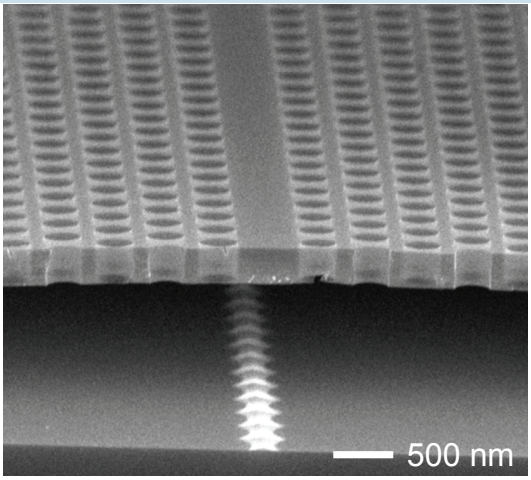
Fall 2010, Volume 3, Issue 13

Mechanical Engineering Newsletter

The Fu Foundation School of Engineering & Applied Science, Columbia University in the City of New York

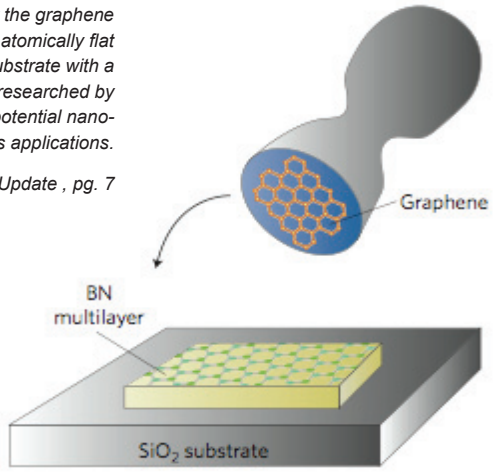


Nanofabricated structures to mold the flow of light, such as nano-opto-mechanical resonators, as researched by James McMillan and Prof. Chee Wei Wong.

See Molding the flow of light , pg. 4

Schematic showing how the graphene is transferred onto atomically flat Boron Nitrate (BN) substrate with a stamping technique as researched by Prof. Jim Hone for potential nano-electronics applications.

See Graphene Update , pg. 7



Message from the Chair

Dear Alumni and Friends,

While the unemployment rate of the country remains high, we welcomed the biggest undergraduate and graduate classes in the history of the Department this fall. We are very pleased with the quality of the incoming students. It is up to us now to provide the same, if not better, learning experience for the enlarged study body, given resource constraints.

Our students and faculty continue making progress in cutting-edge research. Work on nano-opto-mechanical systems and graphene are two examples. Many received recognitions as well as research grants. More efforts have been directed towards societal benefits of our activities, whether to help promote diversity, bring low-cost solutions to developing countries, make contributions to health care quality, or develop technologies for homeland security. We just welcomed Prof. Kristin Myers to join our faculty and will help Prof. Richard Longman celebrate his 40-year service to the Department.

Our connections with departmental alumni have been strengthening. The External Advisory Board (EAB) met again on campus this October. We were grateful to Anna Langobardo for her leadership as the EAB chair last two years and welcomed Dr. Hitoshi Tanaka as the new chair. Two distinguished ME alumni, Dr. Robert Lindberg and Noha El-Ghobashy have recently joined the EAB. One of the very active EAB members, Bill Kennedy, made a generous donation to the Department. We hope to continue engaging alumni to assist the Department in achieving its goals.

I hope you enjoy reading this issue of newsletter as in the past. Please let us know your story and suggestion.

Y. Lawrence Yao

Professor and Chair

In this issue

BACHELOR OF SCIENCE, CLASS OF 2010

Bjorn Anderson, Nelson Andujar, Guilherme Araujo, Mario Avila, Samrat Bhattacharyya, Austin Brauser, William Brown, Rodney Chang, Stanley Chen, Kyle Cobb, Erin Crafts, Jian Dong, Daniel Garcia, James Garofalo, Tucker Gilman, Estela Gonzalez, Frances Jeffrey-Coker, Monica Joshi, Tushar Khandelwal, Edward Kim, Kenneth Koo, Todd Kwao-Vovo, Hiemann Lee, Ning Leung, Raphael Levy, Salvatore Marsico, Mirek Martincik, Ian McKinley, Ismael Nieto, Jefferson Okraku, Darren Pagan, Philippe Putzeys, Jie Qi, Khadijah Ransom, Jeffrey Rodriguez, Chelsey Roebuck, Rajiv Shah, Islam Shawki, David Shimel, Anup Shrestha, Daniel Sievert, Adam Steege, Ian Van Sant, Tat-Hong Wong

SPECIAL CONGRATULATIONS TO THE 2010 MECHANICAL ENGINEERING AWARD RECIPIENTS:

