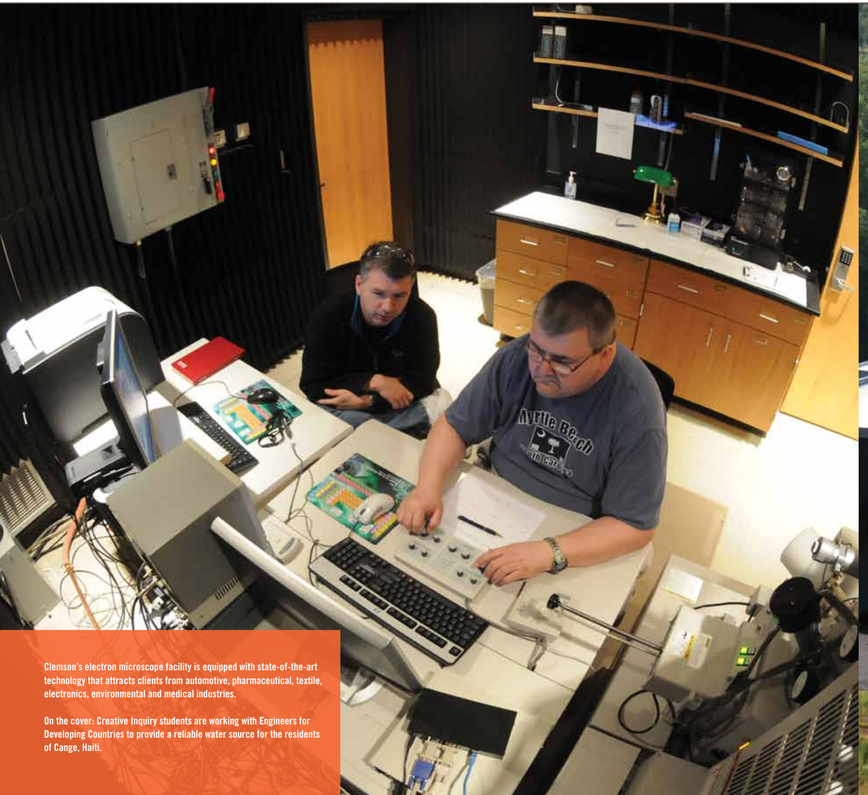


Clemson's electron microscope facility is equipped with state-of-the-art technology that attracts clients from automotive, pharmaceutical, textile, electronics, environmental and medical industries.

On the cover: Creative Inquiry students are working with Engineers for Developing Countries to provide a reliable water source for the residents of Cange, Haiti.

IDEaS

INQUIRY, DISCOVERY IN ENGINEERING AND SCIENCE

COLLEGE OF ENGINEERING AND SCIENCE FALL 2010

in this issue:

CLEMSON
College of ENGINEERING AND SCIENCE

From the Dean

This edition of *IDEaS* offers features that have a service thread running through them. Some are perfect examples of how research often results in applications that benefit society at large. Others underscore the importance of individual commitment.

On a personal note, I've recently had the honor of being elected vice chairman of the National Science Board (NSB). This vote of confidence by the NSB membership presents a unique opportunity – one for which I am extremely grateful. My work with the NSB is a reflection of Clemson's commitment to public service and my own personal philosophy of involvement. Early in my academic career, I made a conscious decision to accept service assignments that provide valuable experiences. As dean, I emphasize the importance of translating discoveries into useful products and services for society.

One of our features tells the story of Engineers for Developing Countries – an organization that provides ways for our engineering students to use their skills for a better world. This group came together more than two years ago with a desire to develop a project or series of projects for which they could take ownership and sustain student involvement for an extended period of time. This story of dedication, commitment and accomplishment is an inspiration. These students are making a real difference in the lives of people in Cange, Haiti, particularly after the devastating earthquake that occurred in January.

Early in my academic career, I made a conscious decision to accept service assignments that provide valuable experiences.

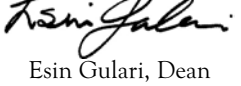
There is also a story about Juan Gilbert and Damon Woodard, professors in the Clemson University School of Computing. Gilbert is the chair of the new human-centered computing division that applies computer solutions to real-world problems. He has translated his research to successful tools for electronic voting and college admissions. In 2008, Woodard established the Center of Advanced Studies in the Identification Sciences. He applies his skills in facial and periocular region-based biometric recognition to national security concerns.

Another feature in this issue describes a public service commitment of a different kind – one undertaken by a corporate partner. Earlier this decade, Eastman Chemical Company donated a portfolio of innovative fiber technology to Clemson comprised of more than 100 U.S. and international patents and other intellectual assets. As promising as the CSM technology was, Eastman felt it didn't fit into its core business. The company set out to find a research university that could develop the technology to its full potential and eventually license it for commercial use. Clemson was deemed eminently qualified. While this gift may benefit the University at some point, the ultimate recipient of Eastman's good will is the general public.

Our "Clemson Family" feature tells the story of Terry Tritt — a Clemson alumnus whose commitment to the institution has put the University on the international stage in thermo-electric research. His avocation also carries him to a different sort of stage, where he's making notable contributions to the arts. His story is enlightening and entertaining.

All of us — particularly engineers and scientists who make time for public service and imagine useful applications of our discoveries — have unprecedented opportunities to contribute to the betterment of mankind. I'm proud to be a part of these efforts.

Sincerely,



Esin Gulari, Dean
College of Engineering and Science
Clemson University

The Ties That Bind

By Ron Grant

Earlier this decade, Eastman Chemical Co. donated a portfolio of innovative fiber technology comprised of more than 100 U.S. and international patents and other intellectual assets. The technology is known by several names, but it is commonly referred to as capillary surface materials, or CSM. Its ability to handle fluids is what makes it unique. CSM fibers have an extraordinary capacity for the wicking of fluids – even viscous fluids such as oil – along the fibers' specially designed surfaces.

As promising as the CSM technology was, Eastman felt it didn't fit into its core business; the company set out to find a research university that could develop the technology to its full potential and eventually license it for commercial use. Clemson was deemed eminently qualified.

"I like to think one reason the Eastman gift came to Clemson is the atmosphere of collaboration that one finds in the College of Engineering and Science," observes Phil Brown, an associate professor of materials science who joined the faculty in 2002. "It's certainly what brought me here."

During his interview visit, Brown was invited to a faculty home for an old-fashioned Southern barbecue. He was joined by a group of professors from the college.

"Here were physicists, chemists, bioengineers, mathematicians and materials scientists – all talking about these research projects they were currently working on together," says Brown. That sort of collegiality and cooperation were things he had not experienced prior to that point. "I decided right there that if Clemson made me an offer, I was going to accept," he adds.

Shortly after his arrival in Clemson, Procter and Gamble (P&G) donated additional fiber technology that complemented the Eastman gift. The company's capillary channel film and fiber technology was similar to CSM in that it dealt with synthetic fibers that had grooves or channels that allowed the fibers to readily wick fluids. Like Eastman Chemical,

Fiber technology threads the needle of economic development.

When a laboratory or company needs to analyze a mixture to determine what components are present, and if they're present in the correct amounts, it relies on a process known as high-performance liquid chromatograpy, or HPLC, to separate those components. The pharmaceutical industry, for example, uses HPLC daily for quality control purposes.

A critical part that resides within the HPLC instrument — where the separations actually take place — is the column. This pencil-sized tube is generally filled with microscopic particles of silica through which the analyte (fluid to be analyzed) is pumped. If production schedules so dictate, a user can speed up the analysis by increasing the flow rate through the column by increasing the pressure. The flow rate, therefore, is limited by how much pressure the instrument can withstand, and that's where Invenca saw an opportunity.

Having obtained a license — based on patents secured by chemistry professor Ken Marcus — to use Clemson University's CSM technology, Invenca replaced the silica particles in the separation column with Clemson's fibers. This revolutionary change allows the instrument to be operated not only at higher flow rates, but at much lower pressures — and at a lower cost. With Invenca's innovative product, upgrading to expensive ultra HPLC instruments will no longer be necessary. Moreover, the company's CSM-filled column is the same size as a standard separation column and can therefore be easily installed in existing HPLC instruments.

Above: Phil Brown discusses fiber research with a graduate student.

Right: Chemistry professor Ken Marcus conducts research with a startup company that has licensed technology through CURF.

Facing page: Bioengineering professor Ken Webb investigates the applications of polymer fiber to regenerate spinal cord and connect other tissue in the body.

P&G did not foresee a future for the development of the technology in its strategic business model.

The Clemson University Research Foundation (CURF), which had accepted the Eastman gift on behalf of the University, recognized that the P&G gift would nourish young talent and find commercial opportunities through continued research and development. CURF has played a vital role by providing funding to maintain portfolio patents so that licensing and technology transfer can take place.

"The Eastman/P&G portfolio seems to hold great potential in so many areas," says Brown. "And through a variety of interdisciplinary efforts, we're certainly trying to mine that potential."

Researchers from a variety of disciplines are examining these structures for device applications, tissue regeneration scaffolding, and coloration and chemical after-treatments of apparel materials.

One of the device applications involves the analytical chemistry of proteins and other biological compounds. The work of chemistry professor Ken Marcus involves the separation of proteins in mixtures that are present in the post-processing of protein therapeutics. Basically, proteins are processed in a variety of solutions (from blood to buffers) that are not compatible with many analytical instruments. Marcus has developed an approach that allows him to sequester proteins from those solutions and then elute them into instrument-friendly solvents. He is a principal researcher along with materials science and engineering research associate Kate Stevens in a startup company called Specialty and Custom Fibers LLC, which has licensed technology through CURF.

In another device application, Chris Cox, professor of mathematical sciences, is working with Brown on a project using shaped fibers from the Eastman Chemical technology in the design of high-efficiency particulate air filters. The large surface area of the shaped fibers (in comparison to round) have interesting effects on airflow, which influences the particulate capture efficiency of filters.

Ken Webb, associate professor in bioengineering, is investigating the application of CSM fibers as scaffolds for tissue engineering. The value of these materials relative to existing alternatives is that parallel channels provide a mechanism for topographic guidance — a biological phenomenon in which living cells orient themselves parallel to physical features of the surface on which they are growing. This is particularly beneficial in designing materials for use in highly organized tissues such as the nervous system, tendons and ligaments, and muscle.

