IE Optimum

Cullen College Department
of Industrial Engineering Magazine | Fall 2014

IE BY THE NUMBERS

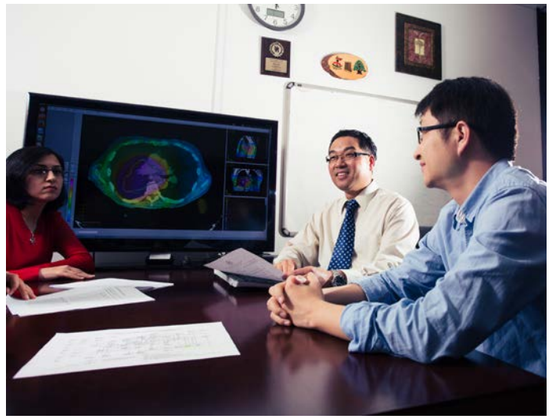
How Industrial Engineering Research
Is Impacting Your City

HITTING THE TARGET

Optimizing Radiation Treatments for Cancer

SEIZING OPPORTUNITY

How One Student is Revolutionizing Radiation
Treatment Therapy



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UNIVERSITY of HOUSTON
CULLEN COLLEGE of ENGINEERING

Industrial Engineering at the Cullen College: **By the Numbers**

CORE RESEARCH AREAS:

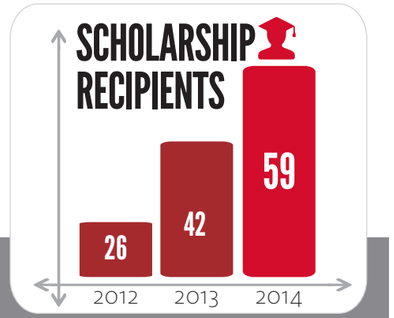
- Healthcare and Medical Decision Making
- Homeland Security, Port Security
- Energy
- Reliability and Maintenance
- Logistics and Transportation, Supply Chain
- Manufacturing

$83,390

= AVERAGE STARTING SALARY FOR INDUSTRIAL ENGINEERS IN 2013 (Source: U.S. Bureau of Labor Statistics 2013 wage data)

72%

OF ALL IE STUDENTS GRADUATE WITHIN 6 YEARS



IE DEPARTMENTAL 2014 FAST FACTS

DEGREE	ENROLLMENT	DEGREES AWARDED
B.S.	105	34
M.S.	136	20
Ph.D.	20	5
Total	261	59

University of Houston Cullen College of Engineering: **By the Numbers**

TOP 100

ENGINEERING SCHOOLS IN THE U.S.
(RATED #78 BY U.S. NEWS & WORLD REPORT)

22:1

STUDENT TO FACULTY RATIO ACROSS UH

80%

OF UH ENGINEERING GRADUATES WITH A B.S. ARE EMPLOYED IN TEXAS WITHIN 1 YEAR

$68,706

AVERAGE STARTING SALARY IN HOUSTON FOR B.S. IN ENGINEERING
(FLC DATA CENTER WAGES FOR 2013-2014)

28

ENGINEERING STUDENT ORGANIZATIONS

$24M

IN RESEARCH EXPENDITURES

11 NAE

TOTAL NAE MEMBERS ON FACULTY
(10% OF TOTAL NAE MEMBERS ARE AT THE CULLEN COLLEGE OF ENGINEERING)

18,045

TOTAL ALUMNI
OF THE CULLEN COLLEGE OF ENGINEERING

CORE RESEARCH AREAS:

We've got everything you'd expect from a top engineering college – outstanding faculty, cutting-edge research and state-of-the-art facilities. But just how good are we?

- Named one of Princeton Review's "Best Value Colleges" (2012, 2013)
- Located in "America's Coolest City" and "One of the best places for 20-somethings" (Source: Forbes.com and Credit-Donkey, 2013)
- Listed as one of the world's top universities for grads who go on to become CEOs (Source: The Times Higher Education of London)
- Ranked #4 in the nation for "Top Colleges Where Students Get the Best Bang for Their Buck" (Source: PolicyMic, 2013)
- Ranked among the top 75 in the nation and #1 in Houston for engineering research and development expenditures (Source: National Science Foundation, 2011)

The Faces of Industrial Engineering: Alumni Q&A

L. Xavier Cano

L. Xavier Cano earned his degree in industrial engineering from the UH Cullen College of Engineering in 2004. During his time at UH, he interned with Continental Airlines, Frito-Lay and Dell, in addition to holding officer-level positions within the Institute of Industrial Engineers. He received his M.B.A. from the University of Texas at Austin in 2010. Cano is a certified Project Management Professional (PMP) and currently works as a project manager for Bank of America in the Existing Customer Credit Process Design Group.

In addition, Cano is also known as The Resume Whiz™, as he has become one of America's leading resume writing coaches for college students and recent graduates for the last 11 years. He is the founder of Innovative Resume Consulting LLC, and the author of "Resumes That Stand Out!"

How has your UH education impacted your life after college?

My education at UH allowed me to discover my passion for engineering while allowing me to gain valuable leadership skills at one of the most diverse campuses in the country.

What is your advice for incoming Cullen College students?

Choose a major that you love, because those who love what they do are the most successful once they get out in the real world. I have to admit that I changed my major three times during my first year at the University of Houston. However, once I discovered industrial engineering, I knew I had chosen a path that represented who I was.

What do you miss most about your time at the University of Houston?

UH gave me the opportunity to get involved through the different student groups, such as my fraternity Sigma Lambda Beta and the Hispanic Student Association. In doing so, I started to feel like a leader on campus. As I became involved, I made many friends and had a chance to serve in leadership roles and do a lot of great work in the community. I miss the wonderful school spirit that any student will experience from just getting involved.

