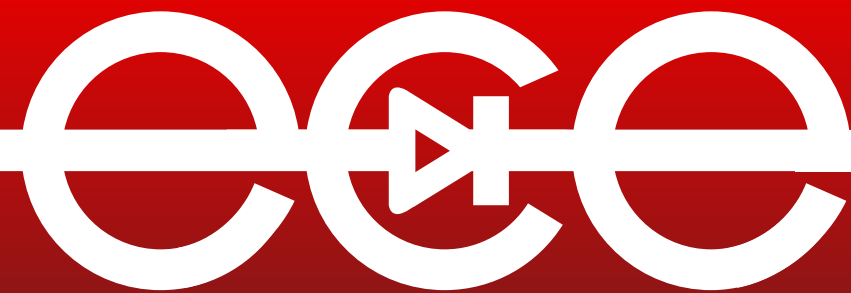


**NC STATE UNIVERSITY**

Volume 2: 2009



# Annual Report 2008-2009



# Message from the Department Head

It is a pleasure to be back at NC State after beginning my career here in the early 1980s. Everyone in the Department and University has been welcoming and supportive, and there definitely is a sense in which it feels like “home.”

At the same time, there have been significant and exciting changes. The ECE Department has grown in both size and quality, and has been completely relocated from Daniels Hall to the Centennial Campus.

In the following pages we have tried to give you a glimpse into some of the highlights of the past year, with topics as diverse as renewable energy, fighting tuberculosis, and Disney Imagineering.

Renewable energy continues to be an area of strength and leadership for the department. The National Science Foundation Engineering Research Center for Future Renewable Electric Energy Delivery and Management (FREEDM) has had a successful initial year. A highlight was the ground breaking of the new Centennial Science Center that will ultimately house the Center along with technology companies desiring to be near the university. The FREEDM Center is directed by Prof. Alex Huang, and is the latest in a long history of NC State energy contributions including innovative power electronics devices developed by Prof. Jay Baliga, and high efficiency solar cells pioneered by Prof. Salah Bedair.

NC State is also known for its innovative Engineering Entrepreneurship Program. Among the creative solutions that emerged from this program during the past year was a simple and inexpensive system for testing for tuberculosis developed by ECE student Hersh Tapadia and Biomedical Engineering teammates Daniel Jeck and Pavak Shah. When mass-produced, this system could have a significant impact on much of the developing world.

A theme of both renewable energy systems and the Entrepreneurship Program is interdisciplinary activity. Taking this theme one step further, ECE student Steven Varela partnered with English major Morgan McCormick and Art and Design majors Ashley Wagner and Corban Prim to create a motion thrill ride to compete in Disney’s ImagiNations Design Competition. Their entry, “Mickey’s Quest to Magma Mountain,” placed Second out of an initial field of 120 entries.

These topics represent only a sampling of the exciting activities, awards, and developments described in this report. I sincerely hope you enjoy learning more about the impact and achievements of our talented students and faculty.



A handwritten signature in black ink that reads "Dan Staneil". The signature is written in a cursive, flowing style.

Electrical and Computer Engineering Department Head and Alcoa Professor

# ECE Annual Report 2008-2009

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## Harvesting the Sun



## Going Green



## Internet for Energy



## Fighting TB: As Easy As 1-2-3



## Disney's Next Generation



*NC State University is dedicated to equality of opportunity. The University does not condone discrimination against students, employees, or applicants in any form. NC State commits itself to positive action to secure equal opportunity regardless of race, color, creed, national origin, religion, sex, age, or disability. In addition, NC State welcomes all persons without regard to sexual orientation.*



# By The Numbers

## Undergraduate and Graduate Enrollment Numbers

### Enrollment Statistics

### Fall 2008

TIME	TOTAL	FR	SO	JR	SR	MR	DR
FULL-TIME	1,241	200	193	158	229	310	151
PART-TIME	265	1	10	37	87	70	60
TOTAL	1,506	201	203	195	316	380	211

### Spring 2009

TIME	TOTAL	FR	SO	JR	SR	MR	DR
FULL-TIME	1,222	142	197	192	318	229	144
PART-TIME	282	4	14	29	108	70	57
TOTAL	1,504	146	211	221	426	299	201

### Degrees Conferred

PHD - 31

MS EE - 66

MS CPE - 62

MS CNE - 18

BS EE - 99

BS CPE - 111



## Computer Engineering and Electrical Engineering Most Lucrative Majors

According to a Forbes.com recent case study, the most lucrative college major today is computer engineering. On average, computer engineers with less than five years' experience earn \$60,500 while those with 10-20 years' experience earn approximately \$104,000 annually.

To rate the most lucrative majors, Forbes.com used PayScale.com, a site which collects real-time salary information from over 10 million users. They looked at 20 of the

most popular majors where most of the graduates go into the private sector. They then used the average salaries of each major to eliminate outliers at the ends of the scales. Graduates with advanced degrees were excluded from the study.

Four of the five highest paid majors for graduates with less than five years' experience were all in fields of engineering, with computer engineering ranking first and electrical engineering ranking third.

Despite the high pay, the number of engineering degrees awarded in the past 10 years has just slightly

increased. One reason is that the programs tend to be very rigorous. Engineering students who can complete the coursework benefit highly from this - employers know they're typically getting competent people straight out of college and are willing to dole out generous salaries to compensate.

"The kinds of majors where you learn to integrate mathematics and science with the everyday world have a tremendous benefit in terms of earnings potential," says PayScale.com's Al Lee. These include economics, engineering, finance and mathematics.

The top half of the page features a composite image. On the left, a man with glasses and a woman are standing in a laboratory setting, smiling at the camera. On the right, a person wearing a white protective suit and hood is working with complex scientific equipment in a cleanroom environment. The title 'Harvesting the Sun' is overlaid in large white letters across the middle of this image.

# Harvesting the Sun

**“...a five percent increase in efficiency means massive changes in energy production and cost efficiency.”**

In 1979 a team led by Dr. Salah M. Bedair, professor of Electrical and Computer Engineering at NC State University, revolutionized solar energy by creating a first-of-its-kind solar cell.

Now, in 2008, he's trying to build upon that research. The results could make solar energy less expensive for consumers.

This time he's accompanied by Dr. Nadia El-Masry, professor of Materials Science and Engineering, and Dr.

John Hauser, professor of Electrical and Computer Engineering. Their goal of improving efficiency could make solar energy production more feasible on a large scale and finally practical and affordable for public use—a goal more than 20 years in the making.

When Bedair began working with his team in the late 1970s, solar cell efficiency was at about 16 percent—meaning the cell was only converting 16 percent of the sun's energy into usable energy. Their goal was to increase this, and their work produced the first multiple-junction solar cell.

“Because solar radiation is made of different wavelengths,” Bedair explained, “the absorption of each wavelength has to be considered separately.”

The original structure they pioneered had two junctions, each capable of separately absorbing a different

wavelength. After much research and improvement, the modern incarnation of that original structure is now produced by Spectrolab, a Boeing company. This cell has three junctions and yields 40 percent efficiency.

The ideal efficiency for a structure capable of absorbing every wavelength would be 70-80 percent, according to Bedair, and though this figure would be “nearly impossible” to achieve, they still hope to improve efficiency by five percent by adding a fourth cell junction. The impact of that increase, he said, will have a huge and immediate impact on the energy market and consumers as solar energy becomes less expensive.

As Bedair pointed out, “at a solar cell station, producing tens of thousands of kilowatts, a five percent increase in efficiency means massive changes in energy production and cost efficiency.”



# Going Green

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Red means go at NC State, but it's green on the minds of university leaders who envision a one-of-a-kind degree for students with an interest in renewable and sustainable energy.

In response to an increasing number of environmental concerns at the global level, as well as a decreasing amount of depletable resources like coal, petroleum and natural gas, leaders at NC State's College of Engineering have been hard at work discussing what could become the first renewable-energy Master's degree program offered at any American university or college.

Beginning in Fall 2009, the ECE department will also begin offering a Renewable Electric Energy Systems (REES) graduate certificate program that will be open to both degree and non-degree students, providing them with the opportunity to develop expertise in renewable electric energy systems and advanced electric power grid technology in addition to their major area of graduate study.

"Right here, in this College of Engineering, our students, our faculty and our staff are making real differences in setting the stage for products to improve our energy, sustainability and our environment," NC State chancellor James L. Oblinger said.

As they go forward with their plans, Dr. Mesut Baran of the Electrical and Computer Engineering Department and others in the College of Engineering will weigh feedback and input from more than 60 industry-leading companies to ensure that the new coursework gives NC State students the tools they need to succeed in the ever-evolving, renewable-energy workplace.





In addition to the new graduate certificate, the REES undergraduate concentration will be open for enrollment to both new and current undergraduate students majoring in the Electrical Engineering degree program. The new concentration enriches the current electrical engineering curriculum with coursework in electromechanical energy conversion, renewable electric power systems, power electronics, and power transmission and distribution systems.

“...I’ve seen the change that is coming in regards to renewable resources...”

Last fall the National Science Foundation (NSF) provided funding for the establishment of an Engineering Research Center (ERC) and created the Future Renewable Electric Energy Delivery and Management (FREEDM) Systems Center at North Carolina State University. One of the center’s key responsibilities is to educate a diverse group of adaptive, creative, globally connected and innovative graduates for the green energy industry through a continuum of educational programs that span from middle school through the doctoral level.

“We are thrilled to start offering an undergraduate concentration in Renewable Electric Energy,” said FREEDM Systems Center College Education Program Director Dr. Mesut Baran. “Students who

complete this concentration will have a working knowledge of current and emerging electric power generation technologies such as photovoltaic arrays, wind turbines and fuel cells along with understanding how to conduct system impact studies to assess the interconnection requirements for a given renewable electrical energy generation system.”