The Clemson Apparel Research Center, under the direction of professor Chris Cole, is investigating fabric applications of the technology for apparel applications. This body of work takes advantage of the ability to design the width and depth of the channels in the fibers to hold active particles. The particles are held without the use of added adhesives. Adhesives would "blind" the activity of the particles by covering a substantial portion of their surfaces.

Clearly, the use of shaped fibers can be quite varied. CSM fibers hold great promise in oil spill remediation, chemical/biological decontamination, sound insulation and synthetic ligaments among other applications. One licensee, for example — Invenca LLC — is using CSM in a process called high-performance liquid chromatography.

Building upon the donated technology, Clemson University researchers are spinning a web of new applications and new markets. ✻

Patent Applications to Date

Inventor(s)	Title	U.S. Patent Filing Date
Ken Marcus	Channeled Polymer Fibers as Stationary/ Support Phases for Chemical Separations by Liquid Chromatography and for Waste Stream Clean-Up	Patent issued 5/20/08
Naren Vyavahare, Qijin Lu	Using of Capillary Surface Materials as Scaffold in Tissue Engineering	6/30/05
Karen J.L. Burg, Chih-Chao Yang	3-D Tissue Systems with Wicking Fibers	8/29/08
Ken Marcus, Rayman Stanelle	Monolithic Structures Comprising Polymeric Fibers for Chemical Separation by Liquid Chromatography (Fiber Bundle Cartridges)	3/13/06
Ken Marcus, Philip J. Brown, Igor Luzinov, and Yonnie S. Wu	Capillary-channeled Polymeric Fiber as Solid Phase Extraction Media	3/13/06
Ken Marcus	Capillary-Channeled Polymer Fibers as Stationary Phase Media for Spectroscopic Analysis	Patent issued 5/20/08
Philip J. Brown, Ken Marcus, Christine Cole, Igor Luzinov	Capillary-channeled Polymer Fibers Modified for Defense Against Chemical and Biological Contaminants	11/14/06 (provisional)
Ken Marcus, Kenneth Christensen	Capillary-channeled Polymer Fibers and Films for the Counting, Sorting and Manipulation of Cellular Matter	2/23/07 (provisional)
Chris Cole, Deborah Lickfield, Kate Stevens and Philip J. Brown	Activated Protective Fabric	6/1/10

Thicker Than Water

Top left: A girl from Cange, Haiti, who will have convenient access to water after the EDC Project is complete.

Middle, left to right: Graduate and undergraduate students work side-by-side on the same team; the EDC team on their first trip to Haiti in 2009.

Bottom, left to right: A Clemson student enjoys taking a break with area children; EDC team members work from a classroom on campus to solve problems identified from the last trip to Haiti; the team conducts a survey with a PVC pipe and a hand level to calculate elevations.

By Rebecca Shepherd

In September 2008, a group of students in the College of Engineering and Science came together in search of a way to offer their skills for a better world. The group, led by civil engineering graduate student Jeff Plumblee, envisioned a project or series of projects for which they could take ownership and sustain student involvement for an extended period of time.

A few months later, a registered professional engineer with volunteer experience in Haiti addressed an undergraduate civil engineering class about the need for clean, accessible water in Cange, Haiti. It was evident that the challenges in Cange were well-suited for the group's project goals and areas of expertise.

By the next summer, the students were in Haiti, conducting research on the situation and collecting data to begin system design once they returned to Clemson. This was the beginning of a Creative Inquiry (CI) project with Engineers for Developing Countries (EDC) that has drawn on the expertise of the community, alumni, faculty and the students themselves.

Laura Simpkins was part of the initial 2009 visit to Haiti. She and other group members collected data to rebuild a water system that will revolutionize how the townspeople approach the daily task of acquiring clean drinking water. The group was searching for ways to eliminate a two-mile walk with an 800-foot vertical climb to the nearest water source.

Simpkins joined the group as an undergraduate chemistry student and has continued participating as she pursues her graduate degree in environmental engineering. "The group started as a way for students to apply the skills they have learned to real-world needs," she says. "We've split up into groups to tackle each aspect of the project. Some raise funds while others design water pumps – but no matter what you do, the experience is life-changing and rewarding."

But the benefits do not stop there. Employers are watching. According to Lance Bell, a civil engineering professor and the group's adviser, this CI project helps the students differentiate themselves from other job applicants by adding community service and

real-world experience to their résumés. "The project is entirely student-driven," he says. "Faculty are available to assist as needed, but it's primarily run by the students. In some cases, employers value this type of experience with teamwork, initiative and networking more than a GPA."

> "In some cases, employers value this type of experience with teamwork, initiative and networking more than a GPA."
>
> — Lance Bell, civil engineering professor and EDC adviser

This CI group has relied greatly on the help of the Clemson Family to make their project successful. Group members who have graduated have served as liaisons to experienced consultants from companies like Duke Energy. The Episcopal Diocese of Upper South Carolina has also responded to the need by helping to raise funds for supplies and service trips.

The students have completed the design of a water filtration system and are currently renovating a water distribution system. Recent challenges include building a barge that is able to carry 2,000 pounds of pumps and pipes across a lake. The ingenious team designed one out of 55-gallon plastic drums.

Future projects include redesigning dilapidated community water distribution stations, implementing a biodigester for waste treatment and investigating the use of modified shipping containers as homes. Twenty-five students, consisting of both undergraduate and graduate students, have signed up to carry on the work of the group during fall semester. *

Clemson's EDC group leader, Jeff Plumblee, was able to collect essential background information and equipment requirements/constraints before visiting Cange. It was determined that traditional surveying equipment such as a total station, tripod and prism pole could be held in customs for some time or even confiscated. As a result, the students had to use some ingenuity in completing their surveys. They decided that a hand level and a dimensioned length of PVC pipe could be used to calculate elevations and approximate distances. Plumblee also acquired surveys previously completed in the area that the students could use as a reference.

Human-Centered Computing Gets a New Face

By Susan Polowczuk

Professor Juan Gilbert is chair of the new human-centered computing division within the School of Computing. He says the division's concept is a relatively new idea in that it applies computer solutions to real-world problems.

"I've been doing this kind of work for years," says Gilbert. "It's finally getting the recognition it deserves as a cutting-edge discipline. Students have flocked to this area because they see the connection between what they are doing in the lab and how it will impact the public. They get it immediately."

Gilbert says students are drawn by the desire to see how technology helps the community, just as he was drawn to Clemson because of the University's willingness to transfer research to the private sector.

"Clemson is very conducive toward startup companies and technology transfer," says Gilbert. "My research is applied — with real-world applications — so it will ultimately transfer. That's what I was looking for when I came to Clemson."

Two of Gilbert's pet research projects have made the successful transfer to business. The first is his research

in electronic voting spawned by the hanging chad controversy in the 2000 presidential election. The result is a first-of-its-kind, accessible voting system called Prime III. Gilbert explains it as a multimodal system where votes are privately and securely taken by touch, voice or both. The technology, known as universal design, allows everyone within a precinct to vote on the same machine, reducing the training required of poll workers and the opportunity for error or security breeches. Gilbert has testified to the U.S. Senate's Rules and Administration Committee and the U.S. Election Assistance Commission Board of Advisors.

"My research is applied — with real-world applications — so it will ultimately transfer. This is what I was looking for in coming to Clemson."

—Juan Gilbert

The second project is a data mining and software analysis tool that allows education admissions officers to address diversity and capacity in admissions while maintaining academic standards and adhering to the law – all done in a shorter period of time than traditional methods. A company called Applications Quest™ of Fairfax, Va., was created as a result of this research.

Gilbert credits students as being the workhorses of research.

"They're vital at every level, undergraduate and graduate," says Gilbert. "It's important to get our freshmen involved at the earliest possible time. The type of research we do is a tremendous recruiting factor. Students love, one, that they play a significant role, and two, that they can jump in early. They're also attracted to the collaborative nature of the research. We work with disciplines across campus to accomplish a common goal."

The editors of *Speech Technology* recently named Gilbert one of four Speech Luminaries for his influence in shaping the speech technology industry, and he was just selected to the 10th Annual 50 Most Important African-Americans in Technology by eAccess Corp. He is also an associate of the National Research Council of the National Academies and a distinguished speaker for the Association for Computing Machinery.

Gilbert is a believer in communicating science to the broader community in an effort to educate the public.

He has been invited to give more than 150 speeches across the country in areas that include motivational talks, career development, technology policy and scientific research. Most recently, he has been selected to serve a two-year term on the National Science Foundation (NSF) Computer and Information Science and Engineering Advising Committee. Made up of members from universities and industry, this committee counsels staff in the NSF's Computer and Information Science and Engineering Directorate. The directorate funds more than 80 percent of all federally sponsored academic computer-science research in the United States. *

School of Computing assistant professor Damon Woodard, right, became acquainted with Juan Gilbert through the Future Faculty and Research Scientist Mentoring (FFRSM) program. The FFRSM is part of Gilbert's experience with his NSF Broadening Participation in Computing: African-American Researchers in Computing Sciences grant. Through the FFRSM, Gilbert mentors soon-to-be computer science Ph.D. students through the academic and research scientist job search process. The FFRSM led Woodard to Clemson, and ultimately, he wound up bringing his mentor as well.

Currently, Woodard is the director of the Center of Advanced Studies in the Identification Sciences (CASIS), located within the School of Computing.

The lab is working with a $2 million grant from the Office of the Director of National Intelligence and has joined with other universities to create CASIS. The aim of the center is to strengthen biometric identification, which is the measurement of physical characteristics to verify a person's identity.

Woodard has led the way in developing periocular and iris recognition techniques, which can achieve high performance when using less-than-ideal-quality data.

"Historically we've looked at the iris for identification, but what if the iris is obstructed when the subject blinks? We then can look at eye region features such as skin folds and wrinkles for more accurate identification, along with the iris," says Woodard.

Woodard believes the techniques he has developed could open up additional possibilities for applications that require the identification of an individual, including airport, border and home security procedures.

Under the five-year, $8.9 million grant, Clemson is working with researchers from Carnegie Mellon University, North Carolina A&T State University and the University of North Carolina at Wilmington.