What lessons have you taken from the industrial engineering curriculum in particular that benefit you in your career today?

I completed many projects catered to providing real-life solutions to companies and agencies around Houston. Having an opportunity to engage in these experiences prepared me for the challenging roles I later had once I graduated.

Daryl Santos

Daryl Santos earned his bachelor's degree in Operations Research and Industrial Engineering from Cornell University in 1987, but he then headed south to the University of Houston where he earned his M.S. and Ph.D. in industrial engineering in 1990 and 1993, respectively. He was recently named Vice Provost for Diversity at SUNY-Binghamton University in Binghamton, New York, where he has taught systems science and industrial engineering since 2006. At Binghamton, he also serves as director of the Integrated Electronics Engineering Center.

How has the University of Houston impacted your life?

My siblings were the first members of my family to ever attend college, and they paved the way at UH. (Santos' older sister, Deborah Santos, earned her B.S. in chemistry from the University of Houston in 1982, and older brother Mark Santos earned his B.S. in economics at UH in 1984 and his M.B.A. in 1992.) UH provided evidence that college was accessible to us.

When I was in high school, I participated in what is now known as STEP Forward Camp. The program allowed us to get a glimpse of college life, expanding our outlook and making us aware of higher education opportunities. That program significantly affected my desire to go to college and pursue an engineering degree. Later on, while I was finishing up my Ph.D. degree, I tried to bring things full-circle in a way by working with John Matthews (PROMES program manager) conducting a variety of workshops for PROMES around 1993-1994. I owe a tremendous gratitude to the PROMES Program.

What is your advice for incoming Cullen College students?

Look beyond your undergrad degree and plan to go to graduate school! I often tell students this, and I truly believe it: Not getting a job after my bachelor's degree was the best thing that ever happened to me.

When I finished my bachelor's degree in '87, there were few job opportunities in the oil/energy industry, so I enrolled in graduate school in UH's industrial engineering department. [As a graduate student,] I worked on complex production scheduling problems stemming from the study of the pre-flight processing activities for space shuttle orbiters as funded by NASA. Had I started a job right after I obtained my bachelor's degree, I truly believe my quality of life would be a lot less enjoyable and fulfilling than it is now.

What do you miss most about living in Houston?

There's passable food here, but when I really want Mexican, BBQ or Vietnamese food - and I get those cravings a lot. Nothing satiates me more than a trip home to Houston! A few years ago, I bought a smoker and started to learn to BBQ the proper, hill-country way...I have to say that my briskets, pork shoulders, salmon and steelhead trout that smoke have gotten rave reviews.

RET Program Earns Spot on President's Higher Education Community Service Honor Roll

Not only is the University of Houston's Cullen College of Engineering home to world-class research – it's also a recognized leader in science and engineering outreach. The latest proof: the college's Research Experience for Teachers (RET) program is one of three University of Houston initiatives that together earned UH a spot on the 2013 President's Higher Education Community Service Honor Roll with Distinction.

The Cullen College's "Innovations in Nanotechnology" RET program is led by Fritz Claydon and Stuart Long, both professors of electrical and computer engineering, and Debora Rodrigues, assistant professor of civil and environmental engineering. Funded by the National Science Foundation (NSF), the program brings about 12 middle and high school teachers to the college every summer to conduct nanotech-related research with a faculty expert. With the assistance of a faculty mentor, teachers are then asked to design lessons for their students based on their time as researchers.

Through the program, dozens of lessons and activities have been posted on teachengineering.org, a highly regarded website dedicated to providing teachers from kindergarten through 12th grade with engaging and informative lesson plans. "Because of the efforts we've made and the success we've had, the NSF is saying that the gold standard for [lesson plan] deliverables is the UH model," Claydon said.

In addition, some of the RET participants have earned national recognition. High school physics teacher Mila Bersabal, a two-time RET participant and current RET program master teacher, was the 2009 State of Texas winner for the Presidential Awards for Excellence in Mathematics and Science Teaching. Through the RET program, she devised a lesson plan that had students use light waves to measure the spacing of nanoscale patterns (measured in the billionth of a meter) on CDs and DVDs.

Another notable RET participant is Madeline Landon, a 2009 RET high school student intern. Landon used her time in the program to study the use of seashells to remove harmful lead from drinking water. The project showed that the seashells' chemical makeup caused chemical reactions that removed up to 90 percent of lead from water. This project earned first prize in Environmental Science in the ExxonMobil Texas Science and Engineering Fair and another award in the Intel International Science and Engineering Fair.

"This college is committed to improving science and engineering education throughout the country, and the RET program is a big part of that," said Claydon. "I'm glad to see that the program has been recognized with this honor. It shows that we're really making an impact. The students, teachers and faculty mentors who support the program deserve a lot of credit for this success."

The honor roll program is run by the U.S. government's Corporation for National and Community Service. It recognizes higher education institutions that "reflect the values of exemplary community service and achieve meaningful outcomes in their communities through service." Out of more than 800 institutions that applied for this award, UH was one of just 113 named to the Honor Roll with Distinction. The formal nomination for the award was submitted by Larry Hill, a research professor with UH's Graduate College of Social Work. In addition to the RET program, the UH efforts included in the nomination materials were the Houston Public Broadcast System and the College of Optometry's Mobile Eye Institute.

Cullen College Launches **Future Faculty Program**

The UH Cullen College of Engineering has launched the first Future Faculty Program within the college to prepare top-performing Ph.D. students for a successful career in academia.

