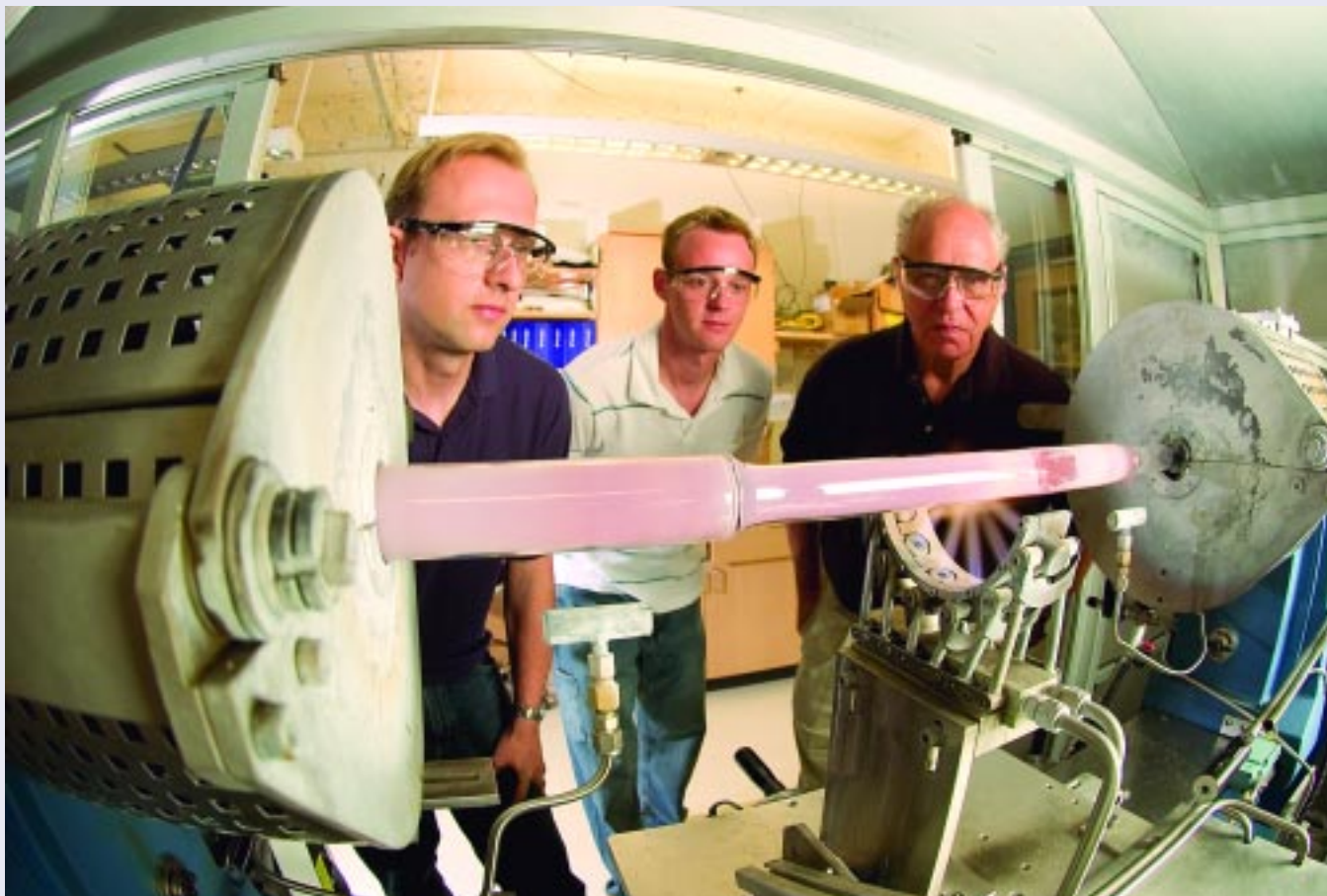
For his dissertation, Chivas is working to find a novel way of making large polycrystalline substances by combining two separate processes involved in the creation of fiber optics. Sol-gel, a technique used to create large glass bodies in a specific shape,

starts with powdered silica. With the addition of water, additional polymers and lubricants, the mixture is centrifuged to ensure an even distribution of ingredients. Lastly, an ester is added to decrease the pH of the solution and start the solidification process. At this point the solution can be pumped into a mold—within a few minutes, the mixture solidifies, creating a glass body in the shape of the mold.

While Shubochkin uses the aerosol process to make custom fibers, Chivas hopes to use the technique to create a powder of nano-crystals that will then be dispersed in the solution used in the sol-gel process. These two techniques can be used to build large polycrystalline structures such as solid state lasers, Chivas says, which are very expensive to produce, especially in large sizes. Other advantages of this technique include the ability to design shapes that enhance properties like thermal cooling, uniformity and beam shape, among others.

"Professor Morse lets the creative side of you go," Chivas says. "He stays on top of all the projects [and] also works on the other side with graduates in the industry, finding out about developments, grant requests, etc. He has deep ties with industry, which is beneficial. If this sol-gel crystal process works, it could be important."

—R.O.



Shubochkin (left) and graduate student Bob Chivas observe the lathing process with Prof. Morse. "I know people don't usually stay in one place for all three degrees," says Chivas, "but BU was just perfect for me and the circumstances of my life at each juncture."



Asst. Prof. Xin Zhang and graduate student Shushen “Forest” Huang inspect arrays of tiny infrared sensors.

Thinking Small

MANUFACTURING ENGINEER XIN ZHANG DEVELOPS TINY MACHINES WITH BIG POTENTIAL

By Ryan Olson

Ironically, Xin Zhang’s career continues to grow on the principle of one overarching theme: thinking small. A specialist in the field of micro-electrical mechanical systems, or MEMS, she helps design and build tiny sensors and machines, including a millimeter-length cryogenic pump used to cool delicate satellite instruments and microscopic arrays for detecting the minute physical forces exerted by cells. Between manufacturing, aerospace and mechanical engineering, she’s a fundamentalist in her approach, trying to increase our understanding of the basic principles associated with these tiny machines to make the next generation of MEMS devices even better.

An assistant professor of manufacturing engineering, Zhang came to Boston University in late 2001 from the Massachusetts Institute of Technology, where she spent several years working first as a postdoctoral researcher and then as a research scientist in the microsystems technology and gas turbine laboratories. In 2002 she founded BU’s Laboratory for Microsystems Technology, with the goal of creating a college-wide, student-centered MEMS research and education program.

From BU Medical School to engineering firms like Fraunhofer, which occupies space near her lab on St. Mary’s Street, across from the Photonics Center, Zhang’s background brings her diverse projects and

collaborators together. Her appreciation and strong desire for collaboration is resulting in the growth of a BU program striving to make important advances in the field.

Power in a Small Package

With her experience constructing microscopic gas turbines and other machines with the potential to revolutionize the entire concept of battery technology, it is not surprising that Zhang's research into the enhancement of power MEMS has attracted the interest of the US Air Force. "Many people in this field share the belief that a revolution is underway," she says. As the desire for unmanned vehicles continues, so too does the need for small, reliable ways to provide these devices with power and cooling. From satellites to small space vehicles, power MEMS devices could be used in propulsion systems, batteries and fuel cells.

Working jointly with engineering firms Foster-Miller and Fraunhofer, Zhang has developed a tiny cryogenic pump designed to keep delicate, densely packed satellite instruments cool. A mere 25 millimeters square, these arrays of pumps can be used to push a coolant-like liquid nitrogen through a series of tiny tubes snaking through telescope optics. Early tests have gone well, but reliability is still a key issue when it comes to the success of these devices. Operating remotely, they must be able to run for years at a time without the need for repair.

Before the large-scale construction of the next generation of power MEMS devices like battery replacements, tiny blowers, compressors and heat pumps, the structures and materials used in their construction must undergo a significant amount of additional study. With

"Many people in this field share the belief that a revolution is underway."

so much power being created by such a tiny machine, the damaging effects of heat become more of a problem, leading to the need for thicker deposited layers as electrical insulation. But because of their small size, layering extra materials creates a second problem—stress. Thin film materials like silicon oxide, silicon nitride, and various metals are combined with one another, then

go through a complex construction process to form structures with specific properties and functions.

"Thin films have, in general, properties different from their bulk counterparts," Zhang says. By doing things like constructing different structures and taking constant measurements and modifications of stress levels during the construction process, she and her student Zhiqiang "Jay" Cao are thinking of new ways of depositing MEMS materials and ways to develop more stress-resistant designs.

High Tech Imaging

Similar to her work with power MEMS because of the problems affecting the construction of many of the devices, infrared MEMS will provide the next generation of thermal imaging technology. One type of device uses arrays of tiny sensors called bolometers to detect infrared energy that can be used to create thermal images. Numerous medical and military applications exist for the technology, which Zhang estimates could reduce the cost of current equipment by a factor of 10, power consumption by a factor of 20 and size by anywhere from 10 to 100 times.

These microscopic sensors, which can be as small as a few dozen micrometers across, work because of their unique response to infrared energy. When struck by infrared light they bend, resulting in a corresponding change in resistive capacity. By measuring the total change in resistive capacity across arrays of these tiny devices, integrated electronics can interpret the signal as an image, whether for night vision goggles or a medical scanner. Using a unique design conceived by her Fraunhofer colleague

and former postdoctoral researcher Biao Li, two bolometers sit at the ends of cantilevers, arranged like a sandwich with a small space in between. When hit with energy they bend, just like a single-layered bolometer does, but in opposite directions from one another, resulting in a more pronounced change in conductance and a higher sensitivity. With low noise (interference)



Sensors arrayed on a wafer.

and an established manufacturing process, many of the difficulties associated with building these devices have already been overcome. But problems remain.