The American Society of Mechanical Engineers Award: Edward Kim
Edward A. Darling Prize in Mechanical Engineering: Adam Steege
William A. Hadley Award in Mechanical Engineering: Rodney Chang
James F. Parker Award in Mechanical Engineering: Philippe Putzeys
Mechanical Engineering Certificates of Merit: Islam Shawki, David Shimel, Jie Qi
Spring 2010 Outstanding Teaching Assistant Award: Matthew Guido
Spring 2010 Outstanding Teaching Assistant Honorable Mention: Jason Pile
Excellence Award (1st Place) for Senior Capstone Design:
"Automatic Trouser Dressing Device for Handicapped" Austin Brauser, Stanley Chen, Darren Pagan, Philippe Putzeys, Islam Shawki
Certificate of Merit (2nd Place) for Senior Capstone Design:
"Laparoscopic Surgery Tool" Kyle Cobb, Adam Steege, Ian McKinley, Daniel Sievert

ACADEMIC YEAR 2010

MASTER OF SCIENCE

Jonathan Abraham, Edward Bossange, Jasmine Bridges, Mateo Chaskel Steiner, Cheng Chen, Matthew Conwell, Ryan Cooper, Amy Dagro, Sibylle Delaporte, Amanda DiMaso, Neha Dobhal, Brian Eisenhauer, Michael Fernandez, Myron Gao, Carlos Gonzalez, Matthew Guido, Erik Huber, Christopher Hwang, Hildigunnur Jonsdottir, Adam Kaczmarek, Adam Kasprzyk, Dong-Ook Kim, Emine Kuran, Shuaimin Liu, Tsung- Ming Liu, Fanny archese, Rochan Mehta, Ross Myers, Elizabeth Novak, Mirko Palla, Jaspreet Paul, Jason Pile, Alexander Potulicki, Lisandro Quinones, Mohammad Rahman, Christopher Rappoli, Joy Reichenbach, Stefano Ronca, Stefano Ronca, Karthik Sasihithlu, William Singh, Dharamjyot Sohal, Anand Thaker, Chen-Chan Tsai, Gaurav Verma, Alexander Williams, Jennifer Williams, Kevin Williams, Tao Xiong, JaeYoung Yang, Zhou Ye, Kyoko Yoshida, Geoffrey Young, Suzanne Yuen, Ruosi Zhang, Xian Zhang

MASTER OF PHILOSOPHY

Justin Abramson, Amy Betz, Saba Ghassemi, Adam Hurst, Bhavik Nathwani, Vikram Rajan, Bin Wang, Jie Xu, Mehmet Yilmaz

DOCTOR OF PHILOSOPHY

Jiangcheng Bao, Rajneesh Bhardwaj, Matteo Caligaris, Woong Yeol Joe, Thai Huu Nguyen, Wei Wei, Nathaniel Wilson, Jie Xu, Jian Zhang

AWARDS & DISTINCTIONS

In collaboration with MEMS guru **CJ Kim** at UCLA, **Amy Betz**, a fourth-year Ph.D. candidate who works in **Professor Attinger's** lab has achieved a world record for pool boiling on a flat surface (heat transfer coefficient>125 kW/m2K). Amy's research is in microscale convective heat transfer. She enhances heat transfer by cleverly manipulating nano- and micro-fluidic interfaces. She will present her findings at the 2011 IEEE conference in Cancun. Her latest work just appeared in Applied Physics Letters (http://apl.aip.org/resource/1/applab/v97/i14/p141909_s1), showing that surfaces with gradients of wettability drastically enhance critical heat flux in pool boiling. Amy was also recently featured on SEAS TV (http://tv.seas.columbia.edu/videos/687/60/73). Where she shares her thoughts on the importance of diversity in the engineering field and describes her experience as a woman engineer. Amy has a strong interest in educating and developing underrepresented minorities in engineering and is currently looking for a faculty position in energy.

Mechanical Engineering doctoral student, **Bhavik Nathwani**, has been awarded the *Interfaces in Science and Engineering* fellowship by the Graduate School of Arts and Sciences (GSAS) Dean's office. The fellowship has been instituted this year with the goal of encouraging graduate students to take on challenging cross-disciplinary projects. His research will focus on studying structures of human neurons using superresolution microscopy that breaks the diffraction limit. This work will be jointly mentored by **Professor Jung-Chi Liao** in Mechanical Engineering and Professor **Rafael Yuste** in Biological Sciences. ""Bhavik has led the efforts to build the first superresolution system of its kind at Columbia. This system will advance research activities in multiple disciplines at Columbia by identifying new features that cannot be observed using conventional microscopes. This fellowship is a great support for our application efforts of this new system."

Mechanical Engineering Senior **Mei Yi Cheung** was awarded MASWE Memorial scholarship from the Society of Women Engineers for the current academic year. Only two of these awards, which are intended to stimulate women to achieve full potential in careers as engineers and leaders, are granted each year. On her academic and research experience, Mei affirms: "Working with the Advanced Robotics and Mechanisms Lab (ARMA) lab and **Professor Simaan** was a great experience. I was able to complete a project on mathematically modeling the coiling properties of cochlea electrode arrays, a step towards better path planning for robot assisted cochlea implant surgeries. This project was then presented at (Columbia University Science Journal (CUSJ) Undergraduate Fall Symposium. The experience really motivated me to aspire towards graduate school and full time research in robotics. Currently I am working on a project for the Art History Department and Columbia Robotics Group on the analysis of unique 3-D range scan models of cathedrals."