The first-of-its-kind program was spearheaded by mechanical engineering department chair and M.D. Anderson Chair Professor Pradeep Sharma, along with associate professor Jagannatha Rao. Together, the two hope to prepare leading graduate students to become successful educators and researchers at top engineering schools around the world.

To achieve this goal, Sharma and Rao stress to students involved in the program that simply completing a Ph.D. dissertation is not enough. Students in the Future Faculty Program who want to become successful engineering educators and researchers must be exposed to the challenges of a faculty search and taught how to set goals and expectations at each stage in their academic careers.

Currently, only a few other programs like this exist in the country. Sharma and Rao foresee the Future Faculty Program becoming a mainstay within the college and hope to see it grow into a post-Ph.D. completion program.

Cullen College Playing Key Role in Offshore Energy Safety Institute

No one disputes that offshore energy development carries environmental risks. Through its involvement in the new Ocean Energy Safety Institute (OESI), the UH Cullen College of Engineering will play a key role in ensuring the safety of offshore energy production for years to come.

The institute is a partnership between UH, Texas A&M University and the University of Texas at Austin. The three schools recently won a competitive five-year, $5 million grant from the Department of the Interior's Bureau of Safety and Environmental Enforcement to establish the institute. Its mission is vital: serve as a platform for communications and research among government, academia and industry professionals in the field of offshore energy.

"The institute itself is going to act as a liaison between industry, regulators and the creators of the best available technologies in terms of safety and feasibility," said Ramanan Krishnamoorti, professor of petroleum engineering and chemical and biomolecular engineering at the college and Chief Energy Officer for the University of Houston. "These technologies are going to come out of places like the Cullen College of Engineering. The college is a critical player in bringing cutting-edge academic research to subsea applications, where technology is rapidly evolving."

As home to the only subsea engineering program in the United States, the Cullen College is an established leader in offshore energy education, Krishnamoorti noted. Through this program, students learn about the design and maintenance of the equipment and infrastructure used in the underwater portion of offshore petroleum exploration and drilling. The program began offering a master's degree this fall and already has more than 48 M.S. students, on top of roughly 160 certificate students.

The college's involvement in the institute should help these technologies find their way to real-world use more quickly, Krishnamoorti said. By providing a platform for partnerships with industry, researchers will have easy access to input and guidance from companies in the offshore sector. Likewise, Cullen College faculty members will be able to present their work to industry members on a regular basis thanks to their involvement with the institute.

Such partnerships will help bring the college some well-deserved recognition for its contributions to the offshore sector, added Joseph W. Tedesco, Elizabeth D. Rockwell Dean and Professor of the Cullen College.

"Offshore resources are going to contribute significantly to energy production in the years to come. The Ocean Energy Safety Institute will play a key role in safely and efficiently developing these resources," he said. "I'm proud that our researchers are so prominently involved in this initiative, and I look forward to seeing their advancements adopted by companies in this sector."

Video Exclusive: UH Engineering Students Take Ride of their Lives on NASA's 'Vomit Comet'

Last year, a team of UH Cullen College of Engineering students was chosen to take a coveted ride in NASA's reduced gravity aircraft, known as the Vomit Comet. The UH team members – collectively known as the Cougarnauts – were chosen as part of an elite group to participate in NASA's Reduced Gravity Education Flight Program, where they performed an assigned experiment during 25-second bouts of weightlessness inside the aircraft. The UH students studied the effects of freezing water in zero-gravity conditions.

The Reduced Gravity Education Flight Program is intended to increase minority student interest in math and sciences fields.

Houston's ABC13 KTRK news station followed the team into zero gravity, filming the students as the plane flew over the Gulf of Mexico and performed nine free-falls, which created a sensation as close to zero gravity as possible on Earth. "It was amazing. Time went by fast, it was so much fun. We learned so much," said biomedical engineering student Aashini Patel.

According to KTRK reporter Kevin Quinn, NASA expects that these experiments could play into the design and implementation of its next-generation spaceships.

For an exclusive, behind-the-scenes look at the Cougarnauts' flight in near-zero gravity, watch our video: www.egr.uh.edu/studentsinzerogravity.

HITTING THE TARGET

Optimizing Radiation Treatments for Cancer

Proton beam therapy is one of the most advanced cancer treatments in the world. But what makes it so effective can, for some patients, be one of its greatest shortcomings.

These shortcomings are what **Gino Lim** is working to overcome.

Lim, who serves as Hari and Anjali Agrawal Faculty Fellow, associate professor and chairman of the industrial engineering department at the UH Cullen College of Engineering, works with the University of Texas MD Anderson Cancer Center to create treatment protocols for "pencil beam scanning" proton therapy. These protocols are customized to each individual patient, ensuring that the treatment is as safe and effective as possible.

To understand the benefits and challenges presented by proton therapy, it's best to start with what makes it different. Currently, most cancer patients undergoing radiation therapy aren't getting protons. Instead, they're often getting photon beam therapy. These beams are made up of X-rays or gamma rays that enter the human body, passing through healthy tissue until they strike their target. However, this pass-through can be a problem.

The nature of photon beams means that tissues they come in contact with absorb a significant amount of energy; even tissue that lies beyond the tumor becomes irradiated. As a result, a lot of healthy cells – often cells of vital organs – can be damaged or killed during photon-based radiation therapy.

Proton beams don't present this problem. The individual proton particles are far heavier than photon particles, making it easier for healthcare providers to control exactly where they go. Based on MRI or CT images, the treatment planner can program the beam to travel to an exact depth in the body before releasing a burst of energy called the Bragg Peak. As a result, the tumor is targeted nearly perfectly, minimizing nearby healthy tissue's radiation exposure.