“One of the premier engineering publications said that these are issues of great interest to many students, but that universities have been slow to respond to their needs,” Baran said. “We will be very proactive in our efforts.”

“I’ve worked at Duke Energy for about a year, and I hope to work there after I graduate,” said Kai Hinger (‘10), an electrical engineering major who participates in NC State’s Cooperative Education Program (Co-op). “NC State is on the cutting edge, in terms of where the world is going, and this coursework is just another example of that fact.

“Having worked in the power industry, I’ve seen the change that is coming in regards to renewable

resources, and if we’re the first to help people begin to make those changes, that will be great.”

The potential of this “green energy” curriculum - coupled with NC State’s new renewable-energy research center on Centennial Campus - has already attracted the attention of prospective students interested in attending NC State for both graduate and undergraduate degrees.

“The new renewable energy program will definitely be of interest to students interested in technical aspects of power and energy but who also bear a desire to do something to improve the world in which we live,” said Sharon Schulze, director of The Science House, which partners with K-12 teachers across the state to promote hands-on inquiry-based science learning. “Some students may be thinking of future generations, but the beauty of the research being done now is that the future is well within their lifetime.





# Internet for Energy



The National Science Foundation (NSF) announced that North Carolina State University will lead a national research center that aims to revolutionize the nation's power grid and speed renewable electric-energy technologies into every home and business.

The NSF Engineering Research Center (ERC) for Future Renewable Electric Energy Delivery and Management (FREEDM) Systems, to be headquartered on NC State's Centennial Campus, will partner with universities, industry and national laboratories in 28 states and nine countries. The center will be supported by an initial five-year, \$18.5 million grant from NSF with an additional \$10 million in institutional support and industry membership fees. More than 65 utility companies, electrical equipment manufacturers, alternative energy start-ups and other established and emerging firms have committed to joining this global partnership.

The new center will develop technology that transforms the nation's century-old, centralized power grid into an alternative-energy-friendly "smart grid" that can easily store and distribute energy produced from solar panels, wind farms, fuel cells and other energy sources. This "Internet for energy" will enable millions of users to generate their energy from renewable sources and sell excess energy to the power companies. Researchers envision consumers using this "plug-and-play" system anytime, from anywhere.

An ERC award is one of the largest and most prestigious awards granted by NSF. The FREEDM ERC is one of five new ERCs awarded by the NSF's Generation Three ERC Program. The third-generation Engineering Research Centers build on the successes of the first and second generations of ERCs funded since 1985. They are designed to create university and industry partnerships in research and education that promote innovation, transform engineered systems, advance technology, and produce engineering graduates who can creatively contribute to U.S. competitive advantage in a global economy. The grant to NC State and its partners is a five-year commitment that is renewable for an additional five years. The award follows a two-year selection process by the federal agency.

Dr. Alex Huang, Progress Energy Distinguished Professor of Electrical and Computer Engineering at NC State, will be the center's director. The research will begin immediately, with a new headquarters for the center scheduled to open in 2010 on NC State's Centennial Campus.

Dr. Alex Huang



“North Carolina State University works very hard at creating partnerships and collaborations that produce tangible results,” said Chancellor James Oblinger. “We applaud the collaborative spirit of Alex Huang’s work and believe the results that will come from this NSF center will deliver broad changes in our nation’s approach to energy. Solving the energy crisis is not just about generating renewable energy but developing the infrastructure needed for distribution. As more renewable energy becomes available, NC State research will help deliver it to millions of homes and businesses.”

Transforming the nation’s power grid is vitally important as alternative-energy technologies prepare to flood the marketplace. Center researchers foresee widespread adoption of plug-in hybrid cars over the next several years, for example, but today’s power grid would not be able to handle energy demand during peak charging times, such as when people return home from work in the evening. The smart grid developed at the center will also allow consumers to sell energy back to the power companies when demand is low, preparing the utilities for times when demand is greatest.

This new energy paradigm will speed the development of vehicles, appliances and other devices that can both store energy and send it to the grid. By merging advanced battery technology with windmills and solar collectors, the researchers will combine renewable energy

production with electric energy storage in a network. The center’s energy storage research will focus on storage technology with longer life.

Central to the research will be the development of a “green energy hub” that will power the center’s headquarters and other buildings on Centennial Campus. The one-megawatt grid will serve as a test-bed for the center’s research efforts and demonstrate the technology’s potential.

“Securing this center is a landmark achievement for the College and the University that will add significant resources and momentum to NC

systems and High Voltage Technology of the Swiss Federal Institute of Technology in Switzerland. Industry partners supporting the research will work directly with the center’s faculty, students and unique facilities, speeding innovations developed at the center to the commercial marketplace. The innovation process will be enhanced through the support of small start-up firms to explore product ideas, teaming with university students to give them first-hand experience in innovation and business start-ups. The ERC also will work with 18 state and local government organizations in North Carolina, Arizona, California, Florida, New York and Tennessee to stimulate entrepreneurship and innovation based on its research and technology.

Additionally, the center will feature an intensive education program, including a master’s degree program and an undergraduate concentration in

renewable energy systems. Researchers have fostered partnerships with 14 middle and high schools to give younger students and their teachers a chance to explore the research related to energy and power.

“We are honored that NC State is leading this important research,” Huang said. “Work at this center will help prepare our country and the world to take full advantage of abundant renewable energy resources.”

State’s energy research,” said Dr. Louis A. Martin-Vega, dean of the College of Engineering. “The technology developed at this center will distribute renewable energy on a large scale, helping to build a society based on green energy.”

Huang and other NC State researchers will collaborate with faculty at Arizona State University, Florida A&M University, Florida State University, Missouri University of Science and Technology, the E.ON Energy Research Center at RWTH Aachen University in Germany and the Laboratories of Electric Power



The North American continent as seen at night.



# Fighting TB: As Easy As 1-2-3

It is one of the world's most intractable medical problems, spreading at the alarming rate of one new infection every four seconds. The disease is tuberculosis (TB), and it has now infected up to one-third of the people on Earth, primarily in the developing world, where diagnostic and treatment tools are scarce. And it is an effective killer, claiming 1.7 million victims every year.

But those numbers may change, thanks to the pioneering work of three NC State undergraduates, who have developed the first practical diagnostic device for TB that is cheap, fast and accurate. The device the students created can diagnose tuberculosis with the push of a button. The data can be sent directly to a laptop.

"Here's the simple explanation," says Daniel Jeck, pictured above (bottom right) with Hersh Tapadia (center) and two

other engineering students. "You take a patient's saliva and put it on a slide. Then you place the slide in our device. If it glows green, then the patient has an active case of TB. Diagnosing tuberculosis is now as easy as counting glow-in-the-dark stars on the ceiling."

It seems simple now, but it was a real challenge - and one that had stumped professional medical device developers for years. But Jeck was not alone on the project. He teamed up with two other students in the university's rigorous Engineering Entrepreneurs Program: fellow biomedical engineering major Pavak Shah, and electrical and computer engineering major, Hersh Tapadia.

"Our instructor told us that the most successful teams are multidisciplinary," Shah says. "That's true. We argued a lot, but we couldn't have done it alone."



What they have done has the potential to save thousands of lives and millions of dollars in the developing world, where up to 40 percent of all active TB cases are missed by clinics and hospitals using traditional diagnostic tools.

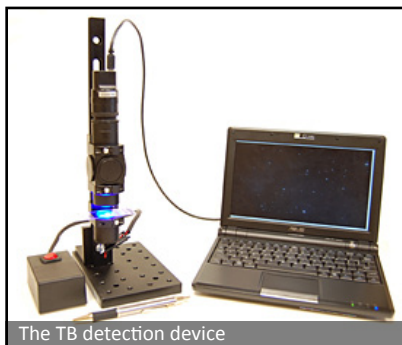
“In India they require three tests,” says Tapadia. “So by the time you get the test results, the disease has progressed and even spread to other people.”

Shah, whose parents were born in India, often visits relatives on the sub-continent. He says the medical infrastructure in the developing world isn’t equipped to stop the spread of tuberculosis.

“For active TB, the way most of the world diagnoses it is to collect sputum, smear it on a slide that’s treated with a stain, and then look at the slide at 1,000 times magnification. That requires a trained microscopist, which is very expensive.”

It is also slow and tedious. At 1,000 times magnification, a microscopist scans just a small section of each slide. The NC State students estimate you could scan 45 times more area of each slide in less than one minute using their device.

The groundbreaking device is just the latest technological marvel to emerge from NC State, where university officials launched a campus-wide entrepreneurship initiative last year



The TB detection device

to expand on the success of the engineering program. NC State holds 641 active patents and has another 141 pending. It has spun off 72 start-up companies based on technology developed by university researchers.

Programs like the Engineering Entrepreneurship Program are transforming students’ classroom experiences, confronting them with real-world problems and training them to think like the world’s most successful entrepreneurs.

The project began to take shape last fall after the students met with their project adviser, Dr. Howard Shapiro, a Boston physician who designs instruments that count and sort cells. After he reviewed the students initial plans for the TB diagnostic device, Shapiro advised them to take a non-traditional approach.

“He told us that philosophically the way we were approaching the project - the traditional approach - was wrong,” Shah says. “He said we were trying to take an expensive box built for Europe and America, take out a few pieces and send to the Third World. He said we needed to start with a new, empty box.”

Shapiro suggested that the team build based on an instrument design he had done some initial work on, showing it was possible to detect TB bacteria with very simple hardware.

“We decided that we had to create something so that you could push a button and read the test results,” Tapadia says. “It had to be that simple.”

They built the device using off-the-shelf components and a laptop computer. They estimate the device



could be mass-produced for under \$500 each.