Perfect Harmony

By Charreau Bell

Although he is known worldwide for his research in the field of thermoelectric materials, Terry Tritt is also known locally – and at least as far as Denver – as the lead vocalist and guitarist for the bluegrass band The Grass Roots Revue. The band's humble beginnings are found in Highlands, N.C., Tritt's hometown, where he grew up loving music.

After graduating from high school, Tritt spent the next three years playing in a band and working. "My dream was to go to Nashville and be a musician," he says. "But my destiny was down a different path." Tritt's first step on that path was inspired by his fiancée, Penny, who indicated she wasn't terribly excited about the prospects offered by a budding musician. Instead of pursuing his musical career, Tritt committed himself to earning his bachelor's and doctoral degrees in physics at Clemson University. He then moved to Washington, D.C., on a prestigious fellowship at the Naval Research Labs. "There's never been a doubt in my mind," he observes. "Going after my education was the right thing to do."

Eleven years after graduating, he returned to his alma mater to interview for a faculty position in the physics department. After joining the faculty in 1996, Tritt began building a world-renowned thermoelectric materials program. Along the way, he rediscovered his love for music. He recalls, "When I came back here, we were working something like 70 hours a week getting the lab going – the first couple years were really intense. Then, I ran into some of the old guys I used to know who I'd played music with. We started getting together and playing, and it became this tremendous release that I really needed."

Now Tritt is making beautiful music, both in the lab and the recording studio. He currently serves as the director of the Complex and Advanced Materials Lab at Clemson, which is one of the premier facilities in the world for thermoelectric research. The current focus is on the development of

Terry Tritt, director of the Complex and Advanced Materials Lab, examines a sample with one of his graduate students.

Tritt is a renowned researcher and professor by day. By night, he is a bluegrass guitarist.

nanocomposites, whose superior physical properties enable more efficient conversion of heat into electric energy. Under his guidance, the lab has obtained more than $11 million of external funding, including grants from the Department of Energy and the Department of Defense. He has been a featured speaker and panel expert at thermoelectric conferences all over the world, including Japan, China and Germany. Tritt has published more than 200 scientific papers, and his research group has published more than 30 refereed articles in the last year alone. For his long history of excellence in research, he was awarded the 2008 S.C. Governor's Award for Excellence in Scientific Research, the Clemson Alumni Award for Research as well as the Clemson College of Engineering and Science Award for Achievement in the Sciences.

For his long history of excellence in research, Tritt was awarded the 2008 S.C. Governor's Award for Excellence in Scientific Research.

Tritt, however, measures his success in terms of the accomplishments of his graduate and undergraduate students. "They come first," he says. "I want to see them succeed — I've had numerous students who've won fellowships and awards over the years. They've all gone on and done well. That's how I measure my success. I tell my students to remember to play hard and work hard, and good things will happen."

And The Grass Roots Revue hasn't done too badly either. "I actually have the distinction of publishing a book in the sciences — *Thermal Conductivity* — and releasing a bluegrass CD — Carolina Star — in the same year," Tritt beams. The band enjoys widespread notoriety, consistently booking more than 20 performances each summer — mostly concentrated in northern Georgia, but ranging as far away as Denver, Colo. The Grass Roots Revue has opened for award-winning bands such as the Del McCoury Band and Tim O'Brien and The O'Boys. The group has released five CDs.

Tritt says, "It's a lot of fun, because music is the thing that gives me an escape. There's no e-mail, there's no phone, you can't think about work because when you're on stage, you have to think about what you're doing." *

News and notes

Clemson announces three-part clean-energy plan

Creating and attracting "green" jobs, preparing people to fill them and generating innovations to propel the state and nation into energy leadership positions are the goals of Clemson University's clean-energy strategic plan, outlined in a recently released white paper.

The white paper entitled "Clemson University's Commitment to Green Economic Development" draws from the proceedings of two energy-related summits Clemson hosted in late 2009. The events drew hundreds of academic, industry and government leaders and included panel discussions and keynote addresses by U.S. Secretary of Energy Steven Chu, General Electric chairman and chief executive officer Jeffrey R. Immelt and U.S. Sen. Lindsey Graham.

Five CES researchers net NSF CAREER awards

The Faculty Early Career Development (CAREER) Program, the National Science Foundation's (NSF) most prestigious awards in support of the early career-development activities of teacher-scholars, announced grants to five CES faculty this spring.

Zahra Hazari, an assistant professor of engineering and science education, received her NSF CAREER grant to study ways to improve physics classes for high school students, hoping to help more of them — particularly young women — develop a positive "physics identity" that will enable them to perform better in science classes. Using classroom case studies, Hazari will identify "personally meaningful learning experiences" that high school students have reported in physics lessons. She will then develop a pedagogical plan including 15 sample lesson plans with detailed activities that connect physics to real-world contexts, counter the stereotypes young people have about physics and help students see themselves as capable of performing well in the subject. She will also seek to gauge the long-term impact of these experiences as students progress from high school to college.

Assistant professor of engineering and science education **Julie Trenor** will research the social interactions that influence underrepresented students' decisions to enter and continue in the study of engineering. She will be the first researcher to apply the theoretical framework of social capital to explain the academic and career choices that are available to engineering students. Building on the results of researchers in other fields, Trenor's study will bring fresh perspectives and new tools to the study of engineering student persistence. The project seeks to increase the number of students who complete engineering degrees and subsequently fill engineering jobs or start new high-tech businesses.

Guang Li, an assistant professor of mechanical engineering, seeks to develop a theory and methodology for analysis of nanomaterials and structures. Because accurate and efficient computational tools are not currently available for analysis of thermomechanical interactions in ultrasmall structures, Li will address the gap that exists between two current models: the continuum and atomistic theories. His project will allow him to develop a multiscale computational approach, combining the thermomechanical models. In addition, he will explore a concept of mechanical design of thermal transport in materials. Li also will develop a simulation-based learning and discovery Web portal to engage K-12, undergraduate and graduate students in the study of nanomaterials.

Brian Dominy's project will take him inside the minds of molecules. The assistant professor of chemistry will use Clemson's "condominium cluster" computer — ranked by The TOP500 Project as the 40th most powerful supercomputer in America — to calculate how molecules, especially the proteins that are the biochemical workhorses of the human body, will adapt and change when they meet new partners, such as medicines. By analyzing experimental data on the movement of protein molecules over time and under different circumstances, Dominy hopes to shed light on how proteins evolve. In addition to identifying the physical and chemical laws that dictate these changes, the research could help medical scientists develop therapies for pathogens that have become resistant to current therapies.

Assistant professor of mechanical engineering **Laine Mears** will research model-based control methods for machining processes, where material is removed by high-shear-rate cutting. His project will involve real-time modeling and the exchange of information among processes in a machining system to maximize efficiency. Mears will focus on model uncertainty and abstraction as a manufacturing system's complexity grows. Improved modeling and control methods would yield more profitable machining and more competitive manufacturing of high-quality parts for automotive, aerospace and consumer products industries, among other manufacturers. Mears also will develop an educational component with the Gateway to Technology, a national middle school program for improving the instruction and experience of S.C. students and encouraging future researchers to pursue an education in manufacturing.

Clemson professors elected Fellows

Anand K. Gramopadhye, professor and chairman of industrial engineering at Clemson University, has been elected an Institute of Industrial Engineers Fellow, the highest recognition conferred by the professional society. The honor recognizes Gramopadhye's career in industrial engineering research, which focuses on solving design problems in human/machine systems and modeling human performance in technologically complex systems, such as health care, aviation and manufacturing.

Kathleen Richardson, professor in the School of Materials Science and Engineering, was elected to the rank of Fellow at the October 2009 Board of Directors meeting of the Optical Society of America (OSA). Richardson joined one of 61 OSA members elevated to this prestigious rank and was acknowledged for her "contributions to the advancement of glass science in optics through teaching and research across institutions and international boundaries."

Jean-Marc Delhaye, a senior lecturer in mechanical engineering, was elected to the College of Fellows for the American Society of Mechanical Engineers. Delhaye's research

has covered a wide area in two-phase flow and heat transfer including analytical formulation, modeling and measuring techniques. His latest research activities mainly concern forced convective subcooled boiling; single-phase, forced convection in narrow rectangular channels; and gas-lift systems for reprocessing plants.

National Science Education Leadership Association recognizes Clemson center coordinator

Thomas T. Peters, executive director of the S.C. Coalition for Mathematics and Science and coordinator for the Clemson University-based Anderson-Oconee-Pickens-Greenville Regional S²MART Center, is the National Science Education Leadership Association's 2010 Outstanding Leader in Science Education.

Peters received the honor, which includes a one-year association membership, a plaque and a $1,000 check from Pearson Publishing Co.

The S²MART Center was created in 1994 by an NSF-funded Statewide Systemic Initiative grant. The center, along with a statewide network of regional centers and business, education and public/policy partners, has been instrumental in leading schools through changes associated with the creation of mathematics and science curriculum standards and the implementation of South Carolina's student achievement testing program.

Clemson students earn prestigious Goldwater Scholarships

Four Clemson University students have received the prestigious Barry M. Goldwater Scholarship. The scholarship honoring the late senator is intended to foster and encourage outstanding students to pursue careers in mathematics, engineering and the natural sciences.

The University may nominate up to four students a year for the scholarship. This year's recipients are:

Benjamin Cousins, a sophomore in mathematical sciences and computer science;

Kemper Talley, a junior physics major;

Chelsea Woodworth, a sophomore biology major; and

Ann Guggisberg, a junior majoring in genetics.

Clemson University named to President's Higher Education Community Service Honor Roll

For the third year in a row, Clemson University has been named to the President's Higher Education Community Service Honor Roll, the highest federal recognition a college or university can receive for its commitment to volunteering, service-learning and civic engagement. Honorees are chosen based on a series of selection factors, including the scope and innovation of service projects, the percentage of student participation in service activities, incentives for service and the extent to which the school offers academic service-learning courses.

Last year, more than 10,500 Clemson students engaged in some form of service-learning activity or community service, spending a total of more than 126,300 hours volunteering.

Clemson to offer new environmental engineering undergraduate degree

Clemson University will offer a new B.S. degree in environmental engineering this fall, the first of its kind in South Carolina. **Tanju Karanfil**, environmental engineering professor and department chairman, says the new program fills a niche within the state.