> "This is an excellent therapy and we should do everything we can to make sure it is as effective as possible."

Treatment plans that stop there, though, aren't accounting for some important biological facts. Involuntary movements can impact the tumor's position. A lung cancer tumor, for instance, will shift as the patient breathes. In prostate cancer patients, the bladder slowly filling up during treatment can shift the location of the tumor.

"If I am shooting it a little too far, I am completely missing the target," said Lim. "That's the potential danger of using proton therapy. The question is what's the best way to hit the target under such uncertain circumstances."

That's where Lim comes in. An expert in large-scale optimization problems, Lim has developed and is constantly refining algorithms that can quickly devise treatment protocols that take these changes into account. These programs determine the exact angles at which the beam should be pointed at the tumor, the exact spots it should hit within that angle and exactly how long each burst of energy should last.

As a purely academic exercise, coming up with the best protocol for this problem isn't that difficult, said Lim. In fact, it could be solved using the techniques found in optimization textbooks. The problem, though, is time. When approached as an optimization problem, a single tumor case is associated with millions of variables and millions of constraints. Even with high-performance computing, solving a single optimization problem of this size with traditional approaches would take weeks to months. That's obviously not acceptable when dealing with cancer treatments.

"I've never completed one of these problems using the typical approaches," Lim said. "We came up with a much better, faster approach. It's very close to the theoretically best solution, probably 3 percent off, but we can produce a solution in about 10 minutes and we're able to solve much larger problems that optimize the angles and every other treatment parameter within 30 minutes using high-performance computing."

The meat of Lim's approach lies in the use of sophisticated optimization techniques with names like "branch-and-bound," "local neighborhood search," "simulated annealing," "simplex algorithms" and "genetic algorithms." Typical combined optimization techniques would evaluate every beam depth and intensity, every combination of beam angles and more. Lim's optimization process starts with a simple solution. Better performing solutions are then sought out through an iterative process that utilizes multiple, otherwise idle CPU cores.

"Eventually, when there's no improvement over time, the algorithm stops. This is the perfect approach for a high-performance multi-core computing environment, which has become the trend in the modern computing world. Whatever number of cores I may have, I can utilize them to evaluate multiple solutions at the same time," said Lim.

As mentioned, Lim is constantly refining these algorithms. One of the questions he's paying extra attention to now is how the tumor shrinks. Though that's the entire purpose of the procedure, it is underappreciated in radiation treatment protocols, Lim said. Though imaging procedures are expensive, Lim believes they should be carried out frequently in order to ensure patients receive the best possible care. In fact, he is working on a paper recommending that tumors be imaged every week during proton therapy.

"The beauty of proton therapy is that it's so precise," Lim said. "The radiation exposure is very low at the point where it enters the body, then it hits the tumor with a big burst of energy. This is an excellent therapy and we should do everything we can to make sure it is as effective as possible."

SPOTLIGHT: May Feng

Q&A:

At what point in your life did you know you wanted to become an engineer, and what influenced you in this decision? How did you decide to pursue the track of industrial engineering?

My father is an engineer, and I knew I would become an engineer like him when I was in high school, so I applied and was admitted to Tsinghua University, the top engineering university in China. I started majoring in manufacturing engineering, and I got a chance to pursue a second bachelor's degree concurrently, so I chose industrial engineering. It was closely related to manufacturing engineering, but with more emphasis on math, something I'm passionate about. It turned out to be a good fit, and I continued in this direction for my career.

Of your listed research interests (reliability & maintenance, quality engineering, probabilistic risk & cost-effectiveness analysis, and six sigma), which do you devote the most time to, and why?

During different stages of my career, I have focused on various interesting problems that can be addressed using powerful IE modeling approaches and analytical tools, such as the Six Sigma analysis of healthcare systems, probabilistic risk analysis of airport security, and reliability and maintenance of evolving technologies. Lately, I devote most of my time to the reliability and maintenance study of advanced and evolving technologies, such as MEMS, biomedical implant devices. My research group has been developing integrated quality and reliability models and preventive maintenance policies for the successful development and commercialization of these evolving technologies with sponsorship from an NSF grant and a Texas ARP grant. Reliability studies of these evolving technologies become increasingly important to achieve widespread acceptance of new devices, both for large-volume commercialization and for critical applications. We have developed reliability models and maintenance optimization for these systems subject to multiple dependent competing failure processes that arise from forces and stresses generated by intended operation of the systems themselves or from external sources. The integrated methodology can provide timely and effective tools for decision-makers in manufacturing to economically optimize operational decisions for improving reliability, quality and productivity.

How did you feel when you learned you had been named the Brij and Sunita Agrawal Faculty Fellow?

I was thrilled to hear that I was named the Brij and Sunita Agrawal Faculty Fellow, especially when I learned that my department was sending out a postcard with my accomplishment and picture on it to many industrial engineering departments nationwide.

At UH, you've received both teaching and research excellence awards. How do you balance performing research with administrative tasks like lesson planning, grading, and mentoring your students?

As a faculty, we are responsible for conducting research, teaching and administrative tasks. It is always a challenge to balance different tasks under pressure from different sources. The most important first step is to prioritize and then manage time accordingly and effectively. One strategy is to create a time management matrix according to importance and urgency of different tasks. I learned to manage my time effectively during my transition from a Ph.D. student to a new faculty member, through various useful sources, such as new faculty workshops, a book called "Tomorrow's Professor" and the associated eNewsletter.

If you weren't involved in engineering, what other profession might you have pursued?