Since the innovation hit the front page of Raleigh’s *News & Observer*, the students have been overwhelmed with calls and e-mails, including an offer by Dr. Jason Stout, the North Carolina director of tuberculosis control, to conduct the first round of clinical trials for the device.

It is unclear whether the development will make them rich; the students are still investigating several options, including working with a medical device manufacturer to make the technology available in the developing world.

“International patents are very hard to enforce,” Tapadia notes. “But if we put aside the issue of money, then perhaps we could partner with a nonprofit. And, anyway, the point isn’t making money. The point is saving lives.”



# Disney's Next Generation

Working at Walt Disney Imagineering may rank as one of the planet's most sought-after dream jobs, especially for creative professionals. Four students from NC State got to sample the magic this summer as finalists in Disney's ImagiNations Design Competition. They won a 10-day trip that took them from the small world of Raleigh, NC to the fantasyland of Imagineering's Southern California studios.

Ten days turned into summer internships for two of the students: Steven Varela, who graduated this spring with a degree in electrical and computer engineering, and Ashley Wagner, a senior majoring in art and design. The other members of the team include Morgan McCormick, an English major who recently graduated with a concentration in creative writing and a minor in Japanese; and Corban Prim, a senior in art and design with experience in video production and animation, who has been offered a one-year internship with Disney's Advanced Technologies Group after he graduates.

"This is the perfect job. I've never had an experience like this," Varela says. "I don't think any of our lives are ever going to be the same. It's the experience of a lifetime."

To secure a spot as one of three top teams in the contest, the students designed a motion simulator thrill ride, called Mickey's Quest to Magma Mountain, that utilizes a circular seating arrangement to give riders an immersive 360-degree, 3D experience. The project was designed so that each time guests ride, they get a new view of the action and hear unique dialogue, but always experience the full story.

For Prim, the trip to California cemented his plans to pursue a career in media production.

"I've found my calling," he says. "I feel like the opportunities are endless."

Imagineering often hires student finalists to fill the ranks of its creative workforce, which is made up of professionals



in more than 140 diverse disciplines, including artists, architects, engineers, writers, machinists, landscape designers, model makers, sound technicians, carpenters, producers, accountants, filmmakers, schedulers, and estimators.

In fact, Prim says, the trip to the Disney Imagineering offices, “was like a nonstop, 10-day interview.”

It also gave the students the chance to work and network with some of the top creative professionals in the industry, like fourth-generation Imagineer Mike Iwerks, the great-grandson of Ub Iwerks, the co-creator of Mickey Mouse and Walt Disney’s business partner in the 1920s.

“You’d think it would have been intimidating, but everyone was so laid back and personable,” Prim says. “I made so many friends.”

Varela had a similar experience.

“I’m surprised by how relaxed it is here,” he says. “Everybody is wearing Hawaiian T-shirts and some people ride scooters to their desks. It’s incredible that we can have fun and do incredible jobs making incredible attractions.”

Walt Disney Imagineering creates – from concept through construction – all Disney theme parks, resorts, attractions, cruise ships, real estate developments, and regional entertainment venues worldwide. The name Imagineering combines imagination with engineering.

NC State graduate student Elena Page knows exactly how the students feel. As an undergraduate in the College of Engineering in 1995 Page took first place in the ImagiNations competition and went on to work at Imagineering for nearly a decade.



Picture of the four NCSU Competitors

Now a graduate research assistant in the Advanced Media Lab in the College of Design, Page coached this year’s NC State team.

“We met once a week to discuss their ideas,” she says. “But before they did anything I asked them to do some research and come up with stories that would be interesting to tell. It always starts with a great story.”

Page says it was important for the students to leverage their diverse skills and to learn to work together.

“What was really valuable was not just doing the project, but being on a collaborative team,” she says. “In that industry, you’re always working on a team.”

Once they had the story line worked out, the students spent several months developing their contest materials,

including a video trailer, three-panel promotional display, storyboard and description of key moments in the ride. In addition to the creative content, the students had to develop a marketing plan identifying the target audience for the ride as well as

a blueprint for how the ride would be laid out at the theme park.

In the end Page, like the Imagineering judges, was impressed by the sophistication of the students’ project.

“They’ve created a story with a strong visual sense and design and demonstrated the ability to communicate and package and engineer it,” she says. “They’ve proven they can be successful.”

## Open House 2010

Want to meet and talk with professors and faculty to see if ECE is the right fit for you!

March 27th, 2010

Interested? Please see:  
[www.ece.ncsu.edu/open\\_house](http://www.ece.ncsu.edu/open_house)



Members of the Legislature atop the bridge.

## Student-Built Bridge Stands Tall at Legislature

Engineering students at North Carolina State University who designed and built a fully functional temporary pedestrian bridge outside the Legislative Building in Raleigh were rewarded for their efforts with the 2009 Future of Engineering Award.

The 2009 *Future of Engineering Award* competition involved development of a design for a temporary pedestrian bridge that is suitable for rapid deployment in remote areas. The competing teams were evaluated by College of Engineering faculty based on the innovative nature of the design, the inclusion of other disciplines from within the College of Engineering, use of sustainable/green materials and/or construction techniques, suitability of the design to meet the allowable constraints, and constructability.

The students received the award, which is sponsored by the American Council of Engineering Companies of North Carolina (ACEC/NC), at a ceremony at the bridge site on April

22. “ACEC of North Carolina has always had a close relationship with NC State and the other engineering schools in the state,” explains Kenneth Smith, P.E., president of ACEC/NC. “We think that having this innovative bridge design constructed on the Halifax Mall during our legislative events will help highlight the importance of engineering to the state’s future and will demonstrate the great work that is being done at NC State in the field of engineering.”

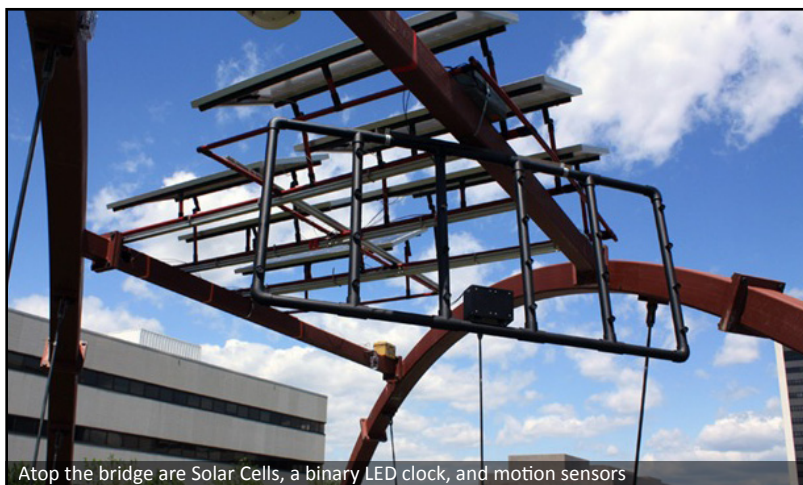
ECE Senior Design students Dan Ternes, Jeremy Page, Steven Varela and Joey Cashman added electrical and electronics enhancements to a bridge built by Civil Engineering students. A solar-powered electrical system was designed and built that powered the entire bridge, including wireless sensor systems designed by Computer Science students. In addition, the four ECE students designed a binary clock that was hung on the bridge and composed a “layman’s guide” for interpreting the display that was etched in wood.

They also designed LED panel lighting that automatically turned on at dusk and produced a very attractive illumination of etched glass panels showing NCSU icons.

According to their instructor, Bart Greene, “This is one of the finest examples of high quality engineering and collaboration with other departments that I have seen.”

The ceremony occurred as part of Engineering Days, an annual event held by the engineering companies of ACEC/NC to highlight the leadership role that engineering plays in the present and future prosperity of North Carolina. Engineering Days 2009 was a program presented by the ACEC/NC to raise awareness among elected and appointed officials and the general public about engineering’s importance for our state’s future prosperity.

Students built the bridge on April 21 and were on hand the following day to give tours and answer questions about its construction. The students were recognized for their work by Sen. Tony Rand in the N.C. Senate chambers.



Atop the bridge are Solar Cells, a binary LED clock, and motion sensors



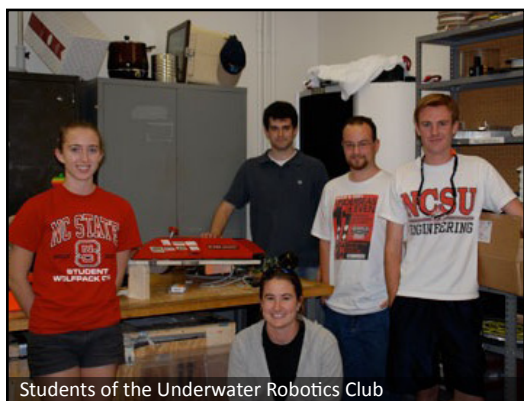
## Club Sub

Members of one NC State engineering student group spend a lot of time at the pool. They're not working on their tans. They're testing their underwater robot.

Every summer since 2005, the NC State Underwater Robotics Club has entered a robot submarine in an international underwater vehicle competition in San Diego, Calif. The event, put on by the Association for Unmanned Systems International (AUVSI), requires each robot to navigate an underwater obstacle course that tests the robot's vision, acoustics and positioning systems.

"The club is a great resume builder," said president Brooks Stephenson, a junior in electrical engineering. "We've had former club members go on to get great jobs at places like Lockheed Martin and Northrop Grumman."

Members hope to score a top-five finish at this year's competition, which pits NC State's robot against those from dozens of universities all over the world. To do that, the club is building a new vehicle that's lighter and more efficient than its predecessor, which is being retired after three years of service.