Stress, an obstacle in the construction of power MEMS, causes problems here as well. The layers of thin films used to create the microbolometers are also made of many different materials, and stress that accumulates during their construction causes the sensors to curve, making them useless. Zhang's team is investigating ways to reduce this curvature, using a machine built by Professor Thomas Bifano (MFG) to work on mirrors. In the technique, called ion beam machining, or IBM, a beam of ions blasts the surface of the bolometers, flattening them by creating an additional layer of material on the surface or removing some of it.

"It's post processing — like a little surgery," Zhang says. "The whole chip can be modified or improved to make it better."

But extensive use of the ion beam can risk deteriorating, or delaminating, the sensors. Because it was designed to work with

mirrors, results aren't perfect, and IBM is often combined with another technique, called rapid thermal annealing, which uses a small oven to heat the structures to high temperatures, causing them to flatten. Funded by the US military and the Photonics Center, Zhang and her student Shusen "Forest" Huang are working on the best possible combination of these two techniques to optimize the reduction in the curvature of the bolometers.

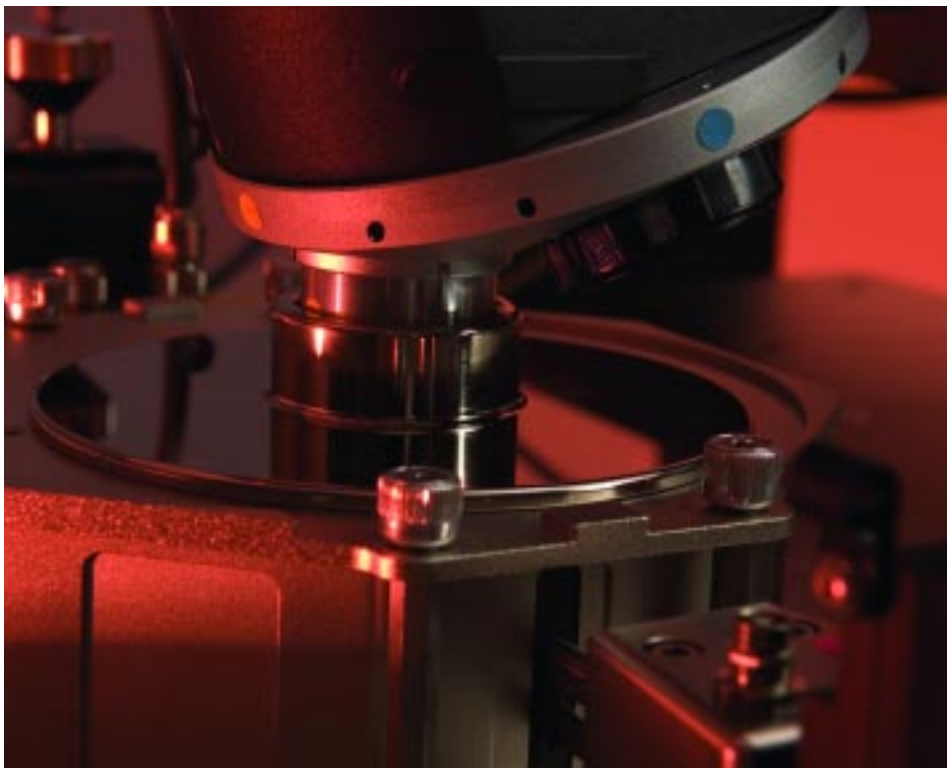
The Future

For Zhang and her students and coworkers at the Laboratory for Microsystems Technology, there does not appear to be a shortage of available work. Between finding ways to reduce the stresses on the tiny machines and moving from micrometer- to nanometer-scale in projects studying cellular forces, she continues to find ways to increase our understanding of these devices, no matter how small. From systems integration, biology, biomedical engineering and her ongoing collaboration with researchers and departments across campus, she always seems to be up to something.

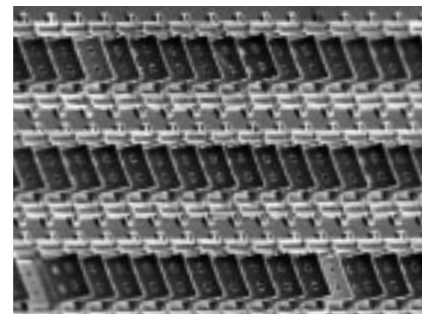
"My group has a lot of potential to grow and perform really competitive research," Zhang says. "I feel excited to get up in the morning and go to work to do something interesting. Students come to me with a high motivation. They feel it's worthwhile to spend a couple of years working in a competitive research field."



Graduate student Yi Zhao uses a microscope in the lab.



Prof. Zhang's team uses this Cascade probe station to characterize MEMS structures and devices.



Arrays of tiny infrared sensors, or bolometers, are used to detect thermal energy. When infrared energy hits their surface, they bend, causing a change in conductivity, which can then be interpreted by integrated electronics and used to create a thermal image. But construction problems resulting in bent, ineffective sensors must be overcome before the technology can be reliably commercialized.

Pillars of science

Zhang's self-described career project is in the field of Bio MEMS. With help from her student and PhD candidate Yi Zhao and a relationship with colleagues at BU Medical School, she is trying to understand the fundamentals of cellular mechanics through the measurement of the physical forces taking place inside and between cells. Important in vital processes like cell division, migration, growth and death, a more complete understanding of these forces might lead to technology able to predict larger-scale changes in the body. But finding answers to questions as simple as what happens when we consume chemical stimulants like caffeine, or more complex ones like understanding the intricacies of heart attacks, means finding unique ways to measure these tiny forces.

Historically, the cells used in cellular mechanics studies haven't had it very easy. Researchers have used invasive, labor-intensive techniques, from the relatively gentle optical tweezers (intense, focused beams of light on either side of the cell prevent it from moving but risk cell damage) to micro force transducers, which attach carbon fibers or glass pipettes to the ends of cells and pull on them. Even the relatively benign atomic force microscope affixes a cell to the end of a tiny cantilever, lowers it until the cell attaches to a surface and then pulls the two apart while measuring the amount of force necessary to do so.

Zhang's approach for measuring cellular forces is dramatically different. Using the strongest muscle cells available to them—heart muscle cells, or cardiac myocytes from rats, she and Zhao place individual cells atop arrays of tiny pillars made of special polymers and observe how the cells affect the pillars.

Using a technique called deep reactive ion etching, the researchers carve out an array of micrometer-width holes in the surface of a piece of silicon to make a master mold. Inverting the mold and placing it on top of a polymer substrate, they then use the pressure differential caused by a vacuum to draw the substrate up into the holes. After heating the polymer and solidifying it, the mold is removed, leaving a platform covered with tiny pillars (see photo). A single mold may be used to make pillars with a variety of flexibilities that are able to detect a wide range of cellular forces. Individual myocytes are placed on top of these pillars while bathed in a solution mimicking cellular fluid. By minimizing harmful outside influences and simulating the most realistic conditions possible, the team is able to obtain more realistic results while studying cells for longer periods of time. Using an environmental scanning electron microscope capable of scanning liquids and living materials, the two are able to directly observe how cells affect these tiny pillars.

By observing the deformation of pillars moved by the cell (see photo), the researchers can determine the total strength of the forces exerted by the cell. Variations in the ingredients used to make the polymers and the curing times give the researchers the ability to create arrays with different flexibilities and corresponding sensitivities. This allows the study of forces of different strengths and, in the future, different types of cells. By designing

and building arrays with multiple chambers for individual cells that include structures to ensure their proper alignment, many cells can be studied at the same time.

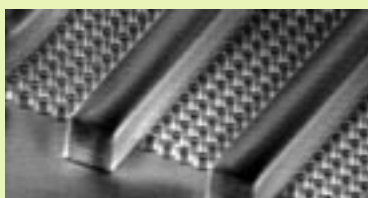
"You can talk about nanotechnologies for days, but finding a specific application is important," she says. "We are doing research [with] practical applications. It's delightful because we're not just picking up cells and doing superficial measurements; we're working with doctors and studying real problems."

The Future is Moiré

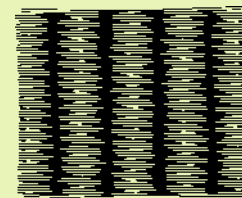
For Zhang and her students, the next step in the study of cellular forces means going even smaller — to nanometers. Because myocytes are the largest and strongest muscle cells in the body, studying other, smaller cells will require more sensitive equipment. Because the movement of pillars that are mere nanometers across is impossible to observe optically, Zhang is using a different technique to detect the changes across the array of pillars. Called Moiré interference, the approach refers to the pattern caused when two identical grids cross one another at an angle.

"This project is a very interesting combination of nanotechnology and biology," Zhang says. Cells are placed above a reference grid and below a second, identical grid and viewed from above; cellular forces affecting the tiny pillars obscure the bottom grid and cause a moiré pattern visible from the top. Fringes of alternating bright and dark bands emerge, at which point a computer is used to analyze the differences between these two images. With this technique it is possible to determine how the pillars on the polymer substrate have moved, even when individually they are too small to reliably see with a microscope.

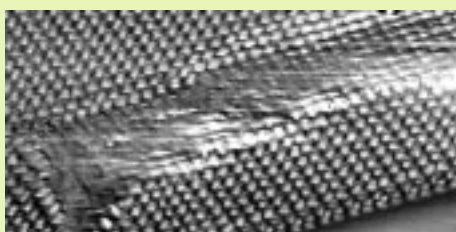
—R.O.



Zhang and Zhao create arrays of tiny pillars sensitive enough to respond to the minute physical forces caused by heart muscle cells.



A reference grating is visible under a moiré pattern generated by polymer nanostructures.



A heart muscle appears as a smudge on a pillar array. Because they know the amount of force needed to move a single pillar, making pillars with appropriate aspect ratios lets researchers more accurately determine the total amount of force the muscle can exert.