I might have pursued accounting if I weren't involved in engineering. My mother was an accountant, and I am good at numbers with attention to details.

Where do you hope to see your career in 5 years? 10 years?

My career goal in the next 5 to 10 years is to enhance the integrated research and educational program in the area of quality, reliability and maintenance. I also want to establish myself to be an outstanding member of the international community of educators and researchers in this field, by producing high-quality research, producing Ph.D. students who become successful academicians, cultivating interests of undergraduate students in participating in research activities and pursuing education in graduate school, and establishing strong interactions with other national and international institutes.

Industrial Engineering Student Works to Optimize Radiation Treatment

If you lie down and put your hand over your heart, you'll feel your chest rise and fall with each breath. It seems trivial, but the movement of lungs expanding and contracting can drastically change radiation treatment options for patients with lung cancer.

As these patients breathe, the tumor in their lung moves along with the surrounding tissue, sometimes causing radiation to miss the tumor entirely and instead blast healthy cells with its toxic rays. For many physicians, this problem can determine whether or not a patient is even eligible to receive radiation therapy – but not if **Laleh Kardar** has anything to do with it.

Kardar is a Ph.D. student studying industrial engineering at the UH Cullen College of Engineering. Her advisor – industrial engineering department chair Gino Lim – suggested she help him with his research on optimizing proton therapy, an advanced form of radiation treatment. Since Kardar already had a master's degree in biomedical engineering, she said it made perfect sense for her to dive right in to the cutting-edge cancer treatment research alongside Lim.

Initially, Kardar studied beam angle optimization, which is the process of identifying the most effective angle to use when delivering radiation to a tumor. "It's a very large optimization problem," Kardar said. For instance, there may be 36 possible angles to deliver radiation from and physicians will be asked to choose the six angles that combine to provide the best treatment.

That leaves them with 72 million combinations to choose from. That's far too complex of a problem for even the most skilled, most experienced patient care teams. Often, they use simple trial and error, which runs the risk of damaging healthy tissues and forces doctors to balance the delivery of a high, effective dose of radiation with the risk of damaging or killing non-cancerous cells surrounding the tumor. Other times, they rely on algorithms to tell them which angles to use, but these algorithms are complex and very time consuming, even for a high-powered computer.

So Kardar and Lim used industrial engineering techniques to "come up with some solution approaches that find the angle set in a reasonable amount of time," Kardar said. "Using our tool, we've developed a new model which can actually solve the problem very efficiently."

A big part of this research involves factoring in the patient's involuntary movements, which can shift the tumor location and result in an incomplete dose of radiation. For example, motions made by the patient during inhaling and exhaling can cause the location of a lung tumor to move during a treatment session. This presents a large problem to physicians because the radiation beam does not move with the breathing motions, so as the patient breathes and the tumor moves, the risk of healthy cells being damaged by the radiation increases.

"So at MD Anderson, we analyzed the amount of motion of more than 100 lung cancer patients, and we developed a tool which can help the physician predict the outcome of the treatment," Kardar said. "Based on the outcome, they can decide if they can treat the patient using the radiation therapy."

Specifically, because the lungs are so close to such vital organs such as the heart, spinal cord and esophagus, Kardar said some physicians will avoid treating patients with small lung tumors because they run the risk of missing the tumor completely as the patient breathes.

Most recently, Kardar has been working to study the rate of tumor shrinkage during a period of radiation treatment. Because shrinkage isn't always taken into account, sometimes the amount of radiation is too large by the end of the treatment because the tumor is smaller than when the treatment began. By analyzing the rate of shrinkage, Kardar hopes to provide more insight into exacting radiation doses throughout the treatment.

For Kardar, using her industrial engineering background in the field of cancer research is extremely fulfilling. "I find this kind of stuff more practical. I think many researchers... are not using the outcome of their research. They just research something and maybe they can publish it, but after they graduate, they start doing something completely different. But I think what I'm working on is very practical, and since I'm working with MD Anderson and I'm seeing how they're using these tools we develop and taking advantage of all the studies we are doing, it makes me feel much better."

Co-op Provides Real-World Lessons for Industrial Engineering Student

For many students, taking a full-time course load of classes like differential equations and thermodynamics is plenty to deal with in one semester. For **Antonio Cabrales Juan**, a sophomore pursuing his bachelor's degree in industrial engineering at the UH Cullen College of Engineering, it wasn't enough.

This semester, Cabrales began a cooperative education program with Risknology Inc., a risk assessment and process safety firm near the Memorial City neighborhood. Recently, his co-op was extended through the spring 2014 semester.

Co-op programs are a type of internship program that enable college students to receive hands-on career training with pay, according to the Engineering Career Center website. For Cabrales, the biggest benefit he's received is the understanding of how classroom theories play into real world engineering.

"You get that responsibility of knowing that as small as a number may be, it may make a big difference. It can save a life. It makes you take everything with a great deal of responsibility," Cabrales said.

Cabrales' boss and Risknology president Andrew Wolford explained that the company examines the three pillars of risk analysis: anticipating what could go wrong, estimating the chances of those things going wrong, and finally, assessing how bad the damage could be if those things do indeed go wrong. After the BP Deepwater Horizon well blowout in 2010, Risknology served as a consultant to the British oil giant on how to safely and effectively cap the leak.