2009-2010 Scholarships

Aigrain Family Scholar:
Kristina Bebedzakova '12
Lauren P. Breakiron Scholar:
Daniel Mullins '13
Edwin and Elizabeth Bright Scholar:
Edward Kim '10
Class of 1951 Scholar:
Anthony Coia '11
Class of 1952 Scholar:
Annie Liu '13
James and Donna Down Scholar:
Eric Soltowski '13
Frank H. Lee Memorial Scholar:
Rajiv Shah '10
Anna Kazanjian and Guy Longobardo Scholar:
Islam Shawki '10
Mary Y. Nee Endowed Scholar:
Jian Dong '10

2010-2011 Scholarships:

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Class of 1951 Scholar:
Anthony Coia '11
Class of 1952 Scholar:
Annie Liu '13
James and Donna Down Scholar:
Eric Soltowski '13
Anna Kazanjian and Guy Longobardo Scholar: *Yasir Diab '12*

ENGINEERING DESIGN

Every spring, the Senior Design committee (formed from Columbia alumni, recent Mechanical Engineering student graduates and faculty from other engineering departments at Columbia) reconvenes to review the original prototypes that are designed, fabricated, and tested by Mechanical Engineering seniors for the course otherwise known Capstone Design.

Students are expected to work in design teams, drawing not only on their analytical skills to predict system performance, but also on their creativity to design an innovative concept.

The 10 teams for 2010 :

- **Resonant Acoustic Refrigerator -** Analysis & design of a scale model refrigerator which uses sound waves to compress atmospheric air
- **Rock Climbing Safety Device –** The device can be inserted in a rock crevice & provide an attachment point for a safety line.
- **Tensioned Cable Cutter -** A device which attaches to a tensioned cable & can release the tension so the cable can be safely cut.
- **Laparoscopic Surgery Tool -** A surgery tool that has multiple degrees of freedom containing both a wrist joint and a gripper to illustrate the manipulation (2nd Place Winner).
- **Automatic Trouser Dressing Device for Handicapped -** An automated chair that allows paraplegic people to put on trousers (1st Place Winner).
- **Robotic Wall Painter -** A scale model of a robotic cart that can automatically paint a wall.
- **Actuated Children's Toy with Communication –** A pair of servo actuated toy bears used as a therapeutically for children who have suffered psychological trauma.
- **UnderActuated Robotic Gripper -** In collaboration with a lab in the Columbia Computer Science department. The research involves the gripping of objects using a mechanism that mimics the human hand.
- **Leg Mounted Energy Harvester -** A charging device for cell phones that attaches to the leg & drives a generator while walking.
- **Steam Engine Power Generator -** A generator to extract power from low pressure steam using air as the working fluid.

The 1st Place Award winning team (l to r): Stanley Chen, Philippe Putzeys, Islam Shawki, Prof. Stolfi (advisor), Austin Brauser, and Darren Pagan.

2TRAIN ROBOTICS READY TO GO FOR THE 2010-11 BUILD SEASON

Competition at the Javits Center spring '10. From left to right: Jose, Adam Cohen, Bob Stark and Rubin Bridges

For the past 12 years, **Bob Stark**, ME lab manager, has volunteered many Saturdays to mentor the 2TRAIN Robotics team, consisting of pupils from Morris High in Bronx and so named because the school is along the #2 train line. As a result, the team has successfully participated in many FIRST Robotics competitions. More importantly, Bob inspired many MECE students to sign up as additional mentors for the team. Without the guidance, support and dedication of Bob and ME mentors such as **Jonathan Barlow, Ben Caimano, Phillip Dupree, Eric Stahl-David and Sabina Smajla**, much of the team's fine achievements would have not been possible. In addition to assistance with the design, fabrication and assembly by use of the MECE lab, Bob and the ME mentors have also served as role models that exemplify the rewards of hard work and academic success. **Gary Israel,** founder of the 2TRAIN Team and a teacher at Morris High, says that "there are aspects of the club that are more rewarding than actually winning the robot competition. There are awards granted (such as the Chairman's Award) that encourage the team to succeed in all aspects. This kind of community outreach helps get the word out on behalf of the club, kind of like being an ambassador of getting other kids excited about science and technology...You don't have to win to have a great year. As they say, it takes a village and Columbia has been that village." **Larry Yao**, the ME departmental chair, says, "We are very pleased to be able to make the MECE lab available for this meaningful endeavor. Functioning as a mentor is quite valuable to ME students as well."

ASME GEARS UP FOR FALL

ASME hosts Boeing Recruitment Oct 12th (l to r): Charlie Hruska, Andrei Popescu, Boeing Recruiter and ME Alum Joshua Modrzynski, Alen Trubeja (ASME President) and Albert Miller (Secretary)

This Fall Columbia ASME Student Chapter has returned with a strong focus and rejuvenated spirit. Our mission is to foster community awareness, help develop students into professionals and encourage academic success. ASME seeks to increase awareness about opportunities available to implement the knowledge developed in classes. This includes a wide range of items from information about the FE exam, to the Graduate School application process, and internships as well. We intend to accomplish this goal by creating programming that brings together students, faculty and corporate sponsors so as to obtain a wide range of perspectives and maximize the learning benefits of students. One of our main goals is also to increase knowledge of the current engineering standards. We aim to set the standard among Pre-Professional organizations on campus.