"The new degree should help keep the best and brightest students here in South Carolina to pursue their education," he said. "We're facing serious environmental issues in the future, such as contaminated water supplies, hazardous wastes, increasing populations and limited resources. We need a highly trained work force ready to tackle environmental issues. This technical and challenging program is led by world-class faculty dedicated to providing the best possible educational experience."

Clemson professor recognized for dedication to manufacturing industry

Two prestigious manufacturing organizations have recognized Clemson University professor **Thomas Kurfess** for his outstanding contributions to the profession.

The Society for Manufacturing Engineers gave Kurfess the 2010 Education Award for promoting manufacturing-related curricula and training methods as well as inspiring students to enter the manufacturing profession.

Kurfess also is one of two new members on the board of directors elected to the National Center for Manufacturing Sciences, North America's largest collaborative research and development organization, in addition to serving as the administrator of the Robotics Technology Consortium.

Proterra selects CU-ICAR for research, development and assembly of hybrid commercial vehicles

Proterra Inc., which develops and assembles fuel-cell hybrid-powered transit vehicles, recently announced that it will locate a facility for research and development as well as assembly of its products at the Clemson University International Center for Automotive Research in Greenville.

Proterra and its partners design, develop and assemble all-electric and battery-dominant hybrid drive solutions and complete vehicles for commercial applications, including transit, school and commercial buses; parcel delivery vehicles; and other class 4-8 trucks.

Proterra anticipates that it will invest $68 million and create 1,300 new jobs over the next seven years in Greenville County. The company will require a variety of skilled workers to support functions such as mechanical assembly, warehouse, logistics, management, engineering and quality assurance.

National Transportation Research Center Inc. recognizes two Clemson engineers

Two Clemson University researchers have been recognized by the National Transportation Research Center Inc. for being among the top in the nation.

John Limroth of Greenville, first recipient of a doctoral degree in automotive engineering from Clemson and in the United States, was named Student of the Year. **Michael Arant** of Williamston, a master's student in mechanical engineering, was named Outstanding Student Researcher.

INQUIRY, DISCOVERY IN ENGINEERING AND SCIENCE

IDEaS

FALL 2010

IDEaS is produced biannually for the College of Engineering and Science at Clemson University by the Office of Creative Services.

On the cover: Clemson's spirit of collaboration attracted professors like Phil Brown to the University. Brown and his research partners have filed for five patents based on their cooperative efforts. For more, flip to page two.

Right: Damon Woodard (right) and his mentor, Juan Gilbert (left), became acquainted through the Future Faculty and Research Scientist Mentoring Program. Both teach and conduct research in Clemson's School of Computing. Find out more on page nine.

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Left to right: Dr. R. Larry Dooley, Dr. Esin Gulari, Dr. E.R. (Randy) Collins

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IDEaS

INQUIRY, DISCOVERY IN ENGINEERING AND SCIENCE

COLLEGE OF ENGINEERING AND SCIENCE FALL 2010

Highlights from our departments

College Structure Is Key to Collaboration

The College of Engineering and Science is made up of 14 separate schools and departments, but the unique structure of combining engineering and science programs within one college has led to an uncommon ability to provide a team-based, integrated approach to teaching and research. Scientists and engineers working together to find more efficient solutions is the structure of Clemson University's College of Engineering and Science.

Bioengineering

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Fast Facts

Tenured/tenure-track faculty: 22
Enrollment: Undergraduate 162; Graduate 106
Degrees awarded (December 2009 and May 2010): Undergraduate 32; Master's 5; Doctoral 6
Research expenditures: $4,380,000
Research thrusts: biomaterials, bioelectrical


Dan Simionescu

Facilities

The bioengineering department recently expanded its research and education facilities with the opening of the Rhodes Annex. The 29,000-square-foot, three-story addition to Rhodes Hall — home of the department since its establishment at Clemson in the mid-1960s — is part of a development plan unveiled by President Barker in 2007 that includes campus-wide facility and information technology improvements.

The annex features classrooms equipped with the latest distance-learning capabilities. It was designed for communication, collaboration and networking among undergraduates, graduate students and faculty. Numerous laboratories include those dedicated exclusively to research that supports the bioengineering B.S. curriculum, such as undergraduate labs for tissue engineering, bioinstrumentation and biomechanics. Several other laboratories are designed to facilitate integration of undergraduate and graduate education.

Faculty Highlights

The American Institute for Medical and Biological Engineering elected **Naren Vyavahare** to its Class of 2010 College of Fellows during the institute's annual event in Washington, D.C. Vyavahare, Hunter Endowed Chair of Bioengineering, received this honor for his outstanding contributions for the treatment of abdominal aortic aneurysms and leadership in biomaterials education and training.

Vyavahare was also recognized with Clemson's Alumni Award for Outstanding Achievements in Research. In October 2009, Vyavahare assumed the role of director of the S.C. Center of Biomaterials for Tissue Regeneration. A $9 million NIH Center of Biomedical Research Excellence aimed at developing new biomaterials technologies, the center provides the mentoring to assure the success of six junior target faculty members as future NIH-funded independent researchers.

Karen J.L. Burg, Hunter Endowed Chair of Bioengineering and interim vice provost for Research and Innovation, has been elected vice president-elect of the Society For Biomaterials (SFB). The SFB is the premier professional society that promotes advances in all phases of materials research and development by encouraging cooperative educational programs, clinical applications and professional standards in the biomaterials field. More than 1,000 members worldwide represent industry, medicine, academia and regulation. Burg's term will last from 2011 to 2012.

The NIH awarded **Dan Simionescu** a four-year, $1.5 million R01 grant to fund the development of a heart valve device engineered from collagen scaffolds and stem cells. Simionescu is assistant professor of bioengineering and director of the Biocompatibility and Tissue Regeneration Laboratory, a multidisciplinary group focused on finding regenerative medicine solutions to treat cardiovascular and orthopedic diseases.

Student Achievement

Ph.D. bioengineering student **Suzanne Parks** was awarded an NSF Graduate Research Fellowship to study tissue-engineering approaches to cardiovascular applications. Parks graduated with a B.S. in bioengineering from Clemson in May 2009. She is currently pursuing her doctoral work in the CU-MUSC bioengineering program in Charleston under the supervision of **Rick Visconti** and **Martine LaBerge**.

Bioengineering junior **Brittany Banik** and senior **Tim Laird** were each awarded a 2010 Atlantic Coast Conference Inter-institutional Academic Collaborative Program in Creativity and Innovation Fellowship for their undergraduate research on *Bioactive Targeted Nanoparticle Drug Delivery for Bone Regeneration* and *Development of a Brain-Controlled Robot*, respectively. They are advised by **Jiro Nagatomi** and **Delphine Dean**.

Balakrishnan Sivaraman, a bioengineering doctoral candidate under the supervision of **Robert Latour**, has received an SFB 2010 Star Award for his work on *Delineating the Specific Interactions Mediating Platelet Adhesion to Adsorbed Plasma Proteins*. The award was presented at the annual meeting of the SFB.

Biosystems Engineering

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Fast Facts

Tenured/tenure-track faculty: 17
Enrollment: Undergraduate 62; Master's 11; Doctoral 7
Degrees awarded (December 2009 and May 2010): Undergraduate 14; Master's 5; Doctoral 2
Research expenditures: $1,176,702
Research thrusts: bioprocessing, biofuels, water quality, non-point-source pollution aquaculture, instrumentation and control, bioseparation, machine design in biosystems engineering


Caye Drapcho

Department Overview

Biosystems engineering is a science-based engineering discipline that integrates engineering science and design with applied biological, biochemical and ecological sciences. The biosystems engineering program is unique among engineering disciplines because it incorporates bioprocess, structural and mechanical design.

Clemson's biosystems engineering program is focused primarily on two areas of research — sustainable bioprocessing and ecological engineering. In the bioprocessing area, researchers are developing ways to produce biofuels, nutraceuticals and pharmaceutical compounds in addition to biomaterials using natural and modified microorganisms. Biofuels — particularly biodiesel — made from biomass and aquatic organisms are currently topics of significant research.

In the ecological engineering area, water management and water quality are major thrusts. Clemson researchers are focused on nearly every aspect of keeping surface runoff as well as ground water safe from chemical or biological pollutants, wastewater treatment, land use and low-impact development.

Facilities

Biosystems engineering has several research facilities, including a fiber-quality lab; an agricultural/chemical/biological lab; aquaculture facilities; and a bioprocessing lab containing multiple fermentors, processing equipment and analytical instrumentation. Off-campus facilities include Edisto Research and Education Center (REC) near Blackville, Pee Dee REC near Florence and the Belle Baruch Institute of Coastal Ecology and Forest Science near Georgetown.

Faculty Highlights

A collaborative project to study minimal allowable flows at 18 sites in the Pee Dee project was recently chosen for funding. The project is led by **Dara Park** from the Pee Dee REC and also involves **Anand Jayakaran** and **Daniel Hitchcock**. By measuring the manner in which the fish community structure, water quality and bacterial loadings are affected by variations in flow, the researchers hope to develop a method to inform the regulation of minimum allowable flows in the river and streams of South Carolina. The project is funded by the PeeDee Endowment Fund.

The BioEnergy Research Collaborative (BERC) was recently established to enable consolidated biofuels research efforts among Clemson University, Savannah River National Lab and the S.C. State University Transportation Center. Matching funds have been enabled through local companies and research organizations including Spinx Corp., Renewable World Energies Inc., Fagen Engineering and S.C. Bio. **Terry Walker** and **Caye Drapcho** participate within BERC, researching the conversion of switchgrass and peach waste to ethanol, algal oil to biodiesel, as well as microbial fuel cell technology.

A USDA Renewable Energy research grant was obtained by a local peach producer to determine the feasibility of converting the sugar contained in waste peaches to hydrogen gas. The award is based on the research conducted in **Caye Drapcho's** laboratory by biosystems engineering graduate students **Xioahui Yu** and **Abhiney Jain** and undergraduate student **Kara Kopf**. With the grant, further research will be conducted to optimize the fermentation process and determine ways to recover co-products in support of the biorefinery concept.