Students of the Underwater Robotics Club

The club is primarily affiliated with the Department of Electrical and Computer Engineering, but it also draws mechanical engineering, nuclear engineering and computer science students. Every Monday and Wednesday night, the group gets together in Burlington Labs to hash out ideas, work on design and construction and, eventually, test the robot in campus pools.

"I think people are interested in joining the club because it gives real-life experience and really helps to solidify the things you may have learned in the classroom," Stephenson said. "It also gives you the chance to learn things that you may see in your classes later on, so you'll already be familiar with them."

The club began in 2004 when a small group of friends teamed up with Vortex HC, LLC, a Morrisville-based robotics company, to build a competition vehicle for the following year's AUVSI event. Their first design, called Seawolf I, suffered some electronic problems and didn't make the final round, but in practice rounds it turned heads with its acrobatic flips and barrel rolls. It was featured in the magazines *Robot*, *Make* and *Servo*.

The next year, the club began to work on a second vehicle that improved upon Seawolf I. The group gave Seawolf II simpler controls, a triangular chassis, separate power and electronics tubes, a Windows operating system and streamlined acoustic navigations. Seawolf II served as the competition vehicle for three years; its best showing at AUVSI was a ninth-place finish in 2006.



One of the club members in a competition

Seawolf III, which will debut this summer, is under construction now and will employ a highly efficient main computer augmented by a series of microcontrollers. This upgrade makes the new vehicle much lighter than its predecessor and addresses past issues with battery life and overheating.

For these students, the benefits of club membership are obvious. They make friends, build a dazzling robot and add heft to their resumes. But there's another perk.

"We also get to spend a week out in California during the summer," Stephenson said, "so that's lots of fun."





Competitors of the Krispy Kreme Challenge running to the finish

## Five Years of the Krispy Kreme Challenge

Five years ago, Chris McCoy dreamed up a four mile race that would become a N.C. State tradition. Called the Krispy Kreme Challenge, participants run two miles from the Bell Tower on N.C. State's campus to the Krispy Kreme store on Peace St., stop and eat a dozen donuts, then run back to the Bell Tower, all in under an hour. McCoy's idea blossomed when ten participants completed the inaugural race on a dare in December 2004 (ironically, McCoy didn't compete because he overslept on race day). Ben Gaddy, then an ECE sophomore, won the first race in 34 minutes and 27 seconds.

The Krispy Kreme Challenge presents runners with a unique blend of difficulty, seemingly tailor-made for college students. After the first two miles, the Challenge's signature doughnuts make the final leg of the participant's journey a struggle to simply keep their stomachs settled. "The first two doughnuts are delicious, but then your saliva starts to turn into a syrupy glaze," said ECE alumni and original organizer Greg Mulholland in a Sports Illustrated: On Campus

article. "When you're running back, it feels like the syrup's coming through your pores."

The striking contrast between eating doughnuts and running has certainly helped set the Krispy Kreme Challenge apart from other contests, but Mulholland thinks the Challenge serves a larger purpose, "N.C. State students, and even people in Raleigh, have been looking for traditions that haven't died over the last fifty years. The Krispy Kreme Challenge could be the next true N.C. State tradition, and that momentum has given it a weight that some random race in a random city wouldn't have."

With these factors in their favor, Mulholland, Gaddy, and several others helped transform the Challenge from a quirky dare amongst friends, to an annual charitable event benefitting the North Carolina Children's Hospital that draws runners and college students from across the nation. The fifth annual Challenge, held February 7, 2009, several years after the Challenge founders graduated, raised over \$40,000 from its 5,519 participants and was taped by ESPN for the daily SportsCenter program.

## Experience Reaps Reward

Ryan Going admits he didn't know anything about engineering when he enrolled at NC State three years ago. He has learned a lot since then. In October, after he graduates with an undergraduate degree in electrical engineering and applied mathematics, Going will head to Cambridge University to complete a master's degree in micro- and nanotechnology enterprise.

It is a remarkable opportunity for the Durham County native, who was one of just 37 American recipients of a highly competitive Gates Cambridge Scholarship this year. The scholarship, which pays the full cost of a master's or doctorate degree at the British university, was established in 2000 by the Bill and Melinda Gates Foundation.

Candidates are judged on their intellectual ability, leadership capacity and desire to use their knowledge to contribute to society by applying their talents and knowledge to improve the lives of others.

"I'm really excited," Going said. "I don't think I've processed the news yet."

The significance was not lost on *The News & Observer*, which named Going its "Tarheel of the Week." On campus, faculty and staff members were quick to praise Going for his academic achievements as well as his volunteer work with Amnesty International and Habitat for Humanity.

"It's a breakthrough step for him," said Dr. Michael Escuti, an



assistant professor of electrical and computer engineering. "It leads him to an expanded set of professional relationships and deep scientific understanding that he would not be able to access easily otherwise."

Escuti was one of a handful of faculty, staff and alumni who helped Going navigate the scholarship process, which included a written application and a face-to-face interview with a panel of educators.

Going's road to the Gates Cambridge Scholarship actually began early in life.

"My introduction to science was a little kid's chemistry set," he said. "I never got to blow anything up, but I thought a microscope was the coolest thing in the world. I always liked the more hands-on science."

That made him perfect match for the North Carolina School of Science and Math, where he completed the last two years of high school, and then NC State, where he developed a love of research.

"My primary area of interest is photonics - using electrical devices and materials to manipulate light," he explained. "I want to work on the next generation of solar panels."

"I'm particularly interested in using nanotechnology to create nano-sized structures that enable solar panel to absorb more energy from the sun and operate more efficiently."

For his senior design project, Going developed a prototype of a solar-powered lantern using LED lights. An international organization called "Lighting a Billion Lives" distributes similar lanterns in rural communities in India that are not connected to a power grid. Going's longer-lasting, more efficient LED lanterns could replace existing lanterns that use florescent lights.



Ryan Going is one of just 37 American recipients of the competitive Gates Cambridge Scholarship

Escuti had hired Going as an undergraduate research assistant for two years, giving him the opportunity to work closely with the professor and five Ph.D. students. He gained experience working as part of a research team, attending meetings, offering solutions to research problems, and presenting his findings.

The experience paid off.

"He has the potential and capacity to not only be a thinker but an educator and a mentor," Escuti said. "He is learning to solve real-world problems."

That is exactly what Going hopes to do in the years ahead. After he completes his master's degree at Cambridge, he plans to pursue a Ph.D. at the University of California, Berkeley, and then become a university professor and researcher.

As he completes his senior year at NC State, Going is thrilled with the doors that have opened to him thanks to the support he has received at the university.

"Dr. Escuti has been absolutely wonderful," he said. "He's a key player in my academic life and research and he's really helped me grow academically mature. He encouraged me to present at a conference, which I never would have thought to do in a million years. And

he helped me get used to writing for scientific journals. That's why I was competitive with this scholarship. The level of maturity you gain from doing those things puts you at a different level."

Going has talked with several NC State students who attended Cambridge and he's clearly excited about the prospect of studying and living at a university that's been in the forefront of higher education since the 13th century.

"From what I've heard, Cambridge is going to be like Disneyland for me," he said.



Scot Wingo (right) shown with other recipients and Dr. Martin-Vega

## ECE Alumnus Awarded Distinguished Engineering Alumnus Award

The College of Engineering at North Carolina State University has named the Distinguished Engineering Alumnus award winners for 2008. Among the recipients is Scot Wingo of Raleigh, co-founder and chief executive of ChannelAdvisor Corp.

Wingo received his master's degree in computer engineering from NC State in 1992. He is a technology entrepreneur who has used his business acumen to found several successful companies.

He is currently president and chief executive officer of Morrisville-based ChannelAdvisor Corp., which enables leading online retailers to maximize their product exposure across multiple e-commerce channels such as eBay, Google, Amazon.com and Overstock.com. The company managed more than \$2.7 billion in gross merchandise value on behalf of its customers in 2007, up almost 70 percent from the previous

year. He also co-founded and sold Stingray Software and AuctionRover.com.

Wingo has authored a number of technology and business books - including the popular *eBay Strategies: 10 Proven Methods to Maximize your eBay Business* - and was named Ernst & Young's Technology Entrepreneur of the Year in 2004. He has also been honored as one of the Triangle Business Journal's 40 under 40.

Wingo has established a generous endowment for the NC State Engineering Entrepreneurs Program and serves as chairman of its advisory board. He also serves on the board of the NC State Engineering Foundation and is a popular speaker at College events.

Other recipients of the award include Bobby Ray Johnson Jr. of San Jose, Calif., co-founder and chief executive of Foundry Networks and Gayle Lanier of Raleigh, a Nortel executive and NC State Board of Trustees member.

## Engineering Alumnus Forges Successful Publishing Career

So an electrical engineering student leaves college, joins the Air Force, heads off to grad school, enters the publishing business, buys an iconic sports magazine, and ends up owning a company that puts "Dora the Explorer" books on supermarket shelves nationwide.

Just your average, run-of-the-mill career path.

Leonard Habas knows his professional trajectory is unusual. The NC State electrical engineering alumnus drew on his engineering background to build a successful and varied business career.

"The discipline that you get from engineering, graduating from NC State, allowed me to educate myself in an area that I wasn't formally trained," said Habas, a 1966 graduate of the College.

Today, Habas is chairman and chief executive officer of Advance Publishers, an Orlando-area publisher of children's books featuring characters from Warner Bros., Nickelodeon and Disney. The company prints everything from Scooby Doo to SpongeBob SquarePants to the wildly popular Dora the Explorer, the top-rated preschool program on commercial television.

"SpongeBob, Dora, Diego (of the Go, Diego, Go! animated series) are the leading children's icons right now, and so that's what we publish," Habas said. "We try to be on the very edge."