Thank you for a record year



Let me begin by thanking you for the unprecedented level of financial support by alumni, faculty, staff, parents and friends of the College of Engineering. Evidence of that support is found in the new W. Bradford Ingalls Engineering Resource Center, and in the establishment of the Hing Wah Chueng Fellowship, both of which are detailed in this issue. Hopefully, you noticed in the August mailing of the Engineering Donor Honor Roll the many other restricted donations received by the College.

We have also received numerous unrestricted gifts, ranging from \$10 to \$25,000, to our unrestricted ENG Fund and each one has helped to make a difference at the College. I'm often asked what these donations actually fund, whether they really come to the College of Engineering, and how even a small donation can make a difference. Donations to the ENG Fund, often called the College of Engineering Annual Fund, do come directly to the College as well as any donations through corporate matching programs. Unlike many universities, BU does not in any way reduce the College's budget because of this alumni support, but rather allows the dean of the College to use the ENG Fund donations as an additional discretionary fund.

Dean Campbell has always chosen to focus on improving the quality of the educational experience and offering additional financial support to deserving students in ways that would not be available without your support. He has funded additional Undergraduate Research Opportunity Program students and provided support to the many student professional organizations when they have come to him with special requests to host conferences, attend national conferences, or participate in regional and national competitions. One unique program which just completed its second year and would not exist without ENG Fund support is our Summer Term Alumni Research Scholars (STARS) program. This past summer, the program allowed 16 undergraduates to work in our research labs, be paid through the faculty's research grant and have free housing provided through the ENG Fund. I'd like to share with you an e-mail a first-year STARS student wrote to Dean Solomon Eisenberg this past summer:

Dean Eisenberg,

Now that summer is winding down, I wanted to take the time to extend my sincere gratitude to the College of Engineering for offering the numerous opportunities for undergraduates to participate in research. As you know, I have before criticized the University for its policies; however, I must contend that, with regard to research, the University, especially the College of Engineering, has very genuine intentions and ambitions. I have benefited greatly from both the Engineering Scholar research stipend and the STARS program. They are excellent programs because they facilitate research participation which wouldn't happen had they not existed. This summer, I have learned and become proficient in MATLAB and LabView and with this knowledge, contributed greatly to my lab. More importantly, I have gained extensive intuition into a process, e-beam, to which I would be completely oblivious had the college's undergrad research opportunities not existed. With my experience so far, I do not know how any undergraduate education could be complete without research.

There comes a lot of risk in investing in undergrads. I cannot thank the college enough for designing these innovative programs which facilitate this research. Once again, thank you.

*Sincerely,
Patrick Murray*

Although the \$158,595 raised in the fiscal year which ended June 30 was a record for the College's Annual Fund, it was far below what is needed to support all the programs we would like to fund and also far below what our peer institutions raise. I do hope those of you who have supported us will continue to do so and those that have been on the sidelines will step forward.

Your support truly will make a difference.

A handwritten signature in black ink, appearing to read "Stephen Witkowski". The signature is fluid and cursive.

Stephen Witkowski
Director of Development and
Alumni Relations

Interdisciplinary Life Science and Engineering Building Opens



University and Boston city dignitaries gathered for the cutting of the double-helix ribbon, formally opening the Life Science and Engineering Building on May 18. From left: University presidents *emeriti* John Silber and Jon Westling; Pamela Beale, president of the Kenmore Association and chair of the BU Community Task Force; Boston Mayor Thomas Menino; University President Aram Chobanian; ENG Dean and Provost *ad interim* David Campbell; and Board of Trustees Chairman Alan Leventhal.

On a spring day in May, the new Life Science and Engineering Building completed its journey from concept to reality when a group of civic and University leaders cut the double-helix ribbon and formally opened the doors of the state-of-the-art facility.

On May 18, Boston Mayor Thomas M. Menino, BU President Aram Chobanian, BU Provost *ad interim* and College of Engineering Dean David Campbell, and Board of Trustees Chairman Alan Leventhal snipped the ribbon on the \$83 million facility. By that point, faculty from the Biomedical Engineering Department had already moved into their gleaming new labs. They share the building with biology, chemistry and bioinformatics researchers, making it the first building on campus, and one of the few in the country, specifically designed to foster interdisciplinary research.

The 10-story, 187,000-square-foot research facility had been under construction since April 2003, when the defunct Nickelodeon Theatre was razed to make way for it. The opening is the capstone to the University's 20-year effort to increase its capacity for interdisciplinary research. The building's design is intended to encourage researchers from similar areas to interact.

Aside from the expensive equipment and the amenities that come with space in a brand new building are the intangible benefits, many of which facilitate pre-existing collaborations with other researchers that faculty like Associate Professor John White believes will only grow stronger.

"Even before this building there has been a great recognition that we're stronger through interdisciplinary work," White said. "I suspect this building will be a big success." Encouraging teams of researchers to

share resources and reduce the tendency to cluster in groups doing similar work is a good way to build on the strengths of everyone involved.

"The administration has shown a lot of imagination here," White said. "I can walk 100 feet one way and talk to the chair of psychology, while 50 feet another way are molecular biologists. It's a terrific idea in that regard — the idea of creating a science and engineering village here on Cummington Street."

But the building's completion does not mean that all construction has stopped at the College of Engineering. Shortly after the Life Science and Engineering Building opened, work began on the Ingalls Engineering Resource Center, which provides needed study and meeting space for students [see story on page 3].

—M.S. and R.O.

New Faculty Join ENG

The College of Engineering welcomed three new faculty members in September and is ready to greet three more when the Spring semester starts in January.

Asst. Prof. Calin Belta joined the Manufacturing Department in July after having worked in a similar capacity in the Mechanical Engineering and Mechanics Department at Drexel University since 2003. Earlier this year, Belta won a prestigious National Science Foundation CAREER Award, given to the nation's most promising young researchers, for the project, "Hierarchical abstractions for planning and control of robotic swarms."

In addition, Belta is working on two other NSF-funded research projects and his funding from the agency totals nearly \$1 million. He has authored or co-authored more than 20 journal papers and book chapters.

Belta earned bachelor's and master's degrees in control at the Universitatea Tehnica in Romania before obtaining a master's degree in electrical engineering from Louisiana State University. He earned a third master's degree and a doctorate in mechanical engineering and applied mechanics at the University of Pennsylvania.



Amit Meller joins the Biomedical Engineering Department this year as an associate professor following five years as the Rowland Senior Fellow and Group Leader at Harvard University's Rowland

Institute. Under his leadership, the group, which will transfer to BU with Meller, secured nearly \$2 million in grant funding in less than two years. He has co-authored 15 articles in peer-reviewed journals.

Meller holds a doctorate and a master's degree in physics from the Weizmann Institute of Science in Israel, and a bachelor's degree in physics and astronomy from Tel-Aviv University.

His research involves the development and application of novel methods to study the structure, dynamics and interactions of biomolecules at the individual molecule and complex molecule levels. He has submitted, or has been granted, three patents.



Anna Swan earned a doctorate in physics at BU and has worked as a researcher and lecturer in ENG since 2001, most recently as an associate research professor. She joined the Electrical and Computer Engineering

Department as an associate professor in September. Prior to working at ENG, she taught in the Physics Department, and was a scientist at the Oak Ridge National Laboratory.

She has published 35 book chapters and articles in refereed journals, and shares three patents. Swan is invited regularly to address conferences, NASA workshops and colloquia on her research involving the optical properties of carbon nanotubes. Her research is funded by NSF, the Department of Energy, the Department of Defense and the National Institutes of Health, among others.

In addition to her teaching and research work in ENG and Physics, Swan is a faculty member at BU's Center for Nanoscience and Nanobiotechnology and the Photonics Center. She has also led an NSF-funded outreach program, "Women in Engineering," which works to draw high school girls into engineering.

In addition to her doctorate, Swan holds a bachelor's degree in physics engineering from Chalmers University of Technology in Sweden.

Asst. Prof. Luca Dal Negro will join the Electrical and Computer Engineering Department on Jan. 1, 2006. He will arrive from MIT's Department of Materials Science and Engineering, where he has been a post-doctoral associate since 2003.

He holds a laurea degree and a doctorate in physics, both from the University of Trento in Italy. He was a 2001 recipient of the Young Italian Scientist Award. His research interests include linear and non-linear optics of semiconductor nanostructures, energy coupling phenomena in rare earth atoms and semiconductor quantum dots, sputtering and PE-CVD deposition of Si-based materials, fabrication and characterization of photonic crystals structures, and the physics of optical quasicrystals.

Dal Negro has published 39 book chap-

ters and articles, holds an international patent and three provisional patents in the United States.



Katherine Yanhang Zhang will join the Aerospace and Mechanical Engineering Department as an assistant professor on Jan. 1, 2006. She has been working as a research associate at

the University of Colorado since 2004, shortly after she earned a doctorate in mechanical engineering there.

Her research interests include the mechanical behavior of soft biological tissues, cardiovascular mechanics, multi-scale modeling of biological composites, and micro- and nano-mechanics of thin film and thin film coatings. She holds a patent and a provisional patent, and has published eight journal articles.

In addition to her PhD, Zhang holds a master's degree in mechanical engineering from the University of Colorado, and bachelor's degrees in engineering mechanics, and economics and management from Tsinghua University in China.



Another January arrival in the AME Department will be **Assistant Professor Sean B. Andersson**, who has worked as an applied mathematics lecturer in the Division of Engineering and

Applied Sciences at Harvard University since 2003.

Andersson holds a doctorate in electrical and computer engineering from the University of Maryland, a master's degree in mechanical engineering from Stanford University, and a bachelor's degree in applied and engineering physics from Cornell University.

His research interests include the detection, estimation and control in scanning probe microscopy; applied mathematics; and mobile robotics and sensing.

Alumni Events

Red Sox Game

Two hundred College of Engineering donors, Alumni Board members and their guests took advantage of a special invitation to attend the penultimate game of the 2005 regular season at Fenway Park on Oct. 1. Prior to the game, guests enjoyed a buffet lunch and open bar at Fenway's Player's Club. A classic, pennant-race game against the New York Yankees followed. Despite two Manny Ramirez home runs, the Sox dropped the game to Randy Johnson and the Yanks, heartening the substantial number of Yankee fans in the ENG contingent.