Terry H. Walker is researching and producing second-generation biofuels. He is taking part in a $3 million project sponsored in part by the U.S. Department of Energy and the S.C. Public Service Administration. He is teaming with the BioEnergy Research Collaborative — a partnership among Clemson University, Savannah River National Lab, USDA Research Labs in Philadelphia and Florence, and private partners. His work focuses on the production of bioethanol from cellulosic resources like switchgrass and biodiesel from microalgae. Walker has recently published a textbook entitled *Biofuels Engineering Process Technology* with co-authors **Caye Drapcho** and **John Nghiem.**

Student Achievement

Kara Kopf was awarded an NSF Graduate Research Fellowship while she was an undergraduate student. She has since completed her bachelor's degree in biosystems engineering and currently attends North Carolina State University to pursue her Ph.D. in environmental engineering.

Many undergraduate students were accepted to summer REU or internship programs, including **Natasha Bell** (Kansas State Biofuels REU), **Jazmine Taylor** and **Liz Edelstein** (Colorado Consortium for Biofuels and Biorefining), and **Andy Gray** (Biofuels Internship; Ford, Bacon and Davis LLC).

Chemical and Biomolecular Engineering

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Fast Facts

Tenured/tenure-track faculty: 10
Enrollment: Undergraduate 150; Doctoral 30
Degrees awarded (December 2009 and May 2010): Undergraduate 33; Master's 1; Doctoral 2
Research expenditures: $3,900,000
Research thrusts: advanced materials, kinetics and catalysis, chemical and biochemical separations, molecular modeling and simulation, biosensors and biochips

Amod Ogale

Department Overview

Based on the sciences of chemistry, biology, physics and mathematics, the Department of Chemical and Biomolecular Engineering (ChBE) is at the forefront of nanotechnology, energy and fuels, and "green" engineering and leads the way in medical and health-related research.

In response to the national trend of greater diversity in areas of employment for chemical engineers, ChBE implemented emphasis areas in energy studies; environmental engineering; polymeric materials; business management; and applied engineering, mathematics and science.

Approximately 55 percent of undergraduate students co-op at companies such as BASF, Dow Chemical, Kimberly-Clark, Michelin, Milliken, NASA and RocheCarolina. In addition, study abroad opportunities abound — including a summer laboratory course offered in Vienna, Austria.

There are numerous opportunities for undergraduate and graduate research in ChBE. Strong departmental research programs exist in advanced membranes, bioelectronics, biosensors and biochips, biofuels, biological separations, kinetics and catalysis, molecular modeling and simulation, nanomaterials, supercritical fluids, polymer science and engineering, and interfacial science and engineering.

Faculty Highlights

Charlie Gooding received the CES 2010 Murray Stokely Award for Excellence in Teaching in recognition of his outstanding teaching abilities, his enormous contributions to the educational mission of the department, and his dedication to our students and their personal and professional development.

Scott Husson was elected to the board of directors of the North American Membrane Society. Husson also received an NSF grant to work with Tetramer Technologies to provide the technical knowledge needed to produce advanced membranes for CO_2 separation from natural gas.

Amod Ogale was awarded research grants of more than $1 million by the Army and Air Force Research Labs, the NSF and industry partners to develop ultrahigh-performance carbon and polymeric fibers from novel precursors — including those derived from ecologically sustainable sources. He is also serving as the director of the Center for Advanced Engineering Fibers and Films.

Anthony Guiseppi-Elie, Dow Chemical Professor, has been appointed the organizing session chair in bionics at the 2011 Annual General Meeting of the Institute of Biological Engineering. Plus, having reviewed the National Institute of Standards and Technology (NIST) Electronics and Electrical Engineering Laboratory, Guiseppi-Elie has been selected to participate in strategic planning efforts to guide the development of emerging standards and metrology in bioelectronics within the Semiconductor Electronics Division of NIST.

David Bruce is the coordinator for all simulation efforts in a multi-university Energy Frontier Research Center funded with $12.5 million from the U.S. Department of Energy. The Center for Atomic-Level Catalyst Design focuses on the development of new catalysts for the production of clean fuels and chemicals from renewable sources.

Student Achievement

Ph.D. student **Daniel Wandera** won an Elias Klein Founders Travel Award from the North American Membrane Society (NAMS). He presented his research on the development of advanced membranes for water treatment at NAMS 2010. Wandera conducts research under the guidance of **Scott Husson**.

Undergraduate **Chas McGill** won second place overall in the undergraduate poster competition at the American Institute of Chemical Engineers Southern Regional Conference. McGill conducts research under the guidance of **Scott Husson**. At the same conference, **Jennifer Moffit** won a second place award in the oral-presentation competition. Moffit conducts undergraduate research with **Christopher Kitchens** in the area of cellulose nanocrystals.

Sourabh Kulkarni won the ACS Petroleum Chemistry Division Student Award at the ACS 2010 Spring National Meeting in San Francisco. Nominees were judged based both on the quality of the written pre-print and oral presentation and on the novelty of the presented research. Kulkarni works with **Mark Thies** in the area of heavy petroleum macromolecules.

Juan Pablo Hinestrosa was selected to participate in a special symposium entitled "Excellence In Graduate Polymer Research" at the ACS 2010 Spring National Meeting. The purposes of this symposium were to provide recognition to outstanding graduate students in polymer science and engineering, to foster networking and exposure, and to help develop the careers of future leaders in those fields. Hinestrosa conducts research under the guidance of **Mike Kilbey**, who is now at Oak Ridge National Laboratory with a joint appointment at the University of Tennessee in Knoxville.

Chemistry

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Fast Facts

Tenured/tenure-track faculty: 22
Enrollment: Undergraduate 152; Graduate 97
Degrees awarded (December 2009 and May 2010): Undergraduate 18; Master's 4; Doctoral 14
Research expenditures: $4,328,018
Research thrusts: analytical, inorganic, organic and physical, polymer and materials, solid-state, bioanalytical, bio-organic and medicinal, and computational chemistry; chemical physics; and chemical education

Brian Dominy

Department Overview

The chemistry program is one of the largest and most active on the Clemson campus. More than 20 faculty members direct the research of about 100 graduate students with the assistance of approximately 15 postdoctoral and visiting scientists. In addition, several faculty are primarily engaged in undergraduate instruction and chemical education research. Faculty members also manage the department's Nuclear Magnetic Resonance Resource Center, Molecular Structure Center and additional computing resources.

The research activities of the faculty include projects in the traditional areas of analytical, inorganic, organic and physical chemistry as well as a broad range of interdisciplinary and nontraditional areas — polymer and materials chemistry, solid-state chemistry, bioanalytical chemistry, bioorganic and medicinal chemistry, computational chemistry, chemical physics, chemical education and other areas.

Faculty Highlights

Computational chemist **Brian Dominy** has won a $588,000 NSF CAREER grant to support his work on computer modeling of how molecules — especially the proteins that are the biochemical workhorses of the human body — will adapt and change when they meet new partners, such as medicines.

Andrew Tennyson recently joined the chemistry faculty as an assistant professor of chemistry. Research in the Tennyson group broadly emphasizes the application of inorganic and organometallic chemistry to the fields of bioimaging and medical and optoelectronic materials. Tennyson earned his B.S. in chemistry from the University of Chicago and his Ph.D. in inorganic chemistry from the Massachusetts Institute of Technology. He worked as a postdoctoral scientist at the University of Texas at Austin prior to coming to Clemson.

William Pennington was awarded the 2009 Philip H. Prince Award for Innovative Teaching. The annual award recognizes outstanding teachers who demonstrate creative and novel teaching methods in the classroom.

Student Achievement

The Graduate School at the University of Georgia (UGA) has awarded **Robert J. Gilliard** an Outstanding Teaching Award. Gilliard earned his B.S. in chemistry from Clemson in 2009 and is now a graduate student at UGA. He is only the second person in the UGA chemistry department to receive this award and the first to receive it during the first year of teaching.

Wendy Queen, a 2009 graduate, received a Postdoctoral Research Associateship Award from the National Research Council to work with Craig Brown at the National Institute of Standards and Technology Center for Neutron Research in Gaithersburg, Md. Her studies are currently focused on understanding the physics and chemistry underpinning H_2/CO_2 interactions in new adsorbent systems, such as metal-organic frameworks and activated carbons.

The Clemson chapter of the Society for Advancing Hispanics/Chicanos and Native Americans in Science (SACNAS) earned the 2009 Role Model Chapter of the Year award at the SACNAS national conference. The award recognizes the chapter's work toward enhancing the professional development of its members, fundraising and mentoring Hispanic students at elementary, middle and high schools in Clemson, Walhalla and Greenville. The award also recognizes the research presented at the conference from four graduate students in the chemistry department.

Civil Engineering

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Fast Facts

Tenured/tenure-track faculty: 20

Enrollment:	Undergraduate	490
	Master's	61
	Doctoral	35
Degrees awarded (Dec. 2009 and May 2010):		
	Undergraduate	150
	Master's	25
	Doctoral	6

Research expenditures: $2,100,000
Research thrusts: resilient and sustainable infrastructure, applied fluid mechanics, construction engineering and management, construction materials, geotechnical engineering, structural engineering and transportation systems engineering


Ronnie Chowdhury

Department Overview

Through internal deliberations and team building, the civil engineering faculty have decided on a research and education focus on resilient and sustainable infrastructure. This interdisciplinary and collaborative initiative addresses some of the most pressing national priorities, resulting in new frameworks for civil infrastructure design. This comprehensive, multi-phenomena model will advance the understanding of interdependencies between infrastructure systems and components that may impact design decisions related to security, energy and the environment.

The civil engineering department will offer a new M.S. program in sustainable and resilient infrastructure as part of a $700,000 NSF grant. The program will involve 14 students over the next three years with the first seven beginning in August 2010. Unlike traditional civil engineering programs, the new curriculum will involve interdisciplinary course work and internships with external partners to help students focus on broader issues involving the nation's infrastructure problems, such as aging roads and bridges, water supplies and power grids.

The NSF proposal was the result of a team effort including members of the civil engineering, environmental engineering, architecture and business departments. External partners will include national laboratories, international engineering firms, state and local government agencies, and nonprofit and professional organizations.

Faculty and Staff

Ronnie Chowdhury has been named one of four inaugural CES *IDEaS* Professors. Chowdhury also received the Frank A. Burtner Award for Excellence in Advising.

Student Achievement

Two civil engineering students received prestigious NSF Graduate Research Fellowships. **Jeff Plumblee** and **Jacqualyn Blizzard** are pursuing advanced degrees under the direction of **Leidy Klotz**.