Leonard Habas (Left) and Dr. Martin-Vega (Right)

Habas took a winding route to the world of children's book publishing. After graduating from NC State, he attended flight school in the Air Force, staying in the service for about four years. After getting a master's degree in engineering and management at Northeastern University, he went into the publishing business.

This career change, he said, was driven by a keen interest in finance. He understood investment opportunities when he saw them, and he was well-versed on tax rules. In the 1980s, he teamed up with a partner to buy Sport magazine, a venerable publication that was the original general-interest sports magazine in America, predating even Sports Illustrated (Habas eventually sold Sport). He also served on a few boards at Merrill Lynch, gaining more knowledge of finance and investing.

Habas and some business partners bought Advance Publishers in 1995, taking over an established company that was already publishing books for Disney and had a long history of selling them in supermarkets. But the company expanded under Habas' leadership, gaining licensing rights to Nickelodeon and other entertainment franchises and establishing relationships with club stores like Costco and Sam's Club, which now sell Advance books.

Habas has also found time for other

entrepreneurial ventures. In 1989, he helped create a dental biotech company that he eventually sold for a substantial profit. Habas and his business partners are supporting similar technology in a spinal-cord application now in trials with the Food and Drug Administration.

Last winter, Habas hosted a "Meet the Dean" event for Dr. Louis A. Martin-Vega, dean of the College of Engineering, and alumni in the Orlando area. The events give Martin-Vega a chance to connect with alumni and update them on the goings-on at their alma mater.

Habas jumped at the chance to host.

"I wanted to do it because it was a privilege," he said.

Habas also sits on boards for the American Red Cross, the Boys and Girls Club, and the Alfred I. DuPont Testamentary Trust, which supports the care and treatment of sick and disabled children. He is helping the group build a new children's hospital in the Orlando area.

"I'm just absolutely thrilled to be a part of that."

The business and volunteer activities keep Habas busy, but he finds time for his four grandchildren and the occasional round of golf. He credits much of his success to his years toiling away in the electrical engineering department at NC State, building a skill set that has lent itself to business.

"It's using that engineering discipline," he said, "and applying it to finance."

## Know Some Great ECE Alumni?

Won an Award? Is your career on the move?  
Creating a startup? Making a Greener Planet? ***Having an IMPACT?***

The ECE Department is looking for alumni to write and hear about. We want to hear ***YOUR*** success story and tell the community.

So please,  
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# Faculty And Staff News

## ECE Welcomes Dr. Cranos Williams and Dr. Srdjan Lukic

The Department of Electrical and Computer Engineering is pleased to announce the addition of Cranos Williams and Srdjan Lukic to the ECE Faculty.

Dr. Cranos Williams received his PhD in 2008 and MS in 2002 from NC State University. Additionally, he received his BS from North Carolina A&T State University in 2001. Dr. Williams's primary interests are in the inter-disciplinary research area known as systems biology. Particularly, Dr. Williams is focused on the development of engineering-based systems approaches that integrate biological information at multiple scales for the purpose of modeling and controlling biological processes at the tissue, cellular, and biochemical levels.

Dr. Srdjan Lukic received his PhD (2007), MS (2004), and BS (2002) from the Illinois Institute of Technology, Chicago. Dr. Lukic's primary research areas are in power electronics and power systems, including power management ICs and power semiconductor devices.



Dr. Cranos Williams

He is also heavily involved in the Advanced Transportation Energy Center at NC State.

## Snyder and Ozturk Elevated to IEEE Fellows

Recognizing the achievements of its members is an important part of the mission of the IEEE. Each year, following a rigorous evaluation procedure, the IEEE Fellow Committee recommends a select group of recipients for one of the Institute's most prestigious honors, elevation to IEEE Fellow.

The IEEE Board of Directors, at its meeting on 12 November 2008, elevated Dr. Wesley Snyder and Dr. Mehmet Ozturk to IEEE Fellows, effective 1 January 2009.

Dr. Snyder is recognized for contributions to education in robotics and computer vision.

Dr. Ozturk is recognized for contributions to silicon and silicon-germanium epitaxy in complementary metal-oxide semiconductor integrated circuits.

Within the next two months, they will receive their IEEE Fellow pin and certificate. Both serve as visible

recognition of their elevation to the highest grade of membership in the IEEE.

## Trew Leading ECCS in NSF Directorate

Robert J. Trew, the Alton and Mildred Lancaster Distinguished Professor in Electrical and Computer Engineering at North Carolina State University, joins the National Science Foundation (NSF) as director of the Division of Electrical, Communications and Cyber Systems (ECCS) in the Directorate for Engineering.

During his extensive academic career, Trew has spent a total of 11 years serving as the head of electrical and computer engineering (ECE) at three universities: NC State, Virginia Tech, and Case Western Reserve University. At each institution, he focused on building the research programs, especially in emerging areas; recruiting diverse, high-quality faculty; strengthening student organizations and their participation in department activities; and providing opportunities for undergraduate research.

Trew has also been a leader in government research. As director of research at the U.S. Department



Dr. Srdjan Lukic



Dr. Wesley Snyder





Dr. Robert Trew

of Defense (DOD), he oversaw the \$1.3-billion-per-year basic research programs, including the DOD University Research Initiative, and represented DOD in many interagency activities, such as the National Nanotechnology Initiative. In addition, Trew has experience as a program manager in the U.S. Army Research Office.

“The Directorate for Engineering is extremely pleased to welcome Dr. Trew,” said NSF Assistant Director for Engineering Thomas Peterson. “He has demonstrated both extensive leadership within the professional community and deep, long-term engagement in academic and government research and administration. These experiences will enable valuable connections between NSF and the ECCS research and education community.”

Trew’s research focuses on nanoelectronics and microwave, millimeter wave, and terahertz solid state devices and systems. He is also interested in photonic, radio frequency, analog, and digital devices, and in power electronics and power systems. He has authored or co-authored more than 170 publications and 20 book chapters, and he holds nine patents.



Dr. Xun Liu

Trew has received many awards for distinguished teaching and scholarship, including the 1998 IEEE Microwave Theory and Techniques Society Distinguished Educator Award and the 2001 IEEE-USA Harry Diamond Memorial Award. He is a Fellow of the IEEE and is currently serving as editor-in-chief of the IEEE Proceedings. He was awarded a B.S. degree from Kettering University and earned an M.S. and Ph.D. from the University of Michigan, all in electrical engineering.

ECCS addresses fundamental research issues underlying device and component technologies, power, controls, computation, networking, communications, and cyber technologies. ECCS supports the integration and networking of intelligent systems principles at multiple scales for applications in healthcare, disaster mitigation, energy, telecommunications, environment, manufacturing, and other systems-related areas. ECCS research and education investments emphasize interdisciplinary collaboration and the convergence of technologies to take on major technological challenges for the next generation of innovative devices and systems.

## Liu Receives NVIDIA Professor Award

Dr. Xun Liu has received an NVIDIA Professor Partnership Award for “Research and Education on VLSI Algorithm Development using CUDA and Nvidia GPUs”. NVIDIA CUDA is a software environment that utilizes the parallel compute engine of the NVIDIA graphical processing unit (GPU) to solve complex computational problems. The award includes a grant of \$25K to support Dr. Liu’s research.

The project aims to apply GPU-based computing to existing VLSI CAD (computer-aided design) software programs. The short term activities involve the manual parallelization of existing algorithms so that they can be executed on GPUs. Design experience will be accumulated to determine algorithmic characteristics that cannot be easily migrated to GPUs. Software solutions will then be proposed to assist the conversion of programs with the above characteristics and improve the efficiency of the resulting programs. Finally, conversion tools will be created to implement semi-automatic parallelization of algorithms. The ultimate goal is to substantially lower the difficulty of sequential to parallel program transformation.

## Ozturk attends NIMS Agreement Signing

A comprehensive agreement between NC State University and the National Institute for Materials Science (NIMS) that provisions for research collaboration and exchange of materials related to high-efficient

energy and resource use was signed into being on July 18th, 2008.

The signing ceremony was held in a joint workshop between the two institutions during NIMS Week. Prof. John Gilligan represented NC State during the signing. Several other NC State professors - including Dr. Mehmet Ozturk who attended the workshop as the director of the NCSU Nanofabrication Facility - were present at the ceremony.

As Japan's Independent Administrative Institution specializing in materials science, NIMS is charged with basic research and development of materials science, and to advance the level of expertise in the field. Research at NIMS is divided into high-priority developmental research and exploratory research.

## **ECE Faculty Chair Major Robotics Conferences**

The Institute of Electrical and Computer Engineers (IEEE), the largest technical society in the world, sponsors hundreds of conferences each year. In the area of Robotics and Automation, however, there are only two: The International Conference on Robotics and Automation

(ICRA), fully sponsored by the IEEE, and the Intelligent Robotics Systems Conference (IROS), co-sponsored by the IEEE and the Japanese Robotics Society.

Both conferences attract over a thousand researchers from all over the world. In 2007, the general chair of IROS was Professor Eddie Grant, of the NC State ECE department. In 2010, the general chair of ICRA will be Professor Wesley Snyder of the NC State ECE department. To have two general chairs from the same department is unprecedented.

## **Device Controls Electron Spin**

In a breakthrough for applied physics, North Carolina State University researchers have developed a magnetic semiconductor memory device, using GaMnN thin films, which utilizes both the charge and spin of electrons at room temperature.

The finding represents a major breakthrough, as previous devices that used magnetic semiconductors (GaMnAs) and controlled electron spin were only functional at 100 K (or -173 Celsius). By controlling the spin of electrons, the new device represents a significant advance in

semiconductor efficiency and speed.