This fall we've hosted several events in order to achieve our goals. The first event was in preparation for the Engineering Career Fair. We brought in a career counselor from CCE to help prepare mechanical engineers to be successful in the job hunt. The second event was titled: Meet and Greet with Boeing. This high profile event was extremely successful with an attendance rate of over seventy students, undergraduate and graduate. Participants had the opportunity to interact with a ME alumnus and a rising BOEING employee, **Joshua Modrzynski** (see photo). Thirdly, we hosted an event in conjunction with the ME department, a graduate school panel where we had two recent faculty members, Prof. Myers and Prof. Terrell, speak candidly about their experiences going through graduate school and the application process.

The next few weeks we will host a discussion on the technology of helicopter dynamics. We will also partner with the Cooper Union ASME Chapter for a design competition. This event intents to increase networking within engineering students across schools while emphasizing the importance and applicability of all that is learned in the classroom. This is also an attempt to increase understanding of basic concepts in engineering for practical purposes. Additionally, in order to continue fostering a strong relationship across engineering fields we will host a social event for undergraduate students to convene outside of an academic atmosphere and become familiar with the project and interests of fellow classmates. This will provide networking opportunities in addition for a space to increase unity and collaboration in the Mechanical Engineering Dept.

KRISTIN MYERS - THE BIOMECHANICS OF THE CERVIX

From *The Record* by Melanie A. Farmer

Cars, bridges, tunnels—these are the structures usually associated with mechanical engineering.

But when Kristin Myers, an assistant professor at the Fu Foundation School of Engineering and Applied Science, was considering research topics in graduate school, her Ph.D. advisor suggested the engineering behind pregnancy. Today, Myers investigates the mechanical behavior of soft tissues, specifically the collagen fibers that make up the cervix, the lower end of the uterus that extends into the vagina. One of the main focuses of her lab is the characterization of the cervix during normal pregnancy and during cervical insufficiency, which is when the cervix starts to soften and dilate too early in the pregnancy. According to the Centers for Disease Control and Prevention, one in every eight babies is born prematurely. Women who have cervical insufficiency are at risk of going into labor in the second trimester, as early as the 24th week of gestation, or miscarrying.

Early in Myers' dissertation research at the Massachusetts Institute of Technology, she took a trip to a neonatal intensive care unit and saw for the first time a one-pound baby. "The doctor who I was working with got a page that his patient at 24 weeks with twins was delivering," said Myers. "I knew this was the project for me." Using hysterectomy specimens, Myers tests the cervix's strength and elasticity; in essence, she is exploring its mechanical properties as a barrier that holds a baby inside and how it can fail as a structure. The goal is to gain a better understanding of the structural properties of the cervix, to discover what goes wrong and why it can sometimes prematurely change. The hope is that the research will lead to treatments or the development of drugs for women with this condition. "There needs to be a way to assess how strong a woman's cervix is," said Myers. "As a mechanical engineer, I am thinking about structure, about material properties. If we can identify a patient with a weak cervix, then perhaps we can manage her pregnancy better." Part of the challenge is to design the tools to test the strength of the cervix. To this end, Myers is working on developing new instruments.

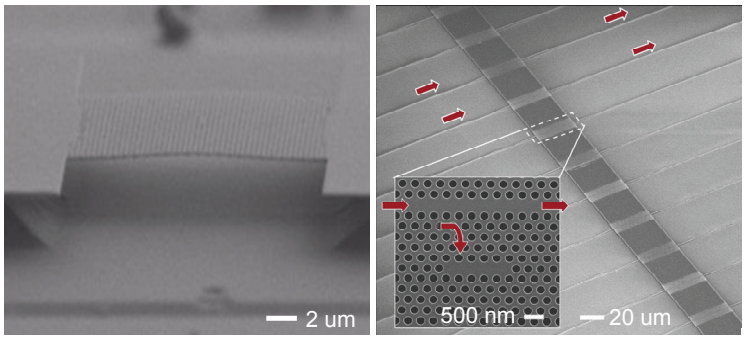
After just a few months on campus, Myers has already teamed up with Dr. Ronald Wapner's team at Columbia University Medical Center's Department of Obstetrics and Gynecology. Wapner, a renowned expert in prenatal diagnostic and screening techniques, directs the division of maternal fetal medicine and was instrumental in developing the chorionic villus sampling (CVS), a prenatal diagnostic test to assess the health of the fetus. He also helped identify a first trimester screening method for Down syndrome, significantly changing the way prenatal genetic disorders are evaluated. "Our bottom line is to find ways to reduce premature births, which is the leading cause of fetal deaths," said Wapner. Myers' work "is the missing piece of what we're trying to accomplish." Growing up in the Detroit area, Myers was around cars a lot. Her father, an electrical engineer for Chrysler, raced cars for fun and tinkered with them in the driveway of their Warren, Mich., home. In high school, Myers interned at General Motors, her first introduction to a research and development lab.

Myers joined Columbia in July after completing her doctoral work at MIT and post-doctoral research at Johns Hopkins University. In addition to the cervical research, Myers also studies glaucoma. She examines the strength of the collagen fibers that make up the white part of the eye, or sclera, which is similar to the tissues in the cervix. Her research explores whether people who are diagnosed with glaucoma have a weaker eye structure, and if so, if there could be a way to correct it mechanically.