BBQ

Seniors, their parents, faculty, alumni and reunioners gathered for a networking opportunity around drinks and a meal at the dean's house over Commencement/Reunion Weekend in May.



Family Pancake Breakfast

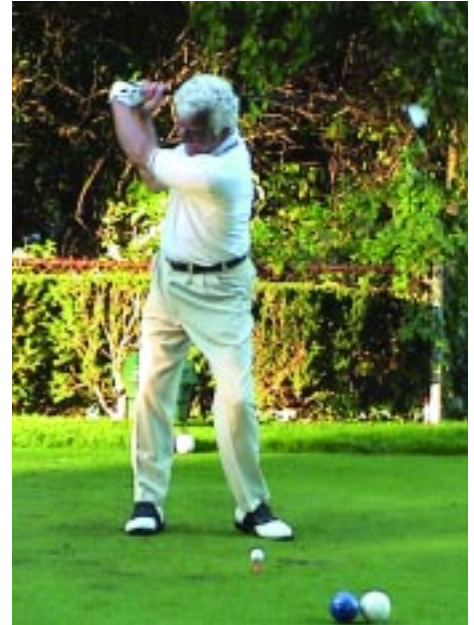


Engineering alumni and families from New Hampshire joined in a tour and breakfast at Parker's Maple Sugar Barn in Mason, NH, on a snowy April day.

Excellence in Engineering Golf Classic



From left: John Flaherty SMG '83, John Rappa, Rick Brown and Michael Duchnowski '91 and '93.



Tournament sponsor Al Muccini '62, shows good form on this tee shot.



Jill Brown and Lisa Dougherty of Beacon Architectural Associates on the green.

About 120 alumni and friends took to the links at the beautiful Woodland Golf Club in Auburndale, Mass. on Oct. 3 for the fourth annual Excellence in Engineering Golf Classic. The day included lunch and dinner in Woodland's classic clubhouse, and a silent auction featuring a large assortment of autographed sports memorabilia and other items. The highly successful event benefited the College's Excellence in Engineering Fund. To find out more about next year's planned Excellence in Engineering Golf Classic, and other alumni events, send your e-mail address to engalum@bu.edu.



Peter Himes measures his shot for the "closest to the hole" competition.



Bettina Briz Himes '86, rolls one to the hole.

BME Reunion



During BME Reunion/Gala Weekend on May 6-7, alumni enjoyed local tours and museum visits and then joined faculty and seniors at the BU Club for an evening of dining and dancing (bottom left). At left, Kerry Foley '91, and her husband Patrick '91 and '94, took a Duck Boat tour of Boston and posed with the captain. Below, the John F. Kennedy Library and Museum, Alumni Board member Karen Kullas '77 (third from right) reunites with other BME alums during tour.



Ski Outing

Alumni young and old, and their families, congregated for the annual outing at Nashoba Valley Ski Resort at the invitation of owner Alan Fletcher '60. They were treated to a day of free skiing and tubing, as well as appetizers.



ENG Alumni Awards 2005



Dean Campbell presented awards to Robert Clarke '90 (left) and Felicita Saiez '80.

Four ENG alumni were recognized for their outstanding contributions to the engineering profession and the College at Commencement Weekend festivities in June. Service to the Profession Awards went to Francis Tiernan '70, and Felicita Saiez '80, while Service to Alma Mater Awards were presented to Alan Fletcher '60 and Robert Clarke '90.

Service to Profession Award Francis Tiernan '70

Francis Tiernan is president of Anritsu Company in Morgan Hill, Calif. and a vice president of its parent company, Anritsu Corp., based in Japan. His promotion came in 2004 after a successful turn as manager of Anritsu's Microwave Measurement Division (MMD).

Prior to his appointment, Tiernan held a number of management positions at MMD. He was director of R&D, director of corporate services and director of manufacturing. He also held manufacturing and engineering management positions with a leading test instrument manufacturer before joining Anritsu.

After earning a bachelor's degree from Boston University, he received a BSEE from San Jose State University, and an MBA from Stanford University.

The Service to Profession Award honors Tiernan's contributions to the field and the recognition his work has brought to him.

Service to Profession Award Felicita Saiez '80

While she has achieved career success in engineering, it is Felicita Saiez's effort to draw young people and women into the profession that has earned her the Service to Profession Award.

After more than 20 years in the high technology and information systems industry, Saiez stepped down as president and CEO of the engineering management and consulting firm she founded, LICl, Inc., to start the Global Institute for Technology & Engineering, a non-profit educational organization dedicated to elevating the status of women in international engineering and technology.

A past president of the Silicon Valley Engineering Council, Saiez is a fellow of the Society of Women Engineers, an organization she has been active in since her days at BU, where she helped charter ENG's SWE chapter. She is a member of the board of the Junior Engineering Technical Society, and of cVision. Saiez is an adjunct professor at Ohlone College, where she also serves as chair of the Women in Engineering Advisory Committee. She is also an extension instructor at the University of California, Berkeley. Saiez is a member of the American Institute of Aeronautics and Astronautics, the Institute for Operations Research and Management Science, and the Order of the Engineer.

In addition to her bachelor's degree in aerospace engineering, Saiez holds a master's degree in operations research from Stanford University.

Service to Alma Mater Award

Alan Fletcher '60

In 1964, four years after earning his bachelor's degree in engineering management, Alan Fletcher founded Nashhoba Valley Ski Area in Westford, Mass. and has owned it ever since. Over the years, the resort has expanded and now offers a swim club, day camp and an adult volleyball league during the summer months.

Alan studied electronics for two years at Wentworth Institute of Technology before enlisting in the Navy, where he worked on submarines as an electronics technician. He then came to BU and, after graduation, worked for 10 years in the data processing business before immersing himself full time in Nashoba.

For the past three years, Fletcher has generously donated a free day of skiing to all ENG alumni, as well as a buffet and drinks for them and their guests, and has supported the annual Excellence in Engineering Golf Tournament. His voluntary association with the University has enhanced the stature of the College and is recognized with the Service to Alma Mater Award.

Service to Alma Mater Award Robert Clarke '90

Robert Clarke received his bachelor's degree in biomedical engineering in 1990, and is now director of research at Pulmatrix, a company that develops products that diagnose, treat, prevent or inhibit the spread of airborne respiratory infectious disease.

He has continued to maintain close ties to ENG and serves as a member of the College's Industrial Advisory Board, providing advice on curriculum enhancements to teach innovation to students. He also volunteered to serve as a member of the Biomedical Engineering Class Agent Committee, where he helped organize BME alumni from the past 20 years to attend the Senior Project Reunion Gala.

As a senior employee of Pulmatrix, Robert has reached out to collaborate with the BME department in providing senior projects at Pulmatrix, and in taking on BME Industrial Internships at the graduate and undergraduate levels. He regularly attends ENG alumni and BME functions, and is highly active in networking and mentoring current students. Last year, he was a guest at the BME banquet to induct students into the National BME Honor Society and attended the BME Undergraduate Research Symposium.

Summer Program Nurtures the Child's Inner Engineer

Engineering, like all professions, requires a steady influx of new talent to maintain the field's vitality over the long term. But a relative dearth of young Americans studying math and science is restricting the flow of home-grown engineers, and a perception among school-age kids that science and engineering are impossibly difficult isn't helping.

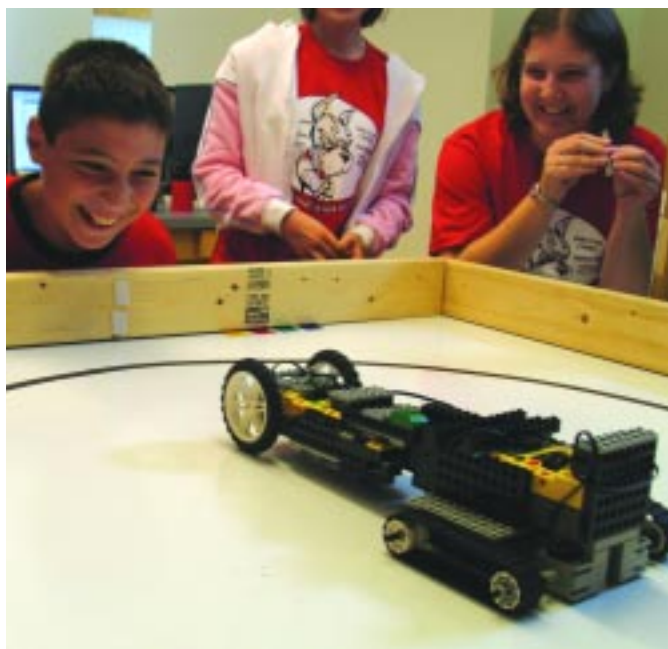
Enter the College of Engineering DESIGNCAMP™, which, for the fourth consecutive summer this year, hosted scores of enthusiastic middle- and junior high-school students, teaching them the engineering basics and showing them the joys of building things and solving problems. This year's program drew a total of 60 students to the two, one-week sessions during July. The classes were taught by high school teachers trained by College of Engineering staff.

"The program teaches them the relevant engineering principles, gives them a box of parts and lets them build something," said Assistant Dean for Administration Richard Lally, who organized the effort. "They create imaginative machines, learn what it's like to be an engineer and have lots of fun."

The younger students built motorized gadgets and constructed candy safes with electromagnetic locks and alarms in the camp's Electrical and Mechanical Gizmos section. Intently laboring next to a board bearing the inscription "Engineering is Problem Solving," the boys and girls focused on their soldering irons, switches, wires and other materials as they built electromagnetic gadgets of their own design.