The new device is also an advance on earlier experimental models because it uses only 5-6 volts to switch the bias of the electrons. Previous cold-temperature devices used much higher voltage. The research was published April 2 in Applied Physics Letters.

The research team included NC State professors S.M. Bedair and Nadia El-Masry, adjunct professor J.M. Zavada, post-doctoral research fellow N. Nepal, and graduate students Oliver Luen and P. Frajtag. The research was supported by the U.S. Army Research Office.

## **Baliga named Tar Heel of the Week**

Dr. Jayant Baliga has been named the Tar Heel of the Week by The News & Observer.

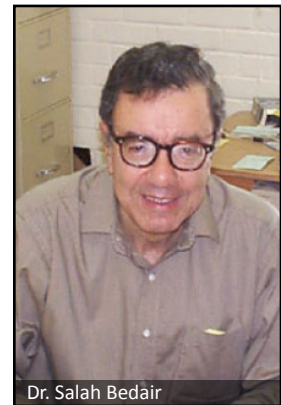
His inventions are used every day in thousands of devices "but nobody knows it," says Baliga. His landmark device, the insulated gate bipolar transistor (IGBT) which he developed at General Electric, greatly increased the efficiency of Bell's original transistors and saves upwards of 125 gigawatts of power consumption a year.



Dr. Mehmet Ozturk



Dr. Eddie Grant



Dr. Salah Bedair





Dr. Jayant Baliga

He has been named one of the eight heroes of the semiconductor revolution by Scientific American and is the recipient of the O. Max Gardner award, which recognizes “the greatest contribution to the welfare of the human race” among all faculty members of the UNC system. Additionally, he is the youngest man to ever be elected to the IEEE and the National Academy of Engineering.

Dr. Baliga is currently working on a silicon carbide-based semiconductor that is projected to be more efficient than IGBTs.

## Dr. Lazzi Awarded Research Award

Dr. Gianluca Lazzi was rewarded for his outstanding contributions in the field of electrical and computer engineering with the 2009 ALCOA Foundation Engineering Research Achievement Award. Through his research in retinal prosthesis, he has pushed the boundaries of engineering development beyond traditional limits and has had an obvious impact on the 10 million people worldwide coping with blindness. His leadership and groundbreaking research in implantable devices and the field of bioelectromagnetics have had a substantial impact on engineering, science and society.



Dr. Gianluca Lazzi

Among his most notable contributions is the demonstration that implantable miniature antennas at frequencies between 1 and 3 GHz can be successfully employed in telemetry systems for high-resolution retinal prosthesis to restore partial vision to the blind. In the field of computational bioelectromagnetics, Dr. Lazzi's work has ranged from the development of models and methods for safety assessment of electromagnetic and wireless devices to models and methods for medical applications, including neural stimulation. The goal of this work is to reduce the electrical current needed for neural stimulation and achieve high-resolution vision.

Dr. Lazzi has published 37 refereed journal articles, 96 conference papers and six refereed invited book papers. He has produced six invention disclosures and has given 20 refereed invited presentations. While at NC State, he has graduated eight Ph.D. students and nine M.S. students. Dr. Lazzi has received more than \$5.4 million in external funding for research projects. He is a past recipient of an NSF CAREER Award, the URSI Young Scientist Award and the ALCOA Foundation Engineering Research Achievement Award.



Brian Carty

## College Rewards Staff Excellence

The College of Engineering at North Carolina State University has recognized Brian Carty of the Department of Electrical and Computer Engineering as a winner of the 2009 Awards for Excellence.

Brian Carty, desktop support administrator for the Department of Electrical and Computer Engineering, is responsible for day-to-day network support for more than 500 graduate students and 125 faculty and staff. He is not only technologically savvy, but has also proven to be a valuable teacher, constantly helping users with applications, complex instructions, and keeping their computers secure. Brian is known for being exceedingly efficient, prompt, and courteous.

Brian has won the Pride of the Wolfpack award twice for his outstanding customer service. He was recognized for his devotion to his customers and ability to support one of the largest departments on campus that spreads throughout five different buildings.

## Construction Begins on the Centennial Science Center

North Carolina State University officials have broken ground on the next building to be developed on its Centennial Campus.

The Centennial Science Center, a privately developed two-story facility, will house corporate partners and university laboratories, and will include 20,000-square-feet of space for the National Science Foundation (NSF) Engineering Research Center for Future Renewable Electric Energy Delivery and Management (FREEDM) Systems. The FREEDM Center is the first NSF-funded engineering research center to focus on revolutionizing the country's power grid by integrating it with new, alternative energy technologies, such as wind and solar. The center is partnering with universities, industry and national laboratories in 28 states and nine countries, and it is being supported by an initial five-year \$18.5 million grant from NSF,

along with an additional \$10 million in institutional support and industry membership fees. The goal of the consortium is to decentralize the nation's century-old power grid so that a new power system can enable consumers to generate their energy from renewable sources and sell excess energy to the power companies.



Under the leadership of the center's director, Dr. Alex Huang, Progress Energy Distinguished Professor of Electrical and Computer Engineering, researchers plan to develop the system based on breakthrough power semiconductor and power electronics technology, advanced energy storage technology and state-of-the art digital communication technology.

"The Centennial Science Center is an important new addition to Centennial Campus," said NC State

Chancellor James L. Oblinger. "With our continued focus on collaborating with our corporate and institutional partners to develop new technologies in smart grid energy, the Science Center will be the prime location for that effort. For example, we intend to develop a one-megawatt green energy hub as part of the building that will serve as a test-bed for the FREEDM Center's research efforts and demonstrate the technology's potential."

"We're very excited about this event," says Dr. Louis Martin-Vega, dean of NC State's College of Engineering. "This building provides a cornerstone for establishing North Carolina as a leader in 21st century energy technologies and turning concepts into reality to benefit not only our state but our nation and the world."

Centennial Campus is a 1,334-acre multi-use research and education campus and is home to 66 corporate, institutional and governmental partners. Created in 1984, the campus also holds two top university programs (Engineering and Textiles),

along with more than 75 university research centers, institutes, laboratory and departmental units. The campus also contains a public middle school, residential units, greenway trails, fishing pier and lake, and an 18-hole public championship golf course.



Projected look of the FREEDM Center via Google Maps



## Top University Officials Tour NCSU Nanofabrication Facility

On August 7th a group of several NC State University officials toured the NCSU Nanofabrication Facility.

Included in the group were Provost Larry Nielsen, Interim Vice-Chancellor for Research Terri Lomax, COE Dean Louis Martin-Vega and Associate Dean for Research John Strenkowski. Before the tour, the team met with the NNF Director, Dr. Mehmet C. Ozturk, lab manager Marcio Cerullo, ECE Interim Department Head Robert Kolbas and the members of the NNF advisory committee including Dr. Veena Misra, Dr. Mark Johnson, and Dr. Steven Shannon. The group discussed NNF's vision, opportunities and challenges.

"We were very pleased to host Provost Nielsen, Vice-Chancellor Lomax, Dean Martin-Vega and Associate Dean Strenkowski in the NCSU Nanofabrication facility. Their visit was indeed a historic event, which showed the

University administration's commitment to advancing the nanotechnology research at NCSU," said Ozturk.

The NCSU Nanofabrication Facility provides users with a broad range of nanofabrication capabilities to support a diverse set of projects. The facility houses virtually all standard thin film processing tools including a state-of-the-art ASML laser scanner for high volume, 193nm patterning. The facility serves as a melting pot for a community of top-notch researchers from academia, government labs and industry representing a variety of disciplines. It is located in the Larry K. Monteith Engineering Research Center on Centennial Campus and occupies a 7,400 square foot class 100 and class 1000 cleanroom.

The facility has a full range of micro and nano-fabrication capabilities including: photolithography, reactive ion etching (RIE), deep RIE, low pressure chemical vapour deposition (LPCVD), plasma enhanced CVD, rapid thermal anneal, thermal oxidation, solid source diffusion, thermal and e-beam evaporation, sputtering, chemical mechanical polishing, various wet etching and cleaning processes, along with various characterization tools.



The Provost being shown a particular process in the NNF Laboratory



The Provost touring the facility



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## NC State University Breaks New Ground in Virtual Research Collaboration

*University Unveils New Cisco TelePresence Room Dedicated to Connecting Researchers Worldwide*

Dr. Louis Martin-Vega, dean of North Carolina State University's College of Engineering, and Dr. Douglas Comer, vice president of engineering for the Cisco Research Center today unveiled a new Cisco TelePresence room at the school. NC State University is one of the first universities forging new ground in higher education by employing Cisco TelePresence, a breakthrough technology for virtual meetings, to collaborate "in person" with researchers around the world. NC State University received Cisco TelePresence as part of Cisco's University Exchange Program, which was created to facilitate research collaboration among select universities.

"Cisco TelePresence is an exciting and generous gift from a valued research partner," Martin-Vega said. "We are delighted to be one of the first universities using this technology

and look forward to an enhanced research relationship with Cisco. We are grateful for its support."

Cisco developed Cisco TelePresence as a way to connect people face-to-face without the time, expense, and lost productivity associated with long-distance travel. Recognizing that more than 60 percent of communication is non-verbal, Cisco TelePresence gives users a chance to gauge the body language, facial expressions and subtleties in tone of their counterparts thousands of miles away. Cisco TelePresence reduces the need to travel and therefore lowers carbon emissions. The technology also gives users more control over their time than travel, improving quality of life.

"Cisco TelePresence offers a richness of communication that will make knowledge sharing between NC State, Cisco and other universities much easier," said Dr. Comer. "Cisco has a long research partnership with NC State University. We look forward to enhancing the interaction and work of faculty and Cisco researchers, and helping to advance innovation in many areas."