CHEE WEI WONG: MOLDING THE FLOW OF LIGHT

Recent remarkable advances in nanofabrication have allowed us to make devices with critical length scales smaller the wavelength of light. We can now practically prescribe – from first principles – the interactions of nanoelectromechanical systems with light.

A recent emphasis is the excitation of mechanical radio-frequency vibrations with light, involving linear and nonlinear dynamics. "This has allowed the community to make GHz resonators with ultra-efficient transduction, deployable in the field", says **Professor Chee Wei Wong**. The military and commercial entities are naturally interested in this, both from fundamental physics and for applications such as radio-frequency, atto-gram mass sensing, gravity meters, and optomechanical filters for communications. "Turns out that when you can trap light in a confined space and bounce it back-and-forth for a time equivalent to 1 million cycles, the light intensity gets really strong", notes Professor Wong.



Nanofabricated structures to mold the flow of light, such as nano-opto-mechanical resonators. A magnified view is shown on p 1.

This strong intensity, when properly tuned to a mechanical resonance, can be used to amplify or even cool (damp) the nanomechanical vibrations. In fact, the laser beam can cool the nanomechanical beam to its fundamental quantum mechanical ground state, "the coolest state of its eigenmodes." In this area, with the discovery of nanostructures and coherent electromagnetic fields, researchers can now explore the mechanics of quantized structures, "where it is mind-boggling that the nanostructures can act in such a coherent way."

Other subset of examples at the Wong group include energy transfer and ultrafast dynamics in third-generation nanostructured solar photovoltaics, observations of negative refraction in metamaterials, and nonlinear and quantum mechanical properties of photons. Prof. Wong is fortunate to work with an exceptionally talented team of students and postdoctoral scientists at Columbia. His work has appeared in journals such as *Nature*, *Nature Photonics*, *Physical Review Letters*, *Applied Physics Letters*, *Microelectromechanical Systems*, amongst others. He received the 2009 3M Faculty Award, the 2008 NSF CAREER Award, and the 2007 DARPA Young Faculty Award.

FACULTY UPDATES

Gerard Ateshian: The Biomedical Engineering Society has elected Prof. Gerard Ateshian as one of the 15 fellows for 2010. Recipients of this honor are recognized for their outstanding contributions and achievements in biomedical engineering. Prof. Ateshian has also recently been awarded two research grants: A R01 grant from National Institutes of Health (NIH) on "Biotribology of Diarthrodial Joints," with Ateshian as the sole Principal Investigator for $1,241,280, and another grant from NIH on "Optimizing Nutrient Supply in Large Engineered Cartilage Tissue Constructs," with Ateshian and Prof. Clark Hung of Biomedical Engineering Department as Co-Principal Investigators for $1,742,366.

Daniel Attinger: This November, Prof. Attinger has been invited to participate to a meeting of the FBI-organized Scientific Group SWGSTAIN. The goal of the group is to standardize and advance the forensics discipline of bloodstain pattern analysis. Attinger was interested to apply his unique expertise in drop impact and evaporation to Bloodstain Pattern Analysis. This spring, he assembled an interdisciplinary team at Columbia with expertise in pattern recognition (SF Chang, Chairman EE), fluid mechanics simulation (M. Spiegelman, Appl. Physics) and complex fluids (P. Somasundaran, EEE). He learned the ropes of forensics with Herb MacDonell, a consultant who testified at the OJ Simpson trial. This summer, Attinger's team was awarded $632,244 from the US Department of Justice. A related grant awarded by NSF was reported in the last issue of the newsletter. The work of Attinger's team was also featured by the News Service of the American Institute of Physics http://www.insidescience.org/current_affairs/bleeding_edge_of_forensics) and reprinted by Fox News.

Arvind Narayanaswamy: Arvind Narayanaswamy received a grant from Seagate to work with researchers from there on a project to study the nanoscale heat transfer processes that affect the performance of emerging data storage technologies like heat assisted magnetic recording.

Chee Wei Wong: Prof. Wong has recently completed two DARPA funded research projects: "Non-Linear Signal Processing and Non-Classical Optics in Silicon Ultrahigh-Q/V Photonic Crystal Nanostructured Cavities," and "Deterministic Spectral Matching of Integrated High-Q/V Photonic Crystal Nanocavity Arrays for Coherent Interactions and Controlling Transitions." He has recently been awarded two more multi-year grants by DARPA: "Circuit Cavity Optomechanics for Cooling and Amplification on a CMOS Chip," and "Collaborative Research: Ultra-Dense Quantum Communication Using Integrated Photonic Architecture." Two doctoral students, Demi Ajayi, a NSF Graduate Fellow, and Mathew Marko, a recipient of the DoD SMART Fellowship, joined Wong research group this fall.