The Robo-Alley section had more advanced students, who used special Lego kits to create robotic vehicles with electric motors and small computers, which they programmed to make the vehicles perform specific maneuvers. At the end of each day, the vehicles squared off in a series of contests that tested the maneuverability, speed and durability of the students' creations.

Each day also included a visit to the lab of a BU engineering professor, where they were exposed to some more advanced engineering concepts and experienced what life is like on the campus of a major research university. In one such session each student was invited to take the controls of small, fan-driven airfoil in Prof. Gregory McDaniel's lab. As the students gleefully took turns operating the joystick that controlled the model aircraft swiveling on a pole, McDaniel explained the principle



Students entered their robotic vehicles in daily competitions during DESIGNCAMP™.

of lift and how it is altered by manipulating airfoils.

"They're at the University, going into the different labs and seeing what professors and the older students do," said Josh Neudel, a high school science teacher who has led the program's Robo-Alley section for the last two years. "They get to see things like how to create lift. They're gaining an experience they probably wouldn't have had otherwise."

That is particularly important for students coming from economically disadvantaged backgrounds. Recognizing the need for diversity, the College offers a number of scholarships for eligible students in each session. The result has been a healthy mix of boys and girls hailing from a wide range of Greater Boston communities.

Most of the kids had a pre-existing interest in science and the program seemed to reaffirm that at an age when a lot of students are vulnerable to peer pressure which does not favor aspiring engineers.

"The advantage of this program is that it targets the younger kids who might start to drift away from math and science in the middle grades," said Paul LePlume, a high school math teacher who ran the Electrical and Mechanical Gizmos section. "You can sort of capture them back. You can get them interested in science when they're starting to make those internal decisions about what they like and don't like."

For some students, the session is fueling an already intense interest in engineering, an appetite that is not being sated in traditional

classrooms. Sixth-grader C.J. Duffett was one of those students. "This is definitely more fun than school," he said. "I'm learning more than I would sitting at a desk listening to a teacher. This is more hands-on."

C.J. has long had his sights set on an engineering career — and has been eyeing BU for some time. Already adept at programming robots, he found the camp offered a higher level of learning than he could get at school or on his own. "I learned a different style of programming these robots," he said, cheerfully holding his wheeled Lego creation. DESIGNCAMP™, he added, "is good for me since it's a little more in-depth and hands-on. I've been improving my knowledge of robots and programming."

Seventh-grader Amirah Mitchell, a veteran of several science camps, said the BU DESIGNCAMP™ is different because it stresses experimentation over regimentation.

"A lot of science camps I've been to had a strict curriculum that we always had to follow. They had the experiments all laid out for you instead of letting you figure it out for yourself," she said. "If you like science, if you like exploring and figuring things out for yourself, then this is DESIGNCAMP™ for you."

Solving problems and achieving results independently pays off for all of the students, regardless of their interest in or aptitude for engineering, according to Robo-Alley teacher Neudel.

"It gives the kids a lot of confidence," he said. "There are a lot of kids who come in without any background in programming and when they leave here they actually understand some basic coding. They're able to take something that was once a piece of plastic and build it, program it and make it move around. It builds a lot of confidence."

"First, you try it, and it crashes and collapses," said Nathaly Nicolls Figueroa Quenguan, a ninth-grader, of the robotic vehicle building and testing process. "And maybe the second time, too. But eventually, it actually works and you feel really proud of yourself."

"You think there's a lot to building robots, and there is," she added. "But it's not impossible; you can actually do it. So, in the future, if I want to do something, I know I can."

—Michael Seele

Class Notes

1960

GARY KAFTAN (AME) Fort Worth, Texas
Does anyone know the whereabouts of Tom Papoulias, College of Engineering Class of 1960? Please let me know at gary@castlelineproducts.com

1970

ED CHIUCHIOLO (AME) Danvers, Mass.
Wonder of wonders, retirement is near! Can't believe I'm this old and a grandfather too! I have two daughters. Celebrating my 35th wedding anniversary with Jan this month! Life has been good.

JOSEPH LANZA (AME) New Hartford, Conn.
I am working as an engineer at the Air Force Research Laboratory in upstate New York in the area of signal processing. I am married with three step-children and two grandchildren.

1972

JOE COFFEY (BME) Charleston, SC
My wife, Sharon, and I have recently relocated to the Charleston area, and I am working as the operations manager with General Engineering & Environmental, LLC, a member of the GEL Group, Inc. Our son, Chris, is entering his senior year at Villanova.

1977

KAREN KULLAS (BME) Berkeley, Mass.
My husband, Bruce Newcomb, and I attended the all BME reunion in May and I discovered I was the oldest BME alumni present! The tour of Fenway was terrific, and the JFK Museum was a newly discovered treasure regardless of your political affiliation. The speakers at the evening dinner shed some interesting insight into the depths of medicine from both a personal and a corporate standpoint.

1980

TOM BOVIS (MFG) North Kingstown, RI
I am employed by Blue Cross & Blue Shield of Rhode Island as assistant vice president of Engineering/ Administrative Services, responsible for all real estate development and support departments with over 23 years of service. Upon graduation from BU, I received my MBA from Rensselaer Polytechnic Institute. Professionally, I have enjoyed my years of service and am currently working on a very exciting project to consolidate all our offices into one new building in downtown Providence.

On a personal note, I enjoy service to the community. Currently, I am on the board of directors for the Rhode Island Special Olympics and have served as chairman for the past three years for MDA for the ALS fundraiser event. I enjoy travel and recently returned from the Greek Islands, where I like to go every several years.

I look forward to future BU Engineering alumni events and have attended several sporting events offered the past several years.

STEVE KUSHNICK (AME) Marietta, Ga.
Engineering consultant to the turbomachinery and reciprocating machinery industry.

JOHN HICKEY (AME) Fairfax, Va.
I am doing fine these days, living in Northern Virginia with my wife Debby and two boys, ages 15 and 12. I am director of the Federal Aviation Administration's Aircraft Certification Service, and have responsibility for approving all aircraft, engines and parts in the US. I direct a staff of 1,200 engineers and inspectors around the country and abroad. Some of our more exciting projects include the Airbus A-380 and the Boeing Dreamliner (787). I work in Washington D.C. If any of my old classmates ever visit D.C., please stop by my office on Independence Avenue and I'd be happy to see you again!

1984

LIONEL ALFORD (AME) Dayton, Ohio
Lionel recently retired after a career as a test pilot in the Air Force, completed his PhD in aeronautical engineering from Wright State University in Dayton, Ohio, and completed a novel titled *The Second Mission*. He can be reached at pilotlion@aol.com

MANDANA KAVOUSSI (ECE) Bayville, NY
I am an attorney. My firm is Zervos and Kavoussi in Long Island, New York. Please contact me if you like at kavoussi@netzero.com

ED PHOL (ECE) Fayetteville, Ark.
Ed has recently retired from the Air Force after 21 years of service and taken a position as an associate professor of industrial engineering at the University of Arkansas.

1985

ERIC BERGER (AME) North Attleboro, Mass.
Eric was recently awarded Lambda Chi Alpha Fraternity's Order of Merit. This honor is bestowed on members of the Lambda Chi Alpha Fraternity for exceptional service at the local level. In the history of Lambda Chi Alpha, which was founded in 1909 at Boston University, the Order of Merit has only been bestowed upon about 300 of the 280,000 initiated members. Eric serves as the Alumni Advisor for the chapter at Boston University and as the treasurer of the Alpha Zeta Alumni Association. ericberger@comcast.net

JOHANNA ROTHMAN (ECE) Arlington, Mass.
Joanna is president of the Rothman Consulting Group in Arlington, Mass. (www.jrothman.com), specializing in people, project and risk management for high tech organizations. She has also recently published *Hiring the Best Knowledge Workers, Techies & Nerds* through Dorset House Publishing.

1986

HUGO BUENO (AME) Mahwah, NJ
I changed careers seven years ago from mechanical engineering to IT. Recently joined Publicis Groupe in NYC as a network architect. To all my old friends, drop me a line!

JOHN GARVEY (ECE) Long Beach, Calif.
John is president and CEO of Garvey Spacecraft Corp., a small aerospace R&D company focusing on cost-effective development of advanced space technologies and launch vehicle systems. Garvey announced the successful flight test of the Prospector 6 NLV Development Vehicle on May 21, 2005. More information on Garvey Spacecraft can be found at www.garvspace.com

The Garvey Space Craft/Cal State Long Beach team conducted a successful launch and recovery of the Prospector 6 test vehicle at the Mojave Test Area on Saturday, May 21, 2005

BETTINA BRIZ HIMES (ECE) Palo Alto, Calif.
Bettina and her husband, Peter, just launched their very own winery, San Sakana Cellars. Both are still active in high tech industry; Bettina as a VC advisor and startup mentor, and Peter as VP of WW Sales for a semiconductor company. We hope that old BU friends can come visit us soon. Check out www.sansakana.com for wine/personal information.

MARK HINDERS (AME) Williamsburg, Va.
Mark Hinders (BS 86, MS 87, PhD 90) has been promoted to professor of applied science at the College of William & Mary in Virginia. Dr. Hinders came to Williamsburg in 1993 after 11 years at BU, starting out as a freshman and ending up as research assistant professor of aero/mech engineering. Prof. Hinders is a founding member of the Applied Science Department at W&M, and head of the Nondestructive Evaluation Lab.

MARJORIE F. HSU (ECE) Sudbury, Mass.
Back in Massachusetts the last two years, enjoying New England as a family with husband, David, and sons, Christopher and Alexander. I am vice president of network services at Verizon, where I've been since graduating!