NC State and Cisco unveiled the Cisco TelePresence system at a ribbon-cutting ceremony in Engineering Building II on Centennial Campus in Raleigh, NC. The gift continues the longstanding research relationship



Dr. Kolbas (Left) and Dr. Martin-Vega using the TelePresence Unit

between Cisco and NC State University, which includes NC State's Center for Advanced Computing and Communication, Virtual Computing Laboratory and Secure Open Systems Initiative.



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Dr. Martin-Vega (Left) and Dr. Comer (Right) cutting the ribbon





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## SENIOR DESIGN SPONSORS

The department would like to take the opportunity to thank our corporate sponsors who supported this year's Senior Design project teams.

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NCSU Underwater Robotics Club  
Network Performance Research Group  
Pentair Water Pool & Spa





The 'Lone Wolf' was part of DARPA's Driver Assist competition

## NSF Funds Collaborative Research to Develop "Driver Assist" Technologies

*North Carolina Center for Automotive Research to work with universities and industry to improve driver safety*

North Carolina State University (NCSU), the New Jersey Institute of Technology (NJIT) and Lotus Engineering have announced a joint collaboration with the North Carolina Center for Automotive Research (NCCAR) in the pursuit of advanced technology aimed at increasing driver safety through accident avoidance.

It was announced on August 13, 2008 that the collaborative team will receive \$395,068 in National Science Foundation (NSF) GOALI funding over three years to develop technologies that will provide assistance to impaired drivers to avoid road traffic accidents. The NSF uses the "Grant Opportunities for Academic Liaison with Industry" to encourage collaborative programs between academic institutions and industry: [nsf.gov/Engineering\(ENG\)Funding](http://nsf.gov/Engineering(ENG)Funding) - Grant Opportunities for

Academic Liaison with Industry - US National Science Foundation (NSF).

The overall objective of the program is to develop advanced warning systems that use modern sensor technology combined with new generation recognition and data prioritization

protocols to help drivers avoid dangerous traffic conditions, such as an unauthorized left turn onto busy roads or abnormal driving behavior.

This program is inspired, in part, by the collaborators' experience in the recent DARPA Urban Challenge; whereby, vehicles navigated pre-determined routes autonomously. The intent is to build a new generation of network control technology to monitor, predict, and regulate vehicular flow for the safety of all drivers in the near future. This technology has the additional potential to reduce fuel wastage and emissions, thereby contributing to a greener and safer environment.

"This research program is a great opportunity to use experience, skills and ingenuity to develop commercially valuable and socially responsible technologies that will benefit us all," stated Don Graunstadt, President and Chief Executive Officer of Lotus Engineering Inc., "Lotus Engineering is delighted to be a part of this program with the tremendous capabilities of New Jersey Institute of Technology and North Carolina State University and the facilities of NCCAR."

As automotive safety continues to improve, and, with the arrival of the "baby boomer generation" entering their "golden years" the safety of older drivers is becoming an alarming public health issue. Motor vehicle injuries are the leading cause of injury-related deaths among 65- to 74-year olds. On the basis of estimated annual travel, the fatality rate for drivers 85 and older is 9 times higher than the rate for drivers 25 to 69 years old. As the older population in this country continues to increase, drivers aged 65 and older are expected to account for 16% of all crashes and 25% of all fatal crashes.

The first phase of the program activities will start with senior design projects at NCSU and NJIT Electrical and Computer Engineering departments this fall. The objective will be to develop interactive software tools to form the foundation of time-critical data systems testing at NCCAR later in the program.

"We are excited to see the basic university research done at NC State is becoming the foundation for real world applications," says Dr. Mo-Yuen Chow, Professor of Electrical and Computer Engineering. "We look forward to this collaborative research with partnership with NJIT, NCCAR and Lotus and to developing advanced warning systems that use modern sensor technology combined with new generation recognition and data prioritization protocols to help drivers avoid dangerous traffic conditions."



## Students Design “Green” EcoCAR

North Carolina State University has been selected to participate in EcoCAR: The NeXt Challenge, an engineering competition that pits 17 teams from different universities against one another in order to re-engineer a sports-utility vehicle for improved gas mileage and reduced emissions.



Teams are required to incorporate “green” technology, such as fuel cells and hybrid capabilities, into their design. Competition sponsors include the U.S. Department of Energy and General Motors, who hope to attain a vehicle prototype ready for production.

The NC State team consists of students from Mechanical Engineering and Electrical and Computer Engineering. The students leading the team are a part of the Wolfpack Energy Efficient Locomotion (WEEL) club.

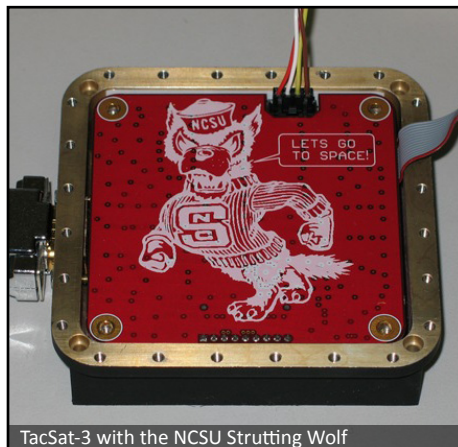
Electrical and Computer Engineering students are charged with designing the vehicles’ electrical control systems. Dustin Vaughn, a team member and ECE student, says

his courses in control systems engineering and embedded systems will “certainly prove themselves useful in the coming months of design and implementation.”

Each team will receive \$10,000, a Saturn VUE donated by GM, power train components to assist the team, and a GM mentor to provide technical support. NC State’s team mentor is Kevin MacFadden, who graduated from NCSU in 1985 with a bachelor’s degree in Mechanical Engineering.

The teams will design their car during the first year of the project, then build and refine it over the next two. At the end of each year each vehicle will undergo a week of tests that determine the vehicle’s greenhouse gas output and production readiness.

The team is already delving into its duties and gaining valuable insight into the responsibilities associated with a career in vehicle design. Says Vaughn, “While in Detroit I met with countless engineers that have already graduated and are currently working in industry. This was a great experience for me, as I was able to get firsthand accounts of what exactly a day in the life of a controls engineer entails.”



TacSat-3 with the NCSU Strutting Wolf

## One Small Step for Wolf

On May 19, 2009 the NCSU Strutting Wolf rode into space aboard the TacSat-3 satellite after a successful liftoff from NASA’s Wallops Flight Facility in Virginia.

The Wolf was pictured on a test module designed and built under the direction of Dr. Paul Franzon as part of the Air Force Research Labs Space Avionics Experiment. The module implements a high speed communications channel and uses the Applique Sensor Interface Module (ASIM) to communicate test results to the satellite. The module is a test case for the ASIM’s space plug-and-play avionics implementation which could allow NASA to set up and launch space vehicles in a matter days instead of months.

Adjunct Professor Dr. John Wilson, Ph.D. student Jian Xu, Post-Doctoral Research Associate Dr. Steve Lipa, and students Akalu Lentiro Lammade and Matthew Hamlett contributed to the project.

TacSat-3 features three revolutionary trials: the Raytheon Company-built Advanced Responsive Tactically Effective Military Imaging Spectrometer hyperspectral imager, the Office of Naval Research’s Satellite Communications Package, and the Air Force Research Laboratory’s Space Avionics Experiment. This trio of payloads will offer real-time imagery, sea-based information transmitted from ocean buoys and plug-and-play avionics to assist the warfighter in keeping one step ahead of the adversary.

# Engineering Entrepreneurs Program

## Brains for Business

Dr. Tom Miller is leading an effort to bring the spirit and principle of entrepreneurship into the classroom. At NC State, we have successfully woven the principles and spirit of entrepreneurship into programs and curricula across campus for more than a decade. This year, building on that success, we launched the Entrepreneurship Initiative, a multidisciplinary effort to transform higher education by encouraging our faculty and students to think outside the classroom.

**“Figure out what  
your track is, go  
after it, and don’t let  
anybody get in your  
way”**

Entrepreneurship is an essential part of educational innovation at NC State because it works. More than 450 students have completed the Engineering Entrepreneurs Program, working in teams to turn creative concepts into marketable products. An alumnus from the first class was one of the founders of Red Hat. Two former students became partners and created DaVinci Systems, one of the world’s leading e-mail products, at a time when NC State was emerging as a power in information technology. One of them went on to found Accipiter, while another student created AuctionRover.com.

With the development of the Entrepreneurship Initiative, this spirit of achievement now encompasses graduate and undergraduate students

in a wide range of disciplines, from science and engineering to textiles, design, the humanities, and business. Through the initiative, we’re closing the gap between the classroom and the outside world, and making higher education an active player in the effort to develop a highly-skilled workforce for the 21st century.

For example, a group of management and engineering students spent spring break in Silicon Valley learning - literally - at the elbows of top technology leaders at companies like Apple, Google and Facebook. When they returned to their classrooms in the fall, they did more than crack open textbooks, they created their own virtual companies and moved them through the start-up process, from product design and testing to market research, sales and manufacturing.

They also returned to campus with a new mindset, inspired in part by a meeting with alumnus John Steensen, a 1973 computer science graduate who runs Spatial Dynamics Corporation.

“Figure out what your track is, go after it, and don’t let anybody get in your way,” he told the students.

At NC State, we take that lesson to heart - and to the limit.



Dr. Miller (Right) is an entrepreneur of education



## The Future is Now

Every day, NC State student achievement soars beyond the borders of that which typically defines the average college experience, ascending to unprecedented heights as our students pursue ideas and concepts that could help revolutionize the world we live in.

This semester alone, a trio of NC State students made significant advances in the development of a low-cost tuberculosis test for possible use in developing nations, while others unveiled elaborate, original fashion designs using state-of-the-art textiles in their work.