Now, Wolford says the risk assessment industry is growing in conjunction with what he calls a "real resurgence back to basics." He says new builds and older plants alike need front end consultations as they're going through design (or re-design) processes. Wolford describes their line of work as "keeping hydrocarbons where they belong," like in contained wells or pipelines, but the real nature of the industry is saving lives. Algorithms and analysis determine the risk of disaster, but 'disaster' doesn't just mean lost money or time. Just like in the Deepwater Horizon disaster, where 11 workers were killed by the blast, the impact of risk analysis can mean the difference between life and death for those working on or around projects. "It's what motivates us to go to work every day, to have that noble purpose, to know that what we do really matters," Wolford said.

That fact isn't lost on Cabrales, either. He said that his co-op with Risknology has helped him to apply the engineering theories he's learning in school to the real world. In his end-of-semester summary paper – a requirement of the co-op – Cabrales stressed that before his work experience, he never fully grasped the gravity of some of the decisions engineers make. Now that he's had first-hand experience with the consequences of poor decision-making, he more completely understands what is at stake: human life.

He also said, thanks to his co-op, he's now better equipped to take lessons taught in class and relate them to how and where they will fit in to his career once he's working full-time. "I try to see how [the lessons] might be helpful. For example, in the user guide for the program we use here (at Risknology), all you see is differential equations. At the beginning of the semester I couldn't understand anything. Now, after the differential equations class, I try to apply what's being taught and it actually makes much more sense."

UH System Board of Regents Appoints Industrial Engineering Alumnus

Cullen College alumnus and advocate **Durga D. Agrawal** has been appointed to the University of Houston System Board of Regents by Gov. Rick Perry.

Agrawal received his master's and doctoral degrees in industrial engineering from the Cullen College of Engineering. Since then, he has become one of the Cullen College's most impassioned proponents, donating his time and energy to the college by serving on its Industrial Engineering Advisory Board and Engineering Leadership Board. Recently, Agrawal donated $1 million for the construction of the new multi-disciplinary engineering research and academic building, known as the MREB.

Agrawal currently serves as president and CEO of Piping Technology and Products and director of the Agrawal Association of America. He is a member of the National and Texas societies of Professional Engineers, and the India Cultural Community and Industry Trade Advisory Committee. He is also a past member of the Texas Higher Education Coordinating Board, a member of the board of advisors and past president of the Indo-American Chamber of Commerce of Greater Houston, board member of Friedman Industries, and a member and past president of India House Houston. Agrawal received a bachelor's degree in mechanical engineering from the University of Delhi College of Engineering in India.

Young Alumna Awards $1K Scholarship to Entrepreneurial IE Student

Nwamaka Nzeocha, an electrical engineering graduate of the Cullen College, awarded a $1,000 scholarship to a current industrial engineering student through her "Dare to be Different" scholarship contest.

"I wanted to make the scholarship something that I'm very passionate about, which is thinking outside of the box, but not in a cliché way," Nzeocha said.

"Not every engineer that graduates has to be a factory-type, run-of-the-mill engineer," she said. "I want to encourage people. If you have an idea that may be a little bit different, it may not be something you saw in a textbook or something you were trained to do, but you've been groomed with all that engineering knowledge and you can use those skills to do something that can really impact somebody's life, really change things for the better."

Nzeocha found a way to use her electrical engineering education both inside and outside of the oil and gas industry. During the day, Nzeocha works as an electrical engineer at Chevron, but when the work day is through, she focuses on EasyWeave.com, an online sales platform for hair extensions that she calls her "baby."

To participate, scholarship applicants submitted a short video explaining their unique entrepreneurial ideas. The winner was **Joe Udoh**, an industrial engineering major at the college who runs Program Lords, a web based system that allows students to schedule tutoring sessions with their more senior peers. Program Lords, Udoh said, has allowed him to learn many of the basics of running a business, including scheduling appointments, hiring and firing employees, validating the business and researching the market. Udoh now wants to franchise Program Lords to give other students the same valuable experiences.

"This has made me a better business-savvy individual," Udoh said in his video. "I would like to take this idea and create a platform out of it, a way for individuals like myself, who dare to be different, to be able to learn how to run a business."

A Special Thank You to our Donors and Supporters!

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IE Annual Awards & Honors Banquet

The UH Cullen College of Engineering's Department of Industrial Engineering hosted its annual awards and honors banquet last May to honor the department's outstanding alumni, donors, faculty, staff and students. The formal affair was held at Brady's Landing restaurant.

The event featured a heartfelt tribute to George Hall, a well-known and beloved alumnus of the department who earned his master's degree in industrial engineering from the Cullen College at the tender age of 86. To this day, Hall serves an inspiration to many Cullen College students and a testament to the fact that it is never too late to follow your dreams.

Awards for scholarship donors and recipients were also presented at the banquet, along with outstanding faculty, staff and student awards.

For more IE Banquet pictures,
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Research Interests: Applied optimization, large-scale computational optimization, robust optimization, operations research applications in health systems, and evacuation planning and management.

Selected Publications:
G.J. Lim, M. Rungta, and M.R. Baharnemati, "Reliability Analysis of Evacuation Routes under Capacity Uncertainty of Road Links," IIE Transactions, vol. 47, pp 50-63, January 2015. (Featured Article)

L. Kardar, Y. Li, X. Li, H. Li, W. Cao, J.Y. Chang, L. Liao, R. X. Zhu, N. Sahoo, M. Gillin, Z. Liao, R. Komaki, J. D. Cox, G. Lim, and X. Zhang, "Evaluation and mitigation of the interplay effects for intensity modulated proton therapy for lung cancer in a clinical setting," in press, Practical Radiation Oncology, August 2014.

J. Cho, G. Lim, T. Biobaku, S. Bora, and H. Parsaei, "Liquefied Natural Gas Ship Route Planning Model Considering Market Trend Chang," Transactions on Maritime Science, 3(2), pp 119-130, October, 2014.