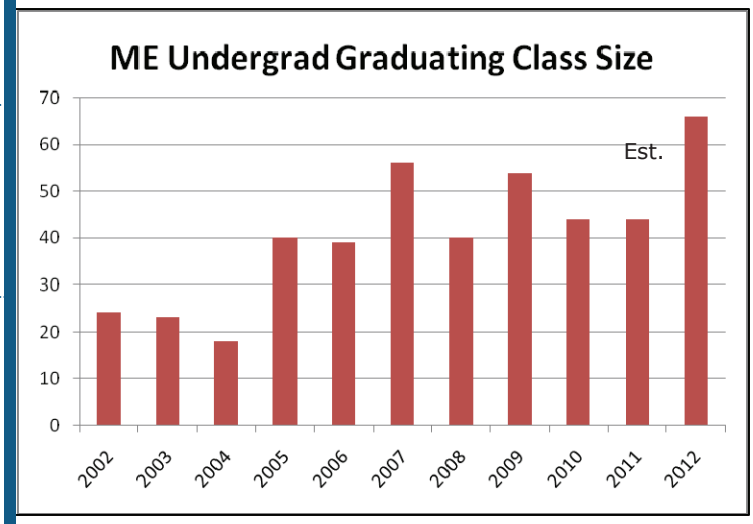
Larry Yao: Prof. Yao has recently been awarded two research grants. One is from National Science Foundation on topic "Laser Modification of Surface Crystallinity of Biodegradable Polymers" to study laser-induced crystallinity changes of these polymers in order to tailor their degrading profiles for potential applications in drug delivery. Prof. Yao is the sole Principal Investigator on this project. The second one is from National Institutes of Health on a project "High-Throughput Minimally-Invasive Radiation Biodosimetry." The Principal Investigator on this project is Prof. David Brenner of Columbia Medical Center. Prof. Yao is one of the Co-Investigators. The total amount of the NSF grant and the Yao's portion of the NIH grant is $1.05M.

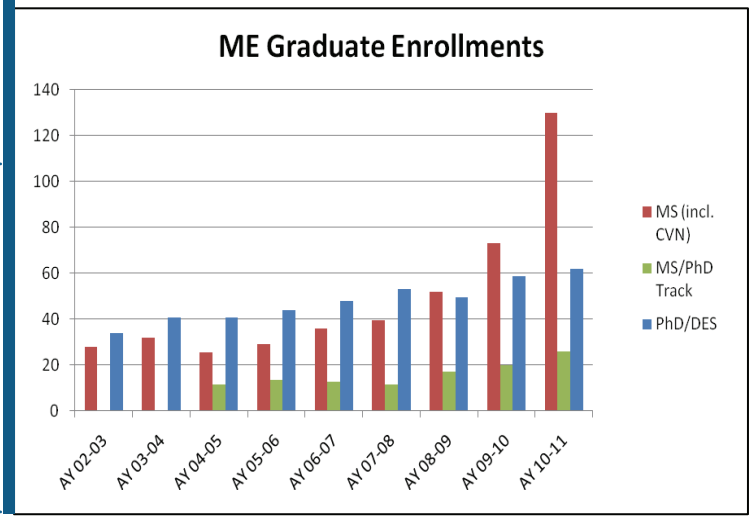
ENROLLMENT AND QUALITY ARE UP

This fall, we have seen an incoming junior class size of 66, perhaps the highest in the history of the department (see figure 1 below). Yet the quality, judging by SAT scores and selectivity, has been up. The increase is perhaps due to a number of reasons. Improvements of our program, (such as more hands-on training), more research and extracurricular opportunities and improved advising has helped attract more students. Generally speaking, interest in ME has increased over at least the last half dozen years. People have begun to see that the fundamental training one receives from a ME program provides an excellent platform to launch a specialization at a higher level.

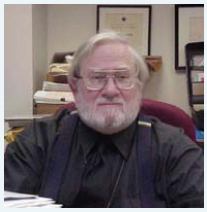
Likewise, our graduate population has grown (see figure 2 below) while quality, judging by GRE Quantitative scores and selectivity, has been up. Currently we have about 130 Masters students, 26 MS leading to PhD track students, and 62 doctoral students (59 PhDs and 3 Doctors of Engineering Science (DES)). The current economic condition is likely a reason that many students come to pursue a Masters degree to improve their academic credentials in time for a job market recovery. The fact that last year we introduced two MS concentrations in micro/nano technologies and energy has also contributed to the increase. Our MS/PhD track and PhD students have steadily increased from 61 five years ago, to 88 this year. This reflects the growth of our research activities.

The expansion of the student body has put strain on our facilities, such as classroom size, computer room seats, and laboratory space. We have been working with faculty/staff, the Registrar's office and SEAS to address the increased needs. We will make sure we continue to provide our students with the superb learning experiences commensurate with our reputation.