1987

JIM ALMAN (AME) St. Petersburg, Fla.
Now living in St. Petersburg, Fla., I've recently left my previous position as director of engineering at Air Tran Airways to join Cyber Defense Systems, Inc. as its first president. CYDF is a development company providing unmanned aircraft ideal for those involved in national defense and law enforcement, as well as monitoring natural resources or in assisting companies requiring security of assets. You can learn more about our company at www.cyberdefensesystems.com. I'd certainly like to hear from classmates or other alums in central Florida. Drop me an email at jim@cduav.com

WEI LEE (ECE) Pleasanton, Calif.
I am married to Amy with two children. Fern is 17, ready to apply to the university and in the process of getting her driver's license. Ning is 14 and just entered high school.

I have been working in the Bay Area since graduation, in the software industry with companies such as Oracle and Cisco. I am the president of a software development company based in San Francisco.

KATHLEEN McLAUGHLIN (ECE)

Toronto, Canada

Hello everyone! I am living in Toronto, am married, and have two little boys. I am a principal at McKinsey & Co., and am applying all those problem-solving skills I learned at the College of Engineering in the business world. I am also working on a number of civic and global projects related to nutrition, sustainable food and the arts. Getting nostalgic as I approach 40 (!) and would love to hear from former classmates.

1988**JIM CAVANAUGH (ECE)** Sudbury, Mass.

I work as a sales rep at SAP America and live in Sudbury, Mass. with my wife and 2-year-old daughter. It's hard to believe it's been so many years since the BU days. You all must be getting old by now.

KEVIN FRYE (AME) Milford, Ohio

Hello to all! I am happily married to my wife Julie, and living in our log home outside of Cincinnati with our two children, Emma (12) and Noah (7). We started our second business this past year, QuikDrop, which is an eBay Drop Site, and we have two stores open and two more being built out, which is keeping us busy! I still think often about the great times I had at BU with my many friends. Would love to hear from you, email is [k2finance@aol.com!](mailto:k2finance@aol.com)

MICHAEL GALLAGHER (MFG)

Sacramento, Calif.

Michael was awarded a doctorate of medicine from the University of California at Davis - School of Medicine. He is now completing an MBA in Management of Technology from the Graduate School of Management at UC Davis. Go Aggies, Go Terriers!

JOHN NAPIER (ECE) Cambridge, Mass.

EMC Corp. sent my job to India in 2001; was unemployed 3 _ years, lost all my savings. Currently employed, paying off \$25,000 remaining credit card debt that kept me from being homeless when unemployed. Current and previous employers are still both sending jobs and whole departments to India, bringing Indian employees here for training and ignoring natives, etc. But for now I have medical care for the first time in three years and homelessness does not immediately threaten, and I am starting to feel happy again sometimes.

GRETCHEN WILSON (MFG) Hampstead, NH

I have been working for Raytheon since 1989, when I was hired as an industrial engineer in the harness/cable department. Next, I supported the Trident program as a process engineer. In 1996, I became a technical writer on the PATRIOT program, and while in this position became a Certified Professional Logistician (CPL). In 2003, I left PATRIOT to become a supportability engineer on a new surface combatant program and now, in addition to that, I am doing some part-time tasks on a missile defense program.

It is evidence that a degree in manufacturing engineering doesn't necessarily mean a career tied to a

factory. I have traveled to the desert while working on PATRIOT (White Sands Missile Range and Ft. Bliss, Texas) and toured destroyers in Pascagoula, Miss. and Norfolk, Va. I live in Hampstead, NH with my husband Eric and our sons Brock (10) and Dana (5). I can be reached by email at gcwilson@alum.bu.edu.

1989**VINCIA FRANCIS-HOLLOMAN (ECE)**

Upper Marlboro, Md.

I'm currently working as an Environmental Scientist with the Environmental Protection Agency in Washington, D.C. My office has oversight responsibility for implementation of the agency's quality system that ensures we use the appropriate quality of data for decisions and policies protecting human health and safeguarding the environment. I also help oversee implementation of the Information Quality Act that governs the quality of information disseminated to the public. I enjoy what I do and travel a lot performing assessments and training. The work isn't engineering related, but the principles are the same. My engineering skills come to play in helping Boy Scouts earn their electrical and electronics merit badges.

WARREN GRILL (BME) Chapel Hill, NC

Warren has been appointed associate professor of biomedical engineering at Duke University. He leads a research program in neural engineering and was named the 2003 Neurotechnology Researcher of the Year by Neurotech Business Report. He lives with his wife Julie and their two children in Chapel Hill, NC.

1990**JORDAN KERR (ECE)** Chicago, Ill.

Jordan is the lead Application Architect for the Sales Force Automation System at Abbott Laboratories, Inc. in Chicago. Contact Jordan at jordankerr@bigfoot.com.

REBECCA BATES (BME) North Mankato, Minn.

I earned my MS from BU in 1996 and finished my dissertation in electrical engineering at the University of Washington at the end of 2003. I am currently an assistant professor in computer and information sciences at Minnesota State University, Mankato. I celebrated the end of my graduate studies by learning a bit of Portuguese and traveling to Brazil.

MIKE SCHAEFFER (AME) Washington, D.C.

I completed my master's degree in political science at Texas A&M and am getting married May 6. Have been in the cockpit as Navy pilot for 15 years but most recent assignment is to State Department as an analyst. Currently living on my yacht in D.C. and would like to hear from my old classmates. I can be most easily reached via my work email account at schaeffermd@state.gov.

BETH (HOTTENSTEIN) TRAVERS (BME)

Coventry, RI

Hello Engineering Class of 1990. Since graduating 15 years ago, I have been working at Brown

University in John Donoghue's lab in the Department of Neuroscience. We have been doing some really exciting research. I married in 1994, and have two wonderful children: Christian, who is 8, and Allison, who is 3. You can email me at beth_travers@brown.edu.

1991**RONALD FINN (AME)** Houston, Texas

Ronald and his wife, Yareni Fiocca Finn, are proud to announce the birth of their first child, Amélie Isabel Finn, on March 5, 2004. Ronald continues to work for United Space Alliance in the Space Shuttle Program at Johnson Space Center, currently as a project engineer for systems engineering and integration. E-mail him at ronald_finn@msn.com.

DAVID MILLER (ECE) Framingham, Mass.

Writing to say "Hi" to the class of '91 and my fellow brothers of Kappa Kappa Psi. My wife Barbara and I celebrated our fifth anniversary in September. We also look forward to the upcoming hockey season, where you can see us with our daughter Kiersten (2) cheering from Section 113. Go B.U. "May thy spirit never die!"

1994**DAVID ALGER (ECE)** Phoenix, Ariz.

David recently returned from a nine-month deployment to Kuwait with his reserve unit in support of Operation Iraqi Freedom. During the deployment he was promoted to the rank of lieutenant commander in the Navy Reserve.

JOSE CALDERON (AME) Boston, Mass.

In February 2005, Jose was awarded the 2004 General Electric Aircraft Engines "Edward Woll Young Engineer Award." This award recognizes technical achievements in their field of specialty by an individual who is 35 years of age or less. Selection is based on creativity, state-of-the-art advances and/or long-term impact on the business.

MICHAEL FRANCO (ECE) Boston, Mass.

Michael was recently named Latin America Process Leader of GE Infrastructure Sensing and as part of his promotion, Michael will spend six weeks in Brazil developing a strategy plan for the country. Following this trip, Michael and his wife, Leila, will enjoy a three-week vacation trip to Greece to celebrate their fifth-year anniversary. E-mail Michael at michael.franco@ps.ge.com.

GARETT KRAUSE (AME) Corpus Christi, Texas

Ryan Thomas Krause was born to Garrett and Sheree on April 29, 2004. His big brother, Kevin, is so happy to have a playmate. LCDR Krause is serving at NAS Kingsville, Texas as a flight instructor for the United States Navy, training student naval aviators in the strike/jet pipeline. E-mail: gkrause@stx.rr.com.

GREGORY MCGURRIN (ECE)

Marlborough, Mass.

Greg and his wife, Jill Greene, are pleased to announce the arrival of their first child, Jonathan Matthew McGurrin. Greg works as a project manager at Teradyne, Inc. in Boston. Jill is pursuing her

Ed.D at Boston University. Greg would like to hear from old friends at greg_mcgurrim1@hotmail.com

PAMELA YOUNG (BME) New York, NY
I am working for Babylon Consulting as a director of information technology. Additionally, I am an MBA student at Cornell University.

1995

CHRISTOPHER RING (AME) Derry, NH
Christopher Ring and wife Jessica (Scott) (CAS, '97) would like to announce the birth of their first child. Their daughter, Shaela Marie, was born on July 15, 2005 weighing 8 lbs., 6 oz. and was 21 inches long. Everyone is doing great and loving every minute of their new family life.

1996

CRYSTAL CASAVANT (MFG) Rutland, Mass.
I completed my MBA last year and am working as an operations manager at Intel's Massachusetts Semiconductor Lab. I recently was in Tara Heath's (ENG '96) wedding to Russel Wolf (CAS '96) at the Venezia in Boston. I am engaged to my fiancé, Mark Roy, and we are planning a September wedding. We live in Rutland, Mass. with our pet cat Skunky and Australian Shepherd Katie.

STEFFEN KALDOR (AME) Fishkill, NY
Steffen married Lu Ann Stephanie Schnable last February in Westfield, NJ. Siavash Yazdanfar (ENG '96) was the best man. Also in attendance were Jeffrey Brinker (ENG '96), Julia Carty (COM '98), Jessica Casucci (SMG '96), Stephanie Cohen Grossman (COM '96), Javier Hernandez (CAS '96), Mariebeth Unsay Hernandez (CGS '95, SAR '98), Rachel Kittner (COM '96), Diane Papaleonardos (CAS '96), Steve Raffaele (CAS '96), and Lucy Roche (CAS '96). Steffen is a materials scientist for IBM, working on semiconductor development and manufacturing at its microelectronics plant in Hopewell Junction, NY. Lu Ann is a freelance product designer in New York City. Write to Steffen at kaldor@alum.bu.edu.

JAMES "BUBBA" MURRAY (BME)
Los Angeles, Calif.