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Yupeng Li, Laleh Kardar, Xiaoqiang Li, Heng Li, Wenhua Cao, Joe Y. Chang, Li Liao, Ronald X. Zhu, Narayan Sahoo, Gillin Michael, Gino Lim, and Xiaodong Zhang, "On the interplay effects with proton scanning beams in stage III lung cancer," Medical Physics, 41(2):021721, February 2014.

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G.J. Lim, S. Zangeneh, M.R. Baharnemati, and T. Assavapokee, "A Capacitated Network Flow Optimization Approach for Short Notice Evacuation Planning,", European Journal of Operational Research, 223(1), pp234-245, November 2012.

W. Cao, G.J. Lim, A. Lee, Y. Li, W. Liu, R. Zhu, and X. Zhang, "Uncertainty incorporated beam angle optimization for IMPT treatment planning," Medical Physics, 39(8), pp 5248-5256, August 2012.

A.D. Sonmez and G.J. Lim, "A decomposition approach for facility location and relocation problem with demand change under uncertainty," European Journal of Operational Research, 218 (2), pp 327-338, 2012.

Gino J. Lim and W. Cao, "A two-phase method for selecting IMRT treatment beam angles: Branch-and-Prune and local neighborhood search,"European Journal of Operational Research, 217 (3), pp 609-618, 2012.

A. Mobasher, G. Lim, J.F. Bard, and V. Jordan, "Daily scheduling of nurses in operating suites," IIE Transactions on Healthcare Systems Engineering, vol. 1, Issue 4, pp 232-246, 2011.

FULL-TIME FACULTY

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Research Interests: Supply chain management, e-commerce, manufacturing processes, project management, management information systems, and enterprise resource planning (ERP).

Selected Publications:
Wireless Communications Network, Technology and Applications, Tjing Ling Institute of Industrial Research and Automation, Taipei, Taiwan, March, 1998.

Artificial Intelligent and Expert System, Institute of Information Technology, Taipei, Taiwan, August, 1992.

Applications of Artificial Intelligence to an Off-Line Instruction System, Volume II, NASA/JSC Contract F19628-86-C-001 T-3589M, MITRE Report, Houston, Texas, September, 1986.

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Research Interests: Discrete event simulation; management, operations, and equipment training simulators; and engineering management.

Selected Publications:
Nwofia, O. C. and Chung, C. A., "A Methodology for Designing Airports for Enhanced Security Using Simulation," Journal of Aviation Technology and Engineering, vol. 3 no. 1, 2013

Chung, C. A., "Simulation Design Approach for the Selection of Alternative Commercial Passenger Aircraft Seating Configurations", Journal of Aviation Technology and Engineering, 2012, vol. 2, issue 1, 1-5.

Alfred, M. and Chung, C, "Simulator for Engineering Ethics Education (SEEE2) Design, Development, and Evaluation of a Second Generation Interactive Simulator for Engineering Ethics Education (SEEE2), Science and Engineering Ethics, June 2011.

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Research Interests: Applied probability and statistics, quality and reliability engineering, and economic optimization in manufacturing.

Selected Publications:
Jiang, L., Feng, Q., Coit, D.W., Modeling Zoned Shock Effects on Stochastic Degradation in Dependent Failure Processes.IIE Transactions. (To appear)

Arab, A., Feng, Q., Reliability Research on Micro- and Nano-electromechanical Systems: A Review. International Journal of Advance Manufacturing Technology, 74(9): 1679-1690, 2014.

Song, S., Coit, D.W., Feng, Q., Reliability for Systems of DegradingComponents with Distinct Component Shock Sets. Reliability Engineering & System Safety. 132:115-124, 2014.

Xiang, Y. Coit, D.W., Feng, Q. Accelerated Burn-in and Condition-based Maintenance for n-subpopulations subject to Stochastic Degradation. IIE Transactions. 46(10): 1093-1106, 2014.

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Peng, H., Feng, Q., Reliability Analysis for Degrading Systems with 100% Quality Inspection after Burn-in.International Journal of Business Analytics, 1(2): 34-48, 2014.

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Keedy, E., Feng, Q., Reliability analysis and customized preventive maintenance policies for stents with stochastic dependent competing risk processes. IEEE Transactions on Reliability, 62(4):887-897, 2013.

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Xiang, Y., Coit, D.W., Feng, Q., n-Subpopulations experiencing Stochastic Degradation: Reliability Modeling, Burn-in and Preventive Maintenance Optimization.IIE Transactions, 45(4): 391-408, 2013.

Jiang, L., Feng, Q., and Coit, D.W., Reliability and Maintenance Modeling for Dependent Competing Failure Processes with Shifting Failure Thresholds. IEEE Transactions on Reliability, 61(4):932-948, 2012.

Keedy, E., Feng, Q., A Physics-of-Failure-Based Reliability and Maintenance Modeling Framework for Stent Deployment and Operation. Reliability Engineering & System Safety, 103: 94-101, 2012.

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Peng, H., Feng, Q. and Coit, D.W., Reliability and Maintenance Modeling for Systems Subject to Multiple Dependent Competing Failure Processes. IIE Transactions, 43(1): 12-22, 2011.

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Research Interests: CAD/CAM, robotics, manufacturing systems, and rapid prototyping and reverse engineering.

Selected Publications:
Arab Naser, Ali K. Kamrani, "An Integrated Methodology for Dynamic Routing in Evacuation Planning," International Journal of Collaborative Enterprise (IJCENT), Vol. 3, No. 4, pp. 314 – 345, 2013.