ME Alumnus, William Kennedy Gives Generous Gift



William Kennedy, a member of our External Advisory Board (EAB), has transcended the bounds of generosity with a handsome donation of $10,000 to the ME department. As a devoted member of the EAB, Bill has been actively participated in every meeting, and has provided valuable suggestions to the well-being of the department. He was invited to give a speech at the graduating senior dinner a couple of years ago. Bill's gift will be used towards departmental efforts in support of graduate students in the form of conference travel grants. Mr. Kennedy is a Vice President and Principal Professional Associate at Parsons Brinckerhoff and is a registered professional engineer in New York, Texas and California. He has worked on the development of the Subway Environment Simulation (SES) computer program since its inception, specializing in the aerodynamics and fire models. He developed special applications of the SES including air curtains, Saccardo nozzles, platform screen doors, etc. He has also served as a guest speaker and success model for various departmental events. Bill received his MS degree in Mechanical Engineering from Columbia in 1972 and a Mechanical Engineer degree (a professional degree 30 hours beyond a Masters degree) in Mechanical Engineering at Columbia in 1979. Additionally, Mr. Kennedy has published about 30 papers in tunnel ventilation and fire-life safety

Nick Chbat, PhDME '95 has been appointed Adjunct Professor for the Mechanical Engineering Department. Dr. Chbat's day job is with Philips Research North America where he is a Senior Staff Researcher. Dr. Chbat received his Ph.D. in Mechanical Engineering specializing in feedback control systems at Columbia University in 1995. In his first semester, Dr. Chbat has introduced a new course: Modeling & Identification of Dynamic Systems. He has also served on the departmental External Advisory Board since 2006.

Richard Wilches, BSME '02 has recently accepted a job offer at Google, Mountain View, CA. As a student, Rich was very influential in revitalizing the MECE ASME chapter. His legacy as the chapter president speaks for itself as the club has remained active and continues to flourish from the enthusiasm and determination of its current members. After earning his Bachelors, Rich went on to work for United Technologies, earn his MBA from Carnegie Mellon and then worked four years at IBM Consulting before transferring to Google, where he leads the Partnership Business Process & Compliance Team. In regards to the ASME chapter, Rich commented, "I hope my contribution to the class of 2002 of re-introducing ASME as a fun, informative organization for the department continues to pay off!" In fact, Rich (richwilches@google.com) has offered to talk to any ME students who are interested in finding out what role a mechanical engineer can play in a company like Google and in exploring employment there.

EXTERNAL ADVISORY BOARD UPDATE

MESSAGE FROM THE EXTERNAL ADVISORY BOARD CHAIR

The External Advisory Board (EAB) would like to gratefully acknowledge the leadership and the contributions of the outgoing Chair Anna Longobardo who has led the group for the past two years.

At our EAB meeting in October, Professor Yao updated the status of various issues which had been touched on in the previous meetings. One of the most gratifying news was the significant increase in the number of undergraduates choosing to major in Mechanical Engineering as well as the sizable increase in graduate students. While this is great news, it brings new challenges to the department in terms of the workload on the faculty, size and space for classrooms and laboratories and other administrative duties. The two new programs, the express admission to the MS program and the integrated BS/MS program, initiated this year by the department are partly the results of the discussions with the EAB.

Professor Stolfi gave us an update on Formula SAE club and senior design. While last year's Formula SAE competition results were somewhat disappointing due to some mechanical failures, the wide participation and enthusiasm of students from multiple disciplines bode well for future efforts. This activity is important in getting Columbia Engineering's name out in public as well as to attract interest in mechanical engineering within our school. On a separate topic, last year's senior design course produced some innovative designs. Some board members participated as judges at the final presentations. Here, students get a real hands-on experience of designing, evaluating and building products which are invaluable lessons closely paralleling real engineering jobs.

We also heard a presentation by Professor Kristin Myers on her research into the mechanics of soft tissue, specifically dealing with the cervix and the eyes. This is an example of research involving the mechanical engineering discipline coupled to other fields such as physiology, biology, pharmacology, etc. which are becoming increasingly important and indicates the department's heavy emphasis on cutting edge interdisciplinary research by its faculty.

The EAB spent a considerable amount of time with Professors Yao and Ateshian as well as by itself, on the topic of a strategic plan for the ME Department. The Board put forth many comments and suggestions on the Plan and offered to help with the writing of the final version. Other topics discussed at length included the pros and cons of requiring or optionally offering an MS thesis (especially in conjunction with industry sponsored research projects), gender and ethnic diversity of ME undergraduates and faculty and how to get more recognition for our faculty.

The EAB is a group of dedicated ME alumni representing industry, academia and nonprofit organizations. Our mission is to advise, assist and contribute to making the ME Department the best department in SEAS as well as in the world. We are happy to report that much progress is being made in various areas toward the goal of being the best.

Hitoshi Tanaka, BSME '63, MSME '65, D.Eng.Sc.ME '76
Chair, External Advisory Board

The Department is very pleased to welcome two new distinguished members to its External Advisory Board

Noha El-Ghobashy, has earned both her BS in 1996 and MS in 2000 from Mechanical Engineering at Columbia University. She is the director of Technical Programming and Development at American Society of Mechanical Engineers (ASME) Headquarters in NYC. In 2008 she was appointed President of Engineering for Change, LLC; a global alliance that facilitates the development of engineering solutions to improve quality of life in under-served communities worldwide. In addition to her 14 years experience in business development, new product development and project management, Noha has two U.S. patents and has served as an Adjunct Professor at the Polytechnic Institute of NYU in Brooklyn, NY.

Robert E. Lindberg, has earned his DES (Doctor of Engineering Science) in Mechanical Engineering from Columbia University in 1982. Dr. Lindberg has served as President and Executive Director of the National Institute of Aerospace (NIA) since 2003. Simultaneously he holds a faculty appointment as Research Professor in Mechanical & Aerospace Engineering with the University of Virginia. Dr. Lindberg has received numerous honors including the 2003 Egleston Medal from CU Alumni Assoc as well as being published in the fields of aerospace systems design, controls, and robotics.