“We want to empower our students to be entrepreneurial thinkers, doers, and leaders,” said Dr. Tom Miller, executive director of the Entrepreneurship Initiative at NC State.

To that end, the Entrepreneurship Initiative and the eGames Olympiad were created, in hopes of giving students across all colleges and disciplines an avenue to develop and chase down their dreams. Approximately 150 students competed in the event and about 200 students attended the eGames event on April 25<sup>th</sup>, 2009.

“This is a really great way for our students to throw their ideas out there in front of real businesspeople and members of the NC State community,” said Autumn Mauney, associate director for external relations for the EI. “We really hope to foster a culture of entrepreneurship right here on campus and make certain that NC State students know it’s okay to

get out there and try something new.”

Former NC State computer science professor Marshall Brain (M.S., ‘89), a noted author, television personality and entrepreneur who founded the online educational resource HowStuffWorks in 1998, delivered the Olympiad’s keynote address in conjunction with the university’s semi-annual Entrepreneurs’ Lecture Series.

“As we develop many of the things that we’ve built the Initiative on - such as the Olympiad and the lecture series - we’ve really tried to take in account what the university’s ‘Red Means Go’ philosophy really means - innovation, creativity and making things happen,” Mauney said. “And as an alumnus, Marshall’s talk will certainly ring more true for our students, as someone whom they can really relate to.”

The money’s not bad, either.

Students competing in the Olympiad vied for \$27,500 in cash and prizes - \$19,000 of which went to EEP Students, handed out across nine different competition categories that spotlight everything from new product designs and business plans to website makeovers and the best use of slogans and logos. The categories are intentionally wide-reaching, Mauney said, to allow entrepreneurially minded students from all colleges and disciplines to compete on common ground.



The Entrepreneurship Initiative brings students from across many disciplines together

“We worked hard to make sure that that criteria was broad enough for students to find a place where their ideas would fit, without limiting them in what they could do,” she said. “It’s events like these where students can really surprise themselves and see how far they can go.”



**STUDENTS!** Interesting in getting involved in the EEP program? Look into getting involved with the eGames for this years competition!

For more information and how to sign up, please visit:  
[www.ncsu.edu/ei/egames](http://www.ncsu.edu/ei/egames)

# Appendix

# PHD DISSERTATIONS

## Fall 2008

### **Image Segmentation/Registration: a Variational Framework for 2-D and 3-D Applications**

*Chen, Ping-Feng - Electrical Engineering*

### **Photoemission Spectroscopic Studies of Metal-Gated MOS structures based on ultra-thin High-k Dielectrics**

*Choung, Jiyoung - Electrical Engineering*

### **Investigation of Vector Antennas and their Applications**

*Gupta, Gaurav - Electrical Engineering*

### **Frequency-Domain Nonlinear Behavioral Modeling Using The Arithmetic Operator Method**

*Hart, Frank P - Electrical Engineering*

### **Multicast Routing Protocols in Mobile Ad Hoc Networks**

*Hu, Shuang - Computer Engineering*

### **Architectures and Design Methodology for Energy Efficient MIMO Decoders**

*Jenkal, Ravi Somnath - Computer Engineering*

### **Single and Multicarrier Adaptive Transmission Systems with Long-Range Prediction Aided by Noise Reduction**

*Jia, Tao - Electrical Engineering*

### **Enhancing dependence-based prefetching for better timeliness, coverage, and practicality**

*Lim, Chungsoo - Computer Engineering*

### **Antenna Design for Ultra Wide Band Communications and Frequency Selective Surfaces**

*Rajagopalan, Ajit - Electrical Engineering*

### **Characterization of High-k Dielectrics and Interfaces on Device Reliability**

*Seo, Hyungtak - Electrical Engineering*

### **Average Packet Delay Analysis for Ultra Wideband Wireless Networks of Simple Nodes**

*Taggart, Christopher Scott - Electrical Engineering*

### **Energy-Efficient and Reliable Data Transfer in Wireless Sensor Networks**

*Tezcan, Nurcan - Computer Engineering*

### **Modeling, Design, and Analysis on the Resilience of Large-scale Wireless Multi-hop Networks**

*Xing, Fei - Computer Engineering*

### **Next Generation Power Factor Correction (PFC) Regulator Based on Silicon Carbide (SiC) Power Devices and New Control Strategy**

*Xu, Xiaojun - Electrical Engineering*

### **A Physics-based Large-signal Analytical Model for AlGaIn/GaN HFETs**

*Yin, Hong - Electrical Engineering*

## Spring 2009

### **Geometric, Statistical, and Topological Modeling of Intrinsic Data Manifolds: Application to 3D Shapes.**

*Aouada, Djamila - Electrical Engineering*

### **Terahertz Generation in Submicron Nitride-based Semiconductor Devices**

*Barry, Edwin Allen - Electrical Engineering*

### **On the Performance of Peer Selection Strategies in Stochastic Peer-to-Peer Networks**

*Chiu, Yuh-Ming - Electrical Engineering*

### **Extending Data Prefetching to Cope with Context Switch Misses**

*Cui, Hanyu - Computer Engineering*

### **Practical Fair Queuing Schedulers: Simplification through Quantization**

*Dwekat, Zyad - Electrical Engineering*

### **Length Adaptive Processors: A Solution for the Energy/Performance Dilemma in Embedded Systems**

*Iyer, Balaji Viswanathan - Computer Engineering*

### **Ultra-efficient Liquid Crystal Projection Displays: Polarizer-free Displays Using Continuous Polarization Gratings.**

*Komanduri, Ravi Kumar - Electrical Engineering*

### **An Accumulative Framework for Object Recognition**

*Krish, Karthik - Electrical Engineering*

### **InGaIn/GaN quantum wells grown on polar and nonpolar GaN substrates**

*Lai, Kun-Yu Alvin - Electrical Engineering*

### **Analytical Physics Based AlGaIn/GaN HFET Large Signal Model and Nonlinearity Analysis with Nonlinear Source Resistance**

*Liu, Yueying - Electrical Engineering*

### **Mobile Robotic Navigation and Control for Large-Scale Wireless Sensor Network Repair**

*Luthy, Kyle Anthony - Computer Engineering*

### **A Multi-Channel Wireless Implantable Neural Recording System**

*Yin, Ming - Electrical Engineering*

### **Design, Modeling, and Analysis of User Mobility and its Impact on Multi-hop Wireless Networks**

*Zhao, Ming - Computer Engineering*



# MASTER'S THESES

## **Netset - A Software Framework for Automation of Network based Tests**

*Arora, Puneet - Computer Networking*

## **Circuit Extraction and Simulation in the presence of Random and Systematic Process Variations**

*Basavarajaiah, Sunil - Computer Engineering*

## **Design of Temperature Sensors for Validation of Aseptic Food Processing**

*Cao, Wei - Electrical Engineering*

## **Electrostatic MEMs Fabry-Perot Modulators in the Visible Spectrum and Electrothermal Wrinkling of Bilayer Thin Films**

*Chintapatla, Shravan - Electrical Engineering*

## **Thermal Design and Optimization of Parasitics for High Power Converters**

*Doss, Shoubhik Ravindranath - Electrical Engineering*

## **Characterization of Load Address Idioms with Implications for Address Prediction**

*Forbes, John Elliott - Computer Engineering*

## **Performance Evaluation of iSCSI Protocol for Mirroring Application.**

*Godbole, Chaitanya Umesh - Computer Engineering*

## **Cost Optimization by Method of Allocating Software Component Units to Electronic Control Units for Model-Driven Designs**

*Honnavaara, Vinay Srinivasan - Electrical Engineering*

## **Efficient receiver Template Design and Propagation Gain analysis for Outdoor UWB communications**

*Mehta, Neil - Electrical Engineering*

## **High-Frequency FET Modeling in GaN with Dispersion Effects**

*Morgensen, Michael - Electrical Engineering*

## **Design and implementation of a Digital Controller for High Power Converters**

*Mundkur, Sameer Shailesh - Electrical Engineering*

## **Reliability Assessment of Power Systems with Wind Power Generation**

*Wang, Shu - Electrical Engineering*

## **Multi-point to single-point service traffic shaping**

*Bolloor, Keerthana - Computer Networking*

## **A Synthesizable HDL Model for Out-of-Order Superscalar Processors.**

*Choudhary, Niket Kumar - Computer Engineering*

## **Low Power Interconnect Circuits using Silicon Carriers**

*Gadfort, Peter - Electrical Engineering*

## **Memory Design for FFT Processor in 3DIC Technology**

*Gonsalves, Kiran - Electrical Engineering*

## **Provisioning Algorithms for Service Differentiation in Middleware Appliance Clusters**

*Habib, Mursalin - Computer Engineering*

## **Transaction-level Modeling for a Network-on-chip Router in Multiprocessor System**

*Hu, Jianchen - Electrical Engineering*

## **Branch Current State Estimation Method for Power Distribution Systems**

*Jung, Jae Sung - Electrical Engineering*

## **An Intelligent Energy Management System for Charging of Plug-in Hybrid Electric Vehicles at a Municipal Parking Deck**

*Kulshrestha, Preetika - Electrical Engineering*

## **Delay Tolerant Behavior Control based Adaptive Bandwidth Allocation for Unmanned Ground Vehicles in a Network Control System**

*Ojha, Unnati - Electrical Engineering*

## **Comparison of End-to-End QoS Reservation Schemes in Next Generation Networks**

*Ramaswamy, Pavithra - Computer Networking*

## **Inductively Coupled Interconnect for Chip to Chip Communication over Transmission Line**

*Shah, Chintan Hemendra - Electrical Engineering*

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