Graduate student **Priyanka Alluri** received the 2010 Women in Transportation Seminars Charlotte Metro Chapter President's Legacy Award and the Helene M. Overly Memorial Graduate Scholarship. Alluri is pursuing a Ph.D. under the supervision of **Jennifer Ogle**.

Graduate student **Yan (Joanne) Zhou** received Clemson's Outstanding Graduate Research Assistant Award. She also won third prize in the 2010 ITS America Annual Essay Competition. Zhou received her Ph.D. with a transportation emphasis under the direction of **Ronnie Chowdhury**.

Graduate student **K.V. Harish** received the ACI BASF Construction Chemicals Student Fellowship for the 2010-2011 academic year. Harish is pursuing a Ph.D. under the supervision of **Prasada Rangaraju**.

Graduate student **Lee Tupper** received the Dwight D. Eisenhower Fellowship for 2010-2011. Tupper is pursuing a master's degree under the supervision of **Ronnie Chowdhury**.

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Fast Facts

Tenured/tenure-track faculty: 28

Enrollment:	Undergraduate	368
	Master's	119
	Doctoral	46
Degrees awarded (Dec. 2009 and May 2010):		
	Undergraduate	39
	Master's	48
	Doctoral	6

Research expenditures: $1,298,803
Research thrusts: computing foundations, software engineering, cyberinfrastructure and networking, bioinformatics, computer graphics and animations, eyetracking, visualization and digital arts, intelligent and interactive systems, electronic health records, biometrics, virtual environments, human/computer interaction (HCI), and pedagogical tools using Tablet PCs and handheld devices


Jason Hallstrom

Faculty Highlights

Jason Hallstrom has been named as one of the first CES *IDEaS* professors. This distinction is specifically oriented toward recognizing CES faculty engaged in exemplary collaborative teaching and research activities.

Sebastien Goasguen and **Jason Hallstrom** have been granted tenure and promoted to associate professors.

Sabarish Babu has joined the faculty as an assistant HCL professor.

Joachim Taiber has joined the faculty as a research professor in HCI. This is a joint appointment with the Department of Electrical and Computer Engineering.

Roy Pargas is on sabbatical and will be spending the 2010-2011 academic year as a distinguished visiting professor in the endowed Coleman-Richardson Chair for Computer Science at the U.S. Air Force Academy.

John D. McGregor was a guest editor for the May/June 2010 special issue of *IEEE Software* on software product lines.

Jim Martin and the iTiger student team completed the first official release of the iTiger stadium product. The system provides video-on-demand game replays and highlights as well as real-time game statistics to Clemson football fans in Death Valley.

Student Achievement

Ph.D. student **Yvon Feaster** received an NSF Graduate Fellowship Award. The program recognizes and supports outstanding graduate students in NSF-supported science, technology, engineering and mathematics disciplines who are pursuing research-based master's and doctoral degrees in the U.S. and abroad.

M.S. student **Jerone Dunbar** won first place in the poster competition at the ADMI 2010 Annual Symposium held at Jackson State University. The competition is sponsored by the Association of Computer and Information Science/Engineering Departments at Minority Institutions. The symposium highlighted undergraduate and graduate research with particular interest on socially inspired computing.

Ph.D. students **Aqueasha Martin**, **Lauren Cairco**, **Toni Bloodworth**, **Xuhong Zhang**, **Yvon Feaster** and **Jamie Lyle** received grants to attend the 2010 CRA-W Graduate Cohort Workshop in Bellevue, Wash. These workshops provide mentoring support for women in the first three years of their graduate studies in computing.

Ph.D. students **Jerome McClendon, Aqueasha Martin, Kinnis Gosha** and **Wanda Moses** received fellowships to attend the 2010 Computer/Human Interaction Mentoring (CHIMe) Workshop in Atlanta. The workshop provided a unique opportunity for underrepresented minority HCI researchers to interact with leaders in their field, network, learn about the latest trends and present their work to the HCI community for constructive feedback.

Ph.D. student **Toni Bloodworth** received an ACM-W scholarship to attend CHI2010: The ACM Conference on Human Factors in Computing Systems in Atlanta. CHI is the premier international conference for HCI.

Electrical and Computer Engineering

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Fast Facts

Tenured/tenure-track faculty: 32
Enrollment: Undergraduate 350; Graduate 134
Degrees awarded (Dec. 2009 and May 2010): Undergraduate 70; Master's 19; Doctoral 7
Research expenditures: $2,851,000
Research thrusts: optoelectronics, cyber-infrastructure, wireless communications, computer networks, nanoelectronic materials processing, biochips, semiconductor lasers, optical systems, integrated circuit design, high-performance computing, computer security, robotics, image processing, biological modeling, situation and threat assessment, power systems

Keith Green

Department Overview

Clemson University has maintained a traditionally rich background in fundamental and applied engineering as research areas have focused on increasingly narrow topics within the subject disciplines. This heritage provides Clemson's Department of Electrical and Computer Engineering (ECE) with the breadth to offer a sound undergraduate education. At the same time, the specialization of faculty provides the stimulating environment for research.

It is widely recognized by both the electric utilities and government policymakers that the shift toward renewable energy sources requires that the current power grid be considerably revised to be smarter, and there is a growing demand for engineers with knowledge in energy-related fields. For example, power companies require employees who can help them integrate renewable forms of energy into the grid and find ways to enhance the energy-related skill set of their existing employees.

To face these challenges, ECE has developed two new certificate programs at the undergraduate level in renewable energy and power systems. These programs are designed to produce engineers who can meet the needs of a changing power industry.

The renewable energy certificate program focuses on the areas of solar power, wind power, and grid penetration. The power systems energy certificate program consists of classes in the areas of power engineering, power systems analysis and electric machines.

Undergraduate students can use these new courses as technical electives, and the certificate programs also allow industrial personnel to broaden their knowledge in renewable energy generation and/or power systems engineering.

Faculty Highlights

At the IEEE/RSJ International Conference on Intelligent Robots and Systems, **Keith Green** presented a robotic wall he developed with ECE's **Ian Walker** and the College of Agriculture, Forestry and Life Sciences called AWE (animated work environment). Green, the director of the school's program on intelligent materials and systems for architecture, explained how the segmented wall can be rearranged to make a single space that is useful for working at a desk, giving presentations — even watching football. The video was featured on the IEEE Spectrum homepage and received more than 30,000 views.

Joachim Taiber recently joined the ECE faculty as a research professor with a joint appointment in the School of Computing. He came to Clemson from the BMW Group in Greer, where he was general manager of the Information Technology Research Center. Taiber received his Ph.D. in technical sciences from the Swiss Federal Institute of Technology in Zurich, Switzerland. His current research interests include clean transportation and advanced vehicle communication.

Student Achievement

The student team from the senior capstone design class earned a $7,500 award in a design competition sponsored by the National Council of Examiners for Engineering and Surveying. The team developed a device that allows children to "feel" their interaction with a computer. The children can actually feel force and vibration as they compare shapes, sizes and weights of objects shown on a computer screen.

The project is entitled "Engineering Haptic Virtual Manipulatives to Enhance K-12 Math and Science Education" and seeks to help children learn basic math and science concepts, such as rotational symmetry and the relative weights of objects.

Members of the award-winning team include **Katelyn Aggas, Tatum Boulware, Christopher Cooper, Justin Coulston, Shawqi El-Tarazi, John Furmanski, Andrew Kinard, Joshua Knuckles, Robert Kriener, Mary Maier, Tyler Rowe, Adam Thompson, Brandon Shropshier** and **Kristen Wallis.**

ECE's senior design classes are taught by **Tim Burg** and **Richard Groff**.

Computer engineering senior **Bradley Collins** is a recipient of a three-year NSF graduate research fellowship. The NSF GRF program recognizes outstanding graduate students in NSF-supported disciplines who are pursuing research-based master's and doctoral degrees, providing them with a yearly stipend and tuition allowances.

Ryan Izard, a rising junior in computer engineering, received a NASA aeronautics scholarship — two years of funding for education-related expenses as well as the opportunity for a summer internship at one of NASA's research centers. Approximately 20 recipients were chosen from a competitive field of more than 200 undergraduate applicants.

William Suski, a first-year electrical engineering Ph.D. student, and **Ryan Craven**, a graduating electrical engineering master's student, are recipients of the Department of Defense SMART Scholarship. A nationally competitive award, the scholarship provides full tuition to support graduate studies.

Steven Boyd is the recipient of the 2010 AFCEA Ph.D. Fellowship. The national award recognizes excellence for demonstrated effort at the doctoral level of study. Boyd is also the recipient of the 2010 ECE John J. Komo Graduate Fellowship for his academic and research achievements in communication systems and networks.

Engineering and Science Education

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Fast Facts

Tenured/tenure-track faculty: 5
Enrollment: Undergraduate 1,100; Certificate 15
Degrees awarded (Dec. 2009 and May 2010): Certificate 12
Research expenditures: $222,455
Research thrusts: epistemologies, learning mechanisms and systems, diversity and inclusiveness, assessment

Beth Stephan

Faculty Highlights

Julie Trenor was presented the Thomas C. Evans Instructional Paper Award at the American Society for Engineering Education (ASEE) Southeastern Section Conference. Trenor was recognized for her work examining teacher efficacy as a result of an NSF-funded Research Experiences for Teachers program. Co-authors Shirley Yu (University of Houston), Denise Simmons Grant (Clemson University) and Hibah Salem (University of Houston) share the award with Trenor.

Beth Stephan was awarded the CES Byars Prize for Excellence in Teaching for the 2009-2010 academic year. Stephan was nominated because of her extraordinary devotion to the well-being of the students in the general engineering program and her excellence in providing a positive teaching and learning experience for them.

Lisa Benson was honored — along with Julia Frugoli from the College of Agriculture, Forestry and Life Sciences — with the CES Award for Mentoring for the 2009-2010 academic year. Benson was recognized for her work in developing a mentoring program for STEM graduate students who are applying for an NSF graduate fellowship. Under the leadership of Benson and Frugoli, the number of NSF graduate fellowships has more than tripled.