Ali K. Kamrani and Maryam Azimi, "Statistical Based Prediction Analysis for Head and Neck Cancer Tumor Deformation", Journal of Healthcare Engineering, Vol. 3, No. 4, pp. 571 – 586, 2012.

Ali K. Kamrani, Hazem Smadi, and Sa'Ed M. Salhieh, "A Methodology for Customized Product Design and Manufacturing," Journal of Manufacturing Technology Management Vol. 23, No. 3, pp. 370-401, 2012.

Ali Kamrani, Hazem Smadi, Sa'Ed M. Salhieh, "A 2-Phase Methodology for Modular Product Customization," European Journal of Industrial Engineering, Vol. 6, No. 4, pp. 391 – 421, 2012

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Ali Kamrani, Arun Adat and Maryam Azimi, "A Methodology for Analysis of Manufacturing Operations due to Complexity", International Journal of Industrial Engineering - Theory, Applications and Practice, 18(2), 71-82, 2011

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Research Interests: Modeling of healthcare, energy and manufacturing systems, facilities design, simulation, and project management.

Selected Publications:
"Artificial Intelligence Approach to Support Statistical Quality Control Teaching," (with M. Reis, E. Paladini and W. Sommer), Computers and Education, 47 (4) 2006, 448-464.

"Controller Design and Performance Evaluation for Deadlock Avoidance in Automated Flexible Manufacturing Cells," (with S. Mohan and A. Yalcin), Robotics and Computer-Integrated Manufacturing, 20 (2004) 541-551.

"Deadlock Avoidance in Flexible Manufacturing Systems," (with S. Mohan and A. Yalcin), Proc. Of International Conference on Flexible Automation & Intelligent Manufacturing, 2003.

"Continuity of Government Operations – Developing an Alternate Relocation Plan," (with M. Rogoff, V. Harrell, et. Al.) Public Works, January 2003, 40-43.

"System Dynamics Modeling of Agility in a Supply Chain," (with M. Deshmukh) Proc. Of VIII Int. Conf. on Industrial Engineering & Operations Management, October 2002.

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Research Interests: Optimization modeling, theory, and algorithm design with applications in healthcare, financial engineering, and big data.

Selected Publications:
X. Chen and J. Peng. New analysis on sparse solutions to StQP with random data. Under review for Mathematics of Operations Research.

J. Peng and T. Zhu. A Nonlinear Semidefinite Optimization Relaxation for the Worst-case Linear Optimization under Uncertainties. Department of Industrial Engineering, University of Houston, 2013. Submitted to Mathematical Programming.

J. Chen, L. Feng, J. Peng and Y. Ye. Analytic results and effective algorithm for optimal portfolio liquidation with market impact. Forthcoming in Operations Research, 2013.

P. Jiang, J. Peng, M. Heath and R. Yang. CBMF: a clustering approach for binary matrix factorization. To appear in Data Mining and Knowl. Discov. for Big Data: Methodologies, Challenges, and Opportunities, Eds W. Chu., Springer series "Studies in Big Data", 281-303, 2013.

X. Chen, J. Peng and Sh. Zhang. Sparse solutions to random standard quadratic programming problems. Mathematical Programming, Vol 141(1),273-293, 2013.

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Research Interests: Ergonomics and human factors, safety engineering, system design and evaluation, and rehabilitation/ biomechanics.

Selected Publications:
Delclos G. L., Bright, K. A., Carson, A. I., Felknor, S. A., Mackey, T. A., Morandi, M. T., Schulze L. J. H., Whitehead LW., "A global survey of occupational health competencies and curriculum," International Journal of Occupational and Environmental Health, 11, 181-194, 2005.

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Schulze, L.J.H., Ramos, M. H., and Tetrick, L., "Effectiveness of arm supports during typing for adults with neurological disorders," Journal of Occupational Rehabilitation, 11(4), 235-253, 2001.

Schulze, L., Delclos, G., and Pinglay, N., "Integrated Job Assessment (IJA) - A Technique to Document Job Activities, Identify Occupationally-Related Risk Factors and Modes of Remediation and Accommodation," International Journal of Occupational and Environmental Health, 7(3), 224-231, 2001.

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Research Interests: Decision making under uncertainty; eesign, control and management of production and service systems; modeling and analysis of flexibility in supply chains; supply chain revenue management; queuing control; and applied probability.

Selected Publications:
E. Tekin, "Asymptotic behavior of discrete-time Markov chains", Wiley Encyclopedia of Operations Research and Management Science, edited by J. Cochran, John Wiley & Sons, Inc., 2011.

E. Tekin, "Asymptotic behavior of continuous-time Markov chains", Wiley Encyclopedia of Operations Research and Management Science, edited by J. Cochran, John Wiley & Sons, Inc., 2011.

E. Tekin, W.J. Hopp and M.P. Van Oyen, "Pooling strategies for call center agent cross-training," IIE Transactions, 46, 1-16, 2009.
S. Cetinkaya, E. Tekin, C.Y. Lee, "A stochastic model for joint inventory and outbound shipment release decisions," IIE Transactions, 40, 1-17, 2008/

W.J. Hopp, E. Tekin, M.P. Van Oyen, "Benefits of skill chaining in production lines with cross-trained workers", Management Science, 50(1), 83-98, 2004.

E. Tekin, I. Sabuncuoglu, "Simulation optimization: Recent developments and applications", IIE Transactions, 36(11), 1067-1081, 2004.

E. Tekin, E. Berk, U. Gurler, "Age-based vs. stock level control policies for a perishable inventory system", European Journal of Operational Research, 134, 309-329, 2001.

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