Bubba is a recipient of the 15th Annual Disney/ABC Writing Fellowship. He's living in Los Angeles spending this year developing his craft.

AMANDA (LOCKS) SONG (ECE) Waltham, Mass.
I am working at Nokia in Burlington, Mass. on a Web browser for series 60 phones. My husband, Kevin, and I just bought a house in Waltham, Mass. in December. Other than the new house, I keep busy volunteering, being a Big Sister, cooking/baking and organizing my book club. I would love to hear from the 91-92 9B Engineering Floor!

1997

JOE GRAND (ECE) San Diego, Calif.
Joe continues to live in San Diego, where he runs Grand Idea Studio, Inc. (www.grandideastudio.com). He specializes in the invention, design and licensing of consumer electronics, video game accessories, and toys. His two most recent books, Game Console Hacking and Hardware Hacking: Have Fun While Voiding Your Warranty, show the fun and educational aspects of

modifying hardware to do things they were never intended to do. Joe occasionally gets out of the office to be a competitive triathlete and bang on his drums.

1998

JENNIFER (CHU) HALL (AME)
Glastonbury, Conn.
Jennifer was named one of American Society of Mechanical Engineers' 2005 Engineer of the Year Award winners for District 1 (New England). She and her team were awarded this honor for having one of the most successful fan blades at FAA certification tests in Pratt & Whitney's history. This engine will power the new A380 from Airbus, scheduled for entry into service in 2006.

THO TRAN (BME) St. Louis, Mo.
Tho married Oula Siphanthone, in Las Vegas earlier this year. Jim Luu (ENG '98) and Hung Tran (ENG '95) were in attendance. Tho is working for Isto Technologies Inc (biotech firm) while attending St. Louis University School of Law part time.

JAMES MARTIN (ECE) Van Nuys, Calif.
Well, I am happy to announce that my new song, "Neverland," off the second record from Hermaphrodite - "Masterpieces of Make-Believe" - received honorable mention in the Rock/Alternative Rock category in the 12th annual Billboard World Songwriting Contest. "Neverland" placed among the Top 1,500 entries and was called a hit song. Rock and Roll!

PROSPERO UYBARRETA (AME)
Hyderabad, India
I am currently a US Air Force captain and the US-Indian Air Force Exchange Officer, teaching Indian cadets advanced flying in the Kiran jet trainer at the Indian Air Force Academy near Hyderabad, India. Previously, I served as E-3B/C pilot and aircraft commander, receiving four Air Medals for flying 35 combat missions supporting Operation Enduring Freedom. Contact me via email at pacodice@hotmail.com.

1999

AMISH AGHERA (BME) New York, NY
After college, I went on to medical school at BU (MED '03). After graduating again, I completed a medical internship at Boston Medical Center. Currently, I am an emergency medicine resident at Jacobi Medical Center in the Bronx, NY. In the midst of all this, I also managed to marry my college sweetheart (Seema Patel, BME class of '00).

CAROLYN (CRAPSTER) LAWRENCE (BME)
Cambridge, Mass.
I've finally returned to school, and am in my second year of the PhD program in biomedical engineering at Boston University.

MARGARET (HERMAN) LORTIE (AME)
Raynham, Mass.
Margaret is a quality systems team leader with Johnson & Johnson. She is married to Jeff Lortie (CAS '97) and they have two little boys, Ben, 4, and Joey, 1. Margaret recently graduated from BU with her MS in manufacturing engineering ('05). She would love to hear from her friends. Send her an email at m.lortie@comcast.net.

ROSANNA (LEGARDA) PASQUALE (BME)
Natick, Mass.
Rosanna Legarda married Stephen Pasquale on Aug. 20, 2005 in Natick, Mass. Diana Legarda-Addison (CAS '97) was the matron of honor. Karen Otero (CAS '99) and Melissa Mauro (CAS '99, SMG '03) were bridesmaids.

SHOSHANA WOLFF (AME) San Jose, Calif.
September was a very exciting month for me. I got married over Labor Day weekend and started graduate school shortly thereafter. My program of study is viticulture and enology (grape horticulture and wine biochemistry) at the University of California, Davis. I hope to utilize my background in engineering to update and improve winemaking technology.

2000

CHRIS BUTLER (ECE) San Francisco, Calif.
I just completed my fifth year at Microsoft at the Silicon Valley Campus and live in San Francisco. I currently work on the MSN Search Toolbar and Windows Desktop Search product as a Lead Program Manager.

SARAH FELIX (MECH) Berkeley, Calif.
After working several years for both Bechtel and Pratt & Whitney, I returned to school last fall in pursuit of a PhD in mechanical engineering at UC Berkeley. In addition, I currently enjoy surfing, art, and learning different languages.

ERIC FOX (AME) Philadelphia, Penn.
After working for three years on the West Coast at Boeing Commercial Airplanes in Seattle, I've returned to the East Coast. I am a flying qualities engineer at the Boeing Rotorcraft division near Philadelphia. For the past two years, I've been analyzing the spin resistance and high angle of attack characteristics of the V-22 Osprey tiltrotor aircraft, which is due to enter service with the Marine Corps and Air Force Special Operations division within the next few years. Additionally, I coordinate related flight test efforts at NAS Patuxent River, Md. as we continue to expand the operational capability of this truly unique aircraft. In my spare time, I also managed to receive my MS in aeronautics and astronautics from the University of Washington. Funny, we never learned about tiltrotors in school! Feel free to write to me. erfox2@juno.com

STEVE ROSS (BME) Brooklyn, NY, and **JESSI PARSONS** (BME) Ann Arbor, Mich.
After leaving BU we both decided graduate school was in order, and as luck would have it we both ended up in the Department of Biomedical Engineering at the University of Michigan. Steve earned his MS in 2001 and went to work for American Express as a financial advisor, first in Ann Arbor and currently in Manhattan. Jessi received her MS in 2002 and decided to stay for the long haul -- she will be finishing her PhD in 2006 and is looking forward to moving to the West Coast. You can email Jessi at jeparson@engin.umich.edu and email Steve at stephen.m.ross@aexp.com

CLAUDIO RIOS (AME) Plainville, Conn.
I am happily married now to a wonderful Chinese woman. Her name is Wen Sun and she has irreversibly changed my life. We have bought our own home in Plainville, Conn. and I'm becoming

MITRA MUJICA (AME) San Diego, Calif.

Well, it is time to report my accomplishments and changes in my life since I graduated from BU College of Engineering in 1999. Upon my graduation, I started working at General Electric Lighting. I was accepted to the Operational Management Leadership program and was responsible for designing and implementing storage for finished product at several lighting manufacturing plants in the Mid-Western part of the country, managing all elements of distribution to \$450 million customers such as Grainger and Home Depot, and implemented SPAN, a Six Sigma program on inbound finished product and outbound shipments to customers.

I obtained a great opportunity at Enron in February 2001, located in Houston, Texas. I worked there for a year. It was a pivotal time of my career. I found my passion. I switched from a mechanical engineering profession to a financial engineering profession. I worked in the Enron Research Group and the wealth of knowledge in the commodities markets and learning about futures and derivative trading was huge! The excitement and subject were fascinating. My colleagues were unbelievably generous with time in teaching the essentials of this new field to me. Seventy percent of my colleagues had a doctorate degree (most in an engineering field), so I felt very privileged to be part of the group. My primary responsibilities were researching and forecasting forward curves commodities, and researching correlations between power and natural gas and other commodities. I was also learning the necessities that must be considered for creating a price for a commodity that had never been traded before (i.e. Benzene and Xylene). The wealth of knowledge and opportunities were incredible. Of course as all of you know, the Enron debacle was the reason for losing my job there, but I do not regret making the decision to work for this company. It opened doors to my career and my future. I do not plan in the near term to leave the commodities business. Every single day I learn and gain a wealth of knowledge. The commodities market has been very valuable these last three years and I believe the commodity markets will continue its positive trend in the market for several more years to come. Until this day the research group that I worked with has reunions around twice a year that I made sure to attend.

Two weeks after my departure from Enron, February 2002, I knew that I wanted to stay in the energy industry and there were any energy companies

that were hiring in the Houston area due to the energy fiasco there, so I moved again to work for Sempra Energy. Sempra Energy headquarters are in San Diego, Calif., so I moved there. I was thrilled to move to San Diego! It is a city with a better climate and sportive, positive environment. I have been also very happy with the opportunities that Sempra has given me. The opportunities that that Sempra Energy gave to me were in risk management and structuring and pricing for the power and gas markets for the customers that are served in the Texas region.

While I was in risk management I was responsible for evaluating, reconciling and reporting daily changes in mark-to-market values, margin and volumetric exposure of electricity deals to the structuring, operations and portfolio management groups, providing monthly risk-management reports to corporate management, developing firm-wide procedures for evaluating electricity deals in partnership with audit firms and validating objectivity of pricing used by trading groups by conducted research and comparisons with prices provided by third-party relationships; databases such as Bloomberg, Reuters and ICE; and publications such as Amerex, Gas Daily, Megawatt Daily, and Natsource. Just a wealth of knowledge every day was being absorbed. I was in this position until July 2004.

Starting August 2004 I transferred to the front office (sales) of the company. I was assigned to structuring and pricing deals for customers in the Texas region. Ever since I started this position, I have transacted a mark-to-market of significant net worth. This position was very different from the other positions I held in the commodity field. It was truly exciting, because for the first time I was dealing face to face with sales and the customers I was pricing and structuring for. I analyze and recommend optimal hedges on structures that initial profit estimates and customer expectations for various terms. The interaction with individuals in departments and outside the company is required to achieve our yearly goals and it is the best part of the job. Golf is a big part of communicating with the customer and it has become a bi-weekly activity.

On a more personal note, I am engaged to a lovely gentleman who studied in Cambridge area.

uncomfortably domesticated. I miss the city of Boston very much. With my wife, I would like to live in China five years from now, taking in her culture as much as I can. Life is really good.