The E&SE department was awarded an NSF EPSCoR grant to fund a seminar series. The grant supported visits from Philip Sadler of the Harvard Smithsonian Center for Astrophysics and Sandra Ditka from the University of Puerto Rico-Mayaguez. Both have produced seminal work in STEM education that has informed the current understanding of the factors that affect student recruitment, retention and learning — with particular emphasis on underrepresented populations.

Julie Trenor, president of the Women in Engineering Program Advocates Network, was recently invited to attend a special meeting of the White House Council on Women and Girls. The purpose of the council is to work across executive departments and agencies to provide a coordinated federal response to issues that have a distinct impact on the lives of women and girls. This includes assisting women-owned businesses to compete internationally and working to increase the participation of women in the science, engineering and technology work force. Another goal is to ensure that federal programs and policies adequately take those impacts into account.

Melanie Cooper was elected a member of the first class of American Chemical Society (ACS) Fellows. The ACS is the largest scientific society in the world, and Cooper is one of only two recipients of this honor in South Carolina.

Student Achievement

Jenny Smith recently presented her undergraduate research with **Julie Trenor** at the ASEE-Southeastern Section Conference held in Blacksburg, Va. Smith was the first author on the paper entitled "Commuter Students' Educational Experiences and Sense of Belonging in the Undergraduate Engineering Community: A Phenomenological Study."

Sonia Miller Underwood received a Transforming Research in Undergraduate STEM Education (TRUSE) travel award. TRUSE brings STEM researchers together in hopes of strengthening the relationships and integrating the work of researchers within these fields.

E&SE recognizes students who have earned a Certificate of Engineering and Science Education. Thirteen CES graduate students from various disciplines completed the certificate, which involves taking courses in pedagogy, professional development, education research and current topics in engineering and science education.These students include **Katherine Berry** (IE), **Jim Chamberlain** (EEES), **Denise Grant** (CE), **Sarah Grigg** (IE), **Apoorva Kapadia** (ECE), **Danielle Lanigan** (IE), **Matt Miller** (IE), **Marisa Orr** (ME), **Cheryl Cass** (BioE), **Thashika Rupasinghe** (IE), **Cassandra Wright-Walker** (BioE), **Melissa Zelaya** (IE) and **Yan Zhou** (CE).

Marisa Orr has been named one of six national winners of the ASEE Educational Research and Methods Division Apprentice Faculty Grant. This award recognizes rising stars in the field of engineering education and provides mentorship to the winners as they pursue a career in engineering education. The award, which includes a travel grant to the ASEE conference, is given to individuals who have demonstrated potential for substantial contributions to the field through engineering education research or scholarship. Orr was nominated by **Lisa Benson**.

Environmental Engineering and Earth Sciences

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Fast Facts

Tenured/tenure-track faculty: 15

Enrollment:	Undergraduate	41
	Master's	54
	Doctoral	28
Degrees awarded (Dec. 2009 and May 2010):		
	Undergraduate	6
	Master's	4
	Doctoral	6

Research expenditures: $2,082,003

Research thrusts: environmental chemistry, environmental fate and transport, hydrogeology, nuclear environmental engineering and science, process engineering, sustainable systems and environmental assessment

Brian Powell

Faculty Highlights

Brian Powell, assistant professor of environmental engineering and earth sciences (EEES), and **Yuji Arai**, a colleague from the College of Agriculture, Forestry and Life Sciences (CAFLS), will lead a $1.18 million, three-year project that has recently received funding from the DOE Office of Science, Biological and Environmental Research. "Development of a Self-Consistent Model of Plutonium Sorption: Quantification of Sorption Enthalpy and Ligand-Promoted Dissolution" is a collaboration with Dan Kaplan from the Savannah River National Laboratory and Udo Becker and Rod Ewing from the University of Michigan. The project will focus on development of a mechanistic model of plutonium reactions at solid/water interfaces.

James Castle and CAFLS professor **John Rodgers** think the same thing happened during each of the five largest mass extinctions in Earth's history. Each time a large die-off occurred, the pair found a spike in the number of fossil algae mats called stromatolites strewn around the planet. Theories proposed by Castle and Rodgers were reported worldwide after they offered a new hypothesis for mass extinctions at the National Geological Society of America meeting. Their research, which includes examining occurrences of modern algal toxins and the distribution of algal structures through geologic time, suggests that toxin-producing algae may have played an important role in the major mass extinction events during the past half billion years.

David Freedman has been awarded a patent (number 7,615 and 153 B1) entitled "Microbial-Based Chloroethene Destruction." The co-inventors are Christopher E. Bagwell and Robin L. Brigmon from the Savannah River National Laboratory and former EEES M.S. students **William Bratt** and **Elizabeth Wood**. The abstract for the patent states: "A mixed culture of Dehalococcoides species is provided that has an ability to catalyze the complete dechlorination of polychlorinated ethenes such as PCE; TCE; cDCE; 1,1-DCE and vinyl chloride as well as halogenated ethenes such as 1,2-DCA and EDB. The mixed culture demonstrates the ability to achieve dechlorination even in the presence of high-source concentrations of chlorinated ethenes."

The 18th Annual Clemson/David S. Snipes Hydrogeology Symposium attracted more than 300 attendees from across the Southeast. Fifty oral and poster presentations were given over three consecutive sessions. The theme sessions covered groundwater and soil remediation using oxidation technologies, CO_2 sequestration, well- and stream-monitoring networks, bioremediation, stream and watershed hydrology, sustainable practices and undergraduate geology Creative Inquiry projects. **Scott Brame** was the main organizer and coordinator of this event. **Larry Murdoch** gave a talk on hydromechanics, **Shelley Miller** discussed life cycle analysis, and **Ron Falta** and **Jim Castle** gave presentations relating to CO_2 sequestration.

Student Achievement

Jose Alfaro, working with professor **Shelley Miller**, was selected as one of the recipients of the NSF three-year graduate research fellowships for students in science, engineering, mathematics, technology and some social sciences.

Darryl B. Jones' master thesis, "The Formation and Control of Iodinated Trihalomethanes in Drinking Water Treatment," placed first for the American Water Works Association's 2010 Academic Achievement Award for the best master's thesis. **Tanju Karanfil** served as the research adviser.

Peng Luo received a trainee grant and was one of four students to receive the Valentin T. Jordanov Radiation Instrumentation Travel Grant to attend and present his research at the 2009 IEEE Nuclear Science Symposium. The title of Luo's presentation is "Sequential Probability Ratio Test Using Scaled Time Intervals for Environmental Radiation Monitoring." **Tim DeVol** serves as Luo's adviser.

Kelly Grogan was selected as the recipient of the 2010-2011 Robert S. Landauer Fellowship for Graduate Studies in Health Physics, sponsored by Landauer Inc. The $6,000 award will support Grogan's graduate work for the 2010-2011 academic year. In addition, he will receive a travel grant of up to $800 to attend the 2011 HPS Annual Meeting in Palm Beach, Fla.

Dan Matz, an M.S. student working with **Stephen Moysey**, spent five months living and working in Madhya Pradesh, India. While there, Matz conducted research on water resource management in collaboration with the Foundation for Ecological Security. He used geophysics, mainly electromagnetic induction, to look at soil variability in agricultural fields to help farmers discover water-efficient irrigation practices.

Industrial Engineering

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Fast Facts

Tenured/tenure-track faculty: 9

Enrollment:	Undergraduate	172
	Master's	116
	Doctoral	37
Degrees awarded (Dec. 2009 and May 2010):		
	Undergraduate	52
	Master's	15
	Doctoral	3

Research expenditures: $767,398

Research thrusts: supply chain optimization and logistics; human factors and safety in health care and other complex systems; education and learning systems

Maria Mayorga

Department Overview

Clemson's industrial engineering (IE) department is highly productive with strong national and international reputations. IE faculty are well-known for cutting-edge research in the areas of production and service systems, human factors, and education and learning systems. Another goal for the department is to strive for greater excellence in industrial engineering education, research and service. Being the only IE program in South Carolina, this department provides a significant pool of IE graduates for state and national work forces.

The IE program offers accredited programs leading to B.S., M.S., M.Eng. and Ph.D. degrees. Because of the broad nature of the discipline, IE graduates are widely sought by a multitude of industries, ranging from manufacturing – such as automotive, electronics and chemical fields – to services – such as information technology, aviation, finance and consulting. One of the defining characteristics in the success of graduates is the dedication of staff and faculty. By working closely with our external constituents, the faculty has developed an innovative industrial engineering curriculum that responds to the needs of the profession.

Faculty Highlights

Assistant professor **Maria Mayorga** has been elected to the board of directors of the Operations Research Division of the Institute of Industrial Engineering (IIE). Members of the IIE operations research community use mathematics and sophisticated computer programs to solve engineering problems. Mayorga's recent research focuses on obesity and diabetes and how they affect women of childbearing ages.

Scott Shappell has been awarded the 2010 Henry L. Taylors Founders Award for outstanding contributions in the field of aerospace human factors (AHF). This award came from the Aerospace Human Factors Association, an organization where Shappell is also a Fellow. The winner of the award must demonstrate a contribution to AHF through research and publications, original contributions and general leadership in the field.

Shappell has published more than 60 papers and one book in the fields of aviation accident investigation, spatial disorientation, sustained operations, flight deck injuries and aircrew fatigue. He is the co-developer of the Human Factors Analysis and Classification System and the Human Factors Intervention Matrix that are used worldwide in a variety of high-risk industries – such as aviation, mining and medicine – for accident/incident investigation and the development of interventions.

School of Materials Science and Engineering

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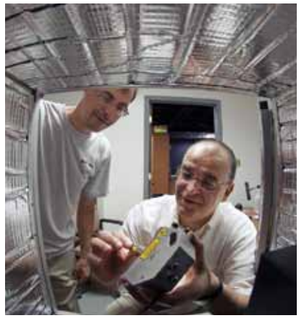
Fast Facts

Tenured/tenure-track faculty: 14

Enrollment:	Undergraduate	117
	Master's	19
	Doctoral	54
Degrees awarded (Dec. 2009 and May 2010):		
	Undergraduate	31
	Master's	13
	Doctoral	8

Research expenditures: $5,247,487
Research thrusts: manufacturing, characterization and structure/property/performance relationships of ceramics, glasses, polymers, photonics/optics, fiber-based materials, thin films and metals



Igor Luzinov

Department Overview

Research in the School of Materials Science and Engineering (MSE) is as diverse as its faculty interests. MSE faculty conduct research on ceramics, glasses, polymers, photonics, medical textiles, biomaterials, fiber science, thin films and metallurgy.