REMINISCENCES OF 40 YEARS IN THE MECE DEPARTMENT—BY PROF. RICHARD LONGMAN

When I arrived at Columbia in 1970, I was a little bemused that the Dean of Engineering had no credentials in engineering. I think the senior class my first year had only 12 students and we had 16 faculty. That student to faculty ratio would have given us good rankings in US News & World Report. This year the junior class enrollment is way up in the mid 60's.

The ME department was good at spawning new departments. Before I arrived, it generated the Nuclear Engineering Department, and there was a nuclear reactor built into the Mudd building for their use. Many years were spent in court getting permission to turn on a reactor in Manhattan. When permission was obtained, Columbia decided not to turn it on. The nuclear engineers recombined with ME, which now contained four nuclear physicists and the rather substantial plasma physics effort headed by Bob Gross. Dean Peter Likins floated the concept of splitting the department again, creating an Applied Physics and Nuclear Engineering Department. I enjoyed when Dean Likins was around. We were both in the same satellite dynamics field, and I helped him stay in the research game while Dean. When he became Provost, we had research meetings in Low Library.

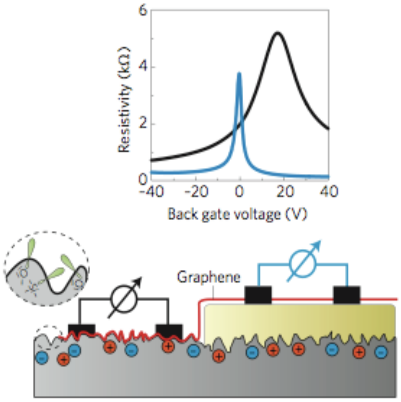
Richard Longman with Sun Yun-Shuan, Premier of Taiwan, 1981

In 1981, I was co-chairman of a conference in Taiwan. The US had recently recognized mainland China, and Taiwan was hungry to keep ties with the US. I was chosen because they needed someone with a title, and at the time I was Vice President of the American Astronautical Society. We could invite quite a number of people from the US and Europe to attend, all expenses paid. The keynote address was given by H. E. Yen Chia-Kan, former President of the Republic of China. We had lunch with him; my wife-to-be Marilynn Danitz sat next to him. Later we had dinner with the minister of education of Taiwan and then we had a meeting in front of the press cameras with Sun Yun-Shuan, the Premier of Taiwan (see photo, I did used to look like that). A couple years later, the department introduced its first robotics class. George Klein arranged for guest speakers each week. I talked about multibody dynamics and Russell Taylor, currently on our ME External Advisory Board, gave a lecture. This effort spawned three new directions for my research and I became one of the early contributors in each. Focusing on the Mercedes production line, I worked on time optimal robot path planning for improved manufacturing productivity. With support from Bob Lindberg, ex-doctoral student, recipient of the Egleston Medal and current member of the External Advisory Board, we started research on space robotics, robots mounted on satellites with a load on one end, and a somewhat similar satellite mass on the other end. In a blackboard discussion with George Klein, we formulated the iterative learning control problem; to make robots doing repetitive tasks learn to produce zero tracking error. Within a year my first paper in the field was written with Graham Goodwin and doctoral student, Richard Middleton, in Australia. It was an idea whose time had come and the same year similar papers appeared on three other continents. Since that time I have produced about 200 papers in these three fields.

The Mechanical Engineering Department has been a wonderful place to work, with a wonderful atmosphere, and a wonderful group of friendly people.

GRAPHENE UPDATE

Profs. Jeffery Kysar and **Jim Hone** were cited in an article published on October 5 in the New York Times on 2010 Nobel Laureates in Physics. The work cited is Kysar/Hone's pioneering work on mechanical property measurements of graphene, published in *Science* and highlighted in a previous issue of the newsletter. The two Russian-born scientists, **Konstantin Novoselov** and **Andre Geim**, who won the Nobel this year, was responsible for creating graphene, an atomically thin form of carbon. The work on graphene at Columbia continues. A paper by Prof. Jim Hone and coworkers published in the November 2010 issue of *Nature Nanotechnology titled*: "Boron Nitride Substrates for High Quality Graphene Electronics." Graphene holds promise for many applications, including advanced electronics. However, its performance is severely limited by the properties of the substrate it sits on, typically silicon dioxide. Hone group used an atomically-perfect two-dimensional material (boron nitrate, BN) as an insulating substrate for Graphene. BN is atomically flat and much less disordered than silicon dioxide, and graphene shows correspondingly superior performance, lower resistivity, lower disorder, and less chemical reactivity (figure). You can view the full article at: http://www.nytimes.com/2010/10/06/science/06nobel.html?_r=1&scp=1&sq=two%20physicists&st=cse



A single piece of graphene (red) is supported by SiO_2 substrate (left) and a flat BN multilayer (right). The corrugations, dangling bonds (inside dashed circle) and charge inhomogeneities that are inherent to SiO_2 surfaces shift and broaden the resistivity peak of the graphene (black line in plot) relative to that of graphene on BN (blue line)

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