I am happily/unhappily working for Pratt & Whitney as a test engineer for the F-22 power plant. I've got such a cool job, if I told anyone about it, they would be envious. Unfortunately, I work killer hours these days making sure that the most advanced jet engines meet their schedule and technical requirements. I also act as a makeshift designer, project engineer, metallurgist, mechanic, and inspector due to the nature of my job; I've got a great job.

LISA (WATERHOUSE) ROGERS (BME)

Londonderry, NH

Lisa and Rob Rogers (CAS '00) announce the birth of their son Caden Gray on March 9, 2005. Lisa is a product development engineer at Atrium Medical Corp. and Rob is a fifth grade teacher in the town of Tewksbury.

DEBBIE TURNER (AME) Chicago, Ill.

I must say that Professor DeWinter is still the best professor/advisor I've ever had. I still follow the advice he gave me throughout school. I'm not sure I could have graduated college had it not been for

him. Besides that little note, life is great in Chicago. My job is a lot of fun and it's nice to be in another happenin' city, although I miss Boston sometimes.

LUKE PREISNER (AME) San Diego, Calif.

After BU, I attended graduate school at Georgia Tech and finished with a master's degree in aerospace engineering. Soon after I moved to Southern California to help work on the A160 unmanned helicopter for Frontier Systems. After leaving Frontier Systems I moved to San Diego. These days I'm working for General Atomics Aeronautical Systems in the propulsion systems group. We do all the sustaining and product improvement for the power plants used in the Predator-A and Predator-B Marauder unmanned aircraft. Many thanks to all, but especially to Dr. Wroblewski, Dr. Bifano and Dr. Grace for their help along the way.

YOSHITAKA KATAYAMA (BME)

Costa Mesa, Calif.

I got married to Jennifer Hegggers on May 7, 2005. I currently work with Oakley as a process engineer and live in Orange County. I would love to hear from old friends.

LORETTA (HAWKES) McHUGH (AME)

Thompson, Conn.

I have been working as a quality engineer at a med-

ical endoscope company since September 2003. I am currently enrolled in the MBA program at Nichols College and plan to complete my studies during summer 2006. Evan and I have lived in Thompson, Conn. since August 2001 and after seven years away from the country, it was nice to move back (but I still miss Boston). We still have season tickets to ice hockey so if you are ever going to a game, send me a note!

loretta.hawkes.200@alum.bu.edu

NICK STEINKE (MFG) Sacramento, Calif.

Nick and Diane Kalar of Sacramento, Calif. were married at Garst Farm in Iowa on May 14, 2005. Alumni in attendance included Nick Condon (CAS '00), Brendan Dwyer-McNally (CAS '00), and Mark Magro (SMG '00). Nick works for engineering-environmental management as an environmental engineer and Diane works for E*Trade as a broker. E-mail Nick at *steinke_nick@yahoo.com*

SHAUN DORIAN SELHA (AME) New York, NY

Upon the completion of my MS in ME ('02) from BU, I moved to NYC and accepted a position in the Leadership Development Program of Consolidated Edison Company of New York. After successfully graduating from that program, I accepted a position as a system engineer with the company and

Class Notes

have been at this post for the past one-and-a-half years. I am also entering my second year of business at NYU's Stern School of Business, where I am working towards my MBA. Look forward to hearing from some of you. selhas@coned.com

KERRY TWIBELL (ECE) Hoboken, NJ
After graduation, Kerry spent a few years working as a software engineer. She's employed as an operations manager at Kaplan Test Prep & Admissions. Kerry is looking forward to becoming a student again, and returning to Boston this fall where she will begin her MBA at MIT Sloan. Kerry is an active member of the BU College of Engineering Alumni Board.

2001

JESSICA (SKORUBSKI) ALBERNAZ (AME) Manchester, Conn.

I am very happy to announce that I was legally married to my partner Tracy Albernaz on May 23, 2004 in Somerset, Mass. We met while I was attending BU; she is from Swansea, Mass. I am working for Pratt and Whitney in East Hartford, Conn. as a design engineer for the F119 engine. I would love to get in contact with old classmates, who may e-mail me at jdalbernaz@hotmail.com.

DOUGLAS CHAN (AME) Danbury, Conn.
Douglas has worked for the last four years as a design engineer for ASM Lithography, Inc. in Wilton, Conn. He will leave his engineering career at the end of July. Douglas and his wife Vivian will relocate to Orlando, Fla. in August, where he will pursue his MBA studies in Rollins College of Winter Park, Fla. Douglas would like to hear from other BU and ENG alumni via e-mail, dchan00@hotmail.com.

PETER CIRAK (AME) North Andover, Mass.
I am working as a senior quality engineer at Palmer Manufacturing Co. in Malden, Mass. I play soccer for the Saugus Iron Workers in the New England Over-the-Hill soccer league, and rock climb when I can.

STEVE COMEAU (BME) Brighton, Mass.
I'm still at BU, entering my fifth year in the PhD program in bioinformatics. I'm working under Dr. Sandor Vajda, with a focus in protein-protein docking.

JEFFREY MARX (BME) Chicago, Ill.
Following graduation and a year working for Harvard Medical School, I returned to Wisconsin to attend law school. This past May I graduated, with honors, from the University of Wisconsin Law School. I am currently a patent attorney working for the intellectual property law firm Brinks Hofer Gilson & Lione in Chicago.

GEORGE PAPAPOULOS (ECE) Walpole, Mass.
George is a principal software engineer for EMC Midrange group. He is engaged to Ashley Ellis (SED '01).

2002

MATTHEW CORBO (ECE) and **TINA (LEWIS) CORBO** (BME) Walnut Creek, Calif.
Matthew Corbo (ENG '02) and Tina Lewis (ENG '02) were married on Oct. 2, 2004 in Vacaville, Calif. Jonathan Seidmann (ENG '03) and Katwren Anderson (ENG '02) were in the wedding party. Also in attendance were John Barraco (ENG '03),

Tomohiko Hayashi (ENG '02), Haruna Morohoshi (ENG '02), and Erik Wood (ENG '03). Matt is enrolled in a PhD program in materials science and engineering at the University of California, Berkeley, and Tina is working for Large Scale Biology Corp. in Vacaville, Calif. We would love to hear from all you 12C'ers. E-mail us at mcorbo@berkeley.edu or talewis1228@yahoo.com.

2003

JILL ANDERSON (AME) and **JAMES NUNAN** (ECE) New York, NY
Jill Anderson (ENG '03) married James Nunan (ENG '03) in Portland, Maine on Oct. 9, 2004. They live in New York City where Jill works for Consolidated Edison Co. of New York and James is an engineer with MGJ Associates. E-mail anderson-ji@coned.com.

NICHOLAS ARCOLANO (ECE) Boston, Mass.
Nick is working as a researcher for MIT Lincoln Laboratory. When not at work, he is usually playing drums for his local band, or planning for his wedding in October.

LUKE COLBY (AME) Lancaster, Calif.
Luke recently visited the College and made a presentation to AME students and faculty. He is working for Scaled Composites, an aerospace and specialty composites development company in Mohave, Calif.

2004

AUDREY ROSENGARTEN (BME) and **BEN McCANDLESS** (MFG) Columbus, Ohio
Audrey Rosengarten (ENG '04) and Ben McCandless (ENG '04) were married Oct. 2, 2004 in Dayton, Ohio. Katherine Buchman (UNI '03) and Paul Jung (ENG '04) were in the bridal party. In attendance at the wedding were Eric Jacobsen (CAS '93, MET '03), Sean Sapcariu (CAS '05), Jami Saloman (CAS '06), Johanna Pacyga (CFA '06), Benjamin Riggs (CAS '02), Jen Ryan (COM '04), Amy Bishop (CFA '06), and Frank Furnari (CAS '02). The couple lives in Columbus, Ohio, where Audrey attends medical school at Ohio State and Ben works as a manufacturing engineer at Central Ohio Welding. Contact Audrey and Ben McCandless at mccandless.10@osu.edu.

**WE WANT
TO HEAR
FROM
YOU!**

**Send your
class notes to
engalum@bu.edu**

Establishing a Legacy

Hing Wah Cheung, father of Wayne Cheung '99 and William Cheung '05, recently established the Hing Wah Cheung Fellowship Fund for engineering graduate students from China and Hong Kong. His \$200,000 gift created an endowed fund that will allow the College of Engineering to attract the very best Chinese doctoral candidates by offering them assistance with tuition and living expenses.

By enhancing the College's ability to compete for the most talented students, the Hing Wah Cheung Fellowship Fund helps Boston University raise its profile in Asia, while offering these students a superior education and exposure to American high-tech opportunities and global culture.

Boston University relies on financial assistance from alumni, parents and corporations to provide student scholarships, and to attract and retain the best faculty. To find out how you can establish an endowed fund for a scholarship or other purpose, contact the College of Engineering's Development Office at (617) 358-0500, or at engalum@bu.edu.



No Barriers

The work of a biomedical engineer is, by definition, interdisciplinary and is made more productive in an environment that encourages collaboration. Joyce Wong works with colleagues in other engineering departments and at the BU Medical School to engineer tiny blood vessels that could provide better outcomes for coronary bypass patients, and to develop a non-invasive technique for evaluating plaque deposits in the carotid artery. "Unlike other places, there really aren't any barriers to working with other people in different departments at BU," she says. "I think it's a great place to work."



BU College of
Engineering
BOSTON UNIVERSITY

WE **CHANGE** THE WAY
THE WORLD WORKS

Joyce Wong

Ph.D., Massachusetts Institute of Technology
Assistant Professor of Biomedical Engineering

To learn more visit:
www.bu.edu/eng

BU College of
Engineering
BOSTON UNIVERSITY

44 Cummington Street
Boston, MA 02215

Non-Profit Org.
U.S. Postage
PAID
Leominster, MA
Permit No. 17