The department is comprised of expert collaborators who work with nearly every CES department and across colleges as their support of numerous University centers and institutes demonstrates. Their ability to create stronger, lighter and more efficient materials makes MSE researchers attractive research partners with broad design, process, characterization and manufacturing experience.

Clemson's MSE program is one of a small group of MSE programs in the country where faculty and students not only work with but actually make many of the materials they design and test – from optical glass and fibers to bricks, bio-polymer fiber scaffolds, space fabrics and nanograined metallic materials. While computational materials science is also employed in the design and evaluation of materials in systems, the school also provides a sound foundation in the study of chemistry, structure and property relationships. Hands-on experience of realizing fundamental principles of science and engineering is taught through laboratory training. Such balance to class and lab focus is a key part of the Clemson MSE curriculum.

Faculty Highlights

At the October 2009 board of directors meeting of the Optical Society of America (OSA), **Kathleen Richardson** was elected to the rank of Fellow. Richardson joined one of 61 OSA members elevated to this prestigious rank and was acknowledged for her "contributions to the advancement of glass science in optics through teaching and research across institutions and international boundaries." Fellow members within OSA are limited to no more than 10 percent of the OSA membership, and the number elected each year is limited to 0.4 percent of the current membership.

In addition to her OSA Fellowship, Richardson is a Fellow in the Society of Glass Technology, the American Ceramic Society and SPIE, with the latter two awards being presented since joining Clemson in 2005.

Igor Luzinov was the recipient of the CARTS USA 2009 Best Paper – The John. D. Moynihan Award for "Electrical characterization of polymer tantalum capacitors with poly (3,4-ethylenedioxythiophene)." Authors included Freeman, Y. (Kemet); Lessner, P. (Kemet); Harrell, W. R. (EE); Holman, B. (EE); and Luzinov. The award was presented by the Electronic Components Association. Luzinov also presented the Earl and Harriet Peters Lecture at the Department of Fiber Science and Apparel Design at Cornell University in October 2009.

John Ballato is the recipient of the ACerS Richard M. Fulrath Award, which promotes technical and personal collaborations between professional Japanese and American ceramic engineers and scientists. It encourages a greater understanding among the diverse cultures surrounding the Pacific Rim. The award recognizes individuals for their excellence in research and development of ceramic sciences and materials.

Student Achievement

Taylor Shoulders, an undergraduate studying ceramic materials engineering, has been selected to participate in the NSF International REU program. Shoulders will conduct research on Raman spectroscopy of poled glasses at the ISM laboratory at the University of Bordeaux in France.

Guillaume Guery and **Cinta Pepin** received the first dual master's degrees awarded under Clemson's ATLANTIS-MILMI program. The degrees are in materials science and engineering from Clemson University and chemistry from the University of Bordeaux in France. The U.S. Department of Education funds the ATLANTIS program, which supports students who carry out one year of study at their home institution then study a year abroad where they complete their course work and M.S. thesis. The MILMI program awards dual degrees in research areas related to laser-interaction with materials and is a joint program involving the University of Bordeaux; Freiderich Schiller University in Jena, Germany; Clemson University; and the University of Central Florida's College of Optics and Photonics.

Mathematical Sciences

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Fast Facts

Tenured/tenure-track faculty: 42

Enrollment:	Undergraduate	224
	Master's	37
	Doctoral	65
Degrees awarded (Dec. 2009 and May 2010):		
	Undergraduate	26
	Master's	28
	Doctoral	13

Research expenditures: $840,883
Research thrusts: algebra/discrete mathematics, applied analysis, computing, operations research, probability/statistics

Mathematical sciences classes are held in 60 of Clemson's 250 smart classrooms interspersed around campus. These smart spaces enable the sharing of work to solve problems and foster collaboration. They also facilitate online quizzes — either in or out of class — and accommodate mathematical modeling.

Department Overview

The Department of Mathematical Sciences at Clemson provides major contributions to the instructional and research mission of the University. Enrollments average 5,500 to 6,500 students per semester in more than 320 sections of math sciences courses, ranging from beginning freshman courses to cutting-edge research courses at the graduate level. Mathematical instruction and research are led by more than 80 faculty members and 100 graduate students.

Prominent research activities include publications (more than 100 per year), invited presentations (30 or more national and international talks each of the past three years), national and international professional involvement of the faculty, and funded research (approximately one million dollars per year). Computational modeling, biomathematics and stochastic modeling are of particular recognition for the department.

Degree programs are organized by discipline into five areas in the mathematical sciences: algebra and discrete mathematics, applied analysis, computational mathematics, operations research, and probability and statistics.

Twenty-six students graduated with bachelor's degrees in the mathematical sciences in 2009-2010. In addition, the department awarded twenty-eight master's degrees and thirteen Ph.D. degrees during the past year.

Faculty Highlights

Professor **Warren P. Adams** received the Clemson University 2010 Alumni Award for Outstanding Achievement in Research.

Professor **Robert Taylor** served as assistant chief reader at the 2009 Advanced Placement Reading for Statistics.

Taufiquar Khan and **Irina Viktorova** lead an interdisciplinary research team in a joint effort with ITRON Inc., a leading technology provider and critical source of knowledge to the global energy and water industries. The team will be developing information theory and noise models for complex power system networks with mathematical techniques for increasing efficiency and cutting costs for an optimal "smart grid" network.

For the sixth consecutive year, the Department of Mathematical Sciences hosted the Clemson Calculus Challenge, a calculus-exclusive competition based on the Advanced Placement Calculus AB syllabus. Recognized with $30,000 in funding by the National Science Foundation, the 2010 competition involved 229 of the region's brightest high school math students, covering areas of the Southeast with most students coming from Georgia, North Carolina and South Carolina. Teams of high school students work together at the Clemson Calculus Challenge, and prizes include $500 scholarships to Clemson University for individual students.

Mechanical Engineering

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Fast Facts

Tenured/tenure-track faculty: 32

Enrollment:	Undergraduate	566
	Master's	161
	Doctoral	90
Degrees awarded (Dec. 2009 and May 2010):		
	Undergraduate	147
	Master's	37
	Doctoral	5

Research expenditures: $4,299,297
Research thrusts: automotive engineering; bioengineering and biomaterials design; dynamics and controls; fluid mechanics; materials and materials processing; manufacturing; solid mechanics; thermodynamics, heat transfer and combustion

Laine Mears

Department Overview

The department includes 32 tenure-track faculty, seven ASME Fellows, one SME Fellow, two Presidential Faculty Fellows, five NSF CAREER awardees, one NSF PECASE awardee and one member of the European national/international journals. The department holds three of the largest endowed chairs in the country – each valued at $10 million.

Faculty Highlights

Assistant professor **Mohammed Daqaq** received the 2010 Eugene H. Bishop Award for his exceptional abilities of working with students and teaching. Bishop is a former department chair and an associate college dean. The award recipient is selected annually by a vote of the students and is presented at the mechanical engineering awards banquet.

Assistant professor **Laine Mears** has been awarded a five-year, $400,000 NSF CAREER Award to research model-based control methods for machining processes. Machining processes, where material is removed by high shear-rate cutting, involve changing the shape and surface conditions of workpieces in the most efficient manner.

The grant will also fund an educational component with a national middle school program for improving the instruction and experience of young technical thinkers. The Gateway to Technology program encourages future potential researchers to pursue an education in manufacturing.

John Wagner was elected as a Fellow of the ASME in recognition of his exceptional engineering achievements and contributions to the engineering profession. He works with undergraduate and graduate engineering students in the research areas of control theory, behavioral modeling and mechatronic system design. His work also includes diagnostic and prognostic strategies with applications to automotive, transportation and mechatronic systems. In addition, he has championed mechatronics education at Clemson with the creation of the Rockwell Automation Mechatronics Educational Laboratory.

Two prestigious manufacturing organizations have recognized Clemson University professor **Thomas Kurfess** for his outstanding contributions to the profession. The Society for Manufacturing Engineers gave Kurfess the 2010 Education Award for promoting manufacturing-related curricula and training methods as well as inspiring students to enter the manufacturing profession. Kurfess also is one of two new members of the board of directors elected to the National Center for Manufacturing Sciences and serves as an administrator of the Robotics Technology Consortium.

Student Achievement

Leigh Herran, a Ph.D. student of **Yong Huang**, has been selected to receive the prestigious 2010 NSF Graduate Research Fellowship, a three-year fellowship to support her doctoral study. This selection was based on her outstanding abilities and accomplishments as well as her potential to contribute to strengthening the vitality of the U.S. science and engineering enterprise. Her research topic focuses on biofabrication of cellular microspheroids for organ printing.

Mechanical engineering students volunteered to help the Greenville Hospital System University Medical Center Children's Hospital solve a problem in their entertainment room. The hospital needed a way to permit patients to play videos and games without having to monitor or check out components. The students designed a novel entertainment center, integrating a Wii console. This project was completely funded by Pi Tau Sigma and designed by students in the student shop. **Todd Schweisinger** headed up the projects and looks forward to continuing to provide chances for practical experience for undergraduates while encouraging students to give back to their community.

Physics and Astronomy

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Fast Facts

Tenured/tenure-track faculty: 25

Enrollment:	Undergraduate	78
	Doctoral	44
Degrees awarded (Dec. 2009 and May 2010):		
	Undergraduate	19
	Master's	5
	Doctoral	8

Research expenditures: $3,118,726
Research thrusts: astronomy; astrophysics; biophysics; atmospheric space, condensed matter, materials and surface physics; computational biophysics and bioinformatics

Chad Sosolik

Department Overview

Classical physics encompasses the fields of mechanics, heat and thermodynamics, electricity and magnetism, acoustics and optics. Modern physics is concerned with the study of atoms and molecules, atomic nuclei, elementary particles and the properties of liquids, crystalline solids and other materials in addition to the nature of planets, stars, galaxies and the large-scale structure of the universe.

The undergraduate physics curricula are designed to provide students with a strong background in the classical areas of physics as well as introduce the more important aspects of modern physics. The B.S. in physics provides a good basis for graduate study or industrial work in areas such as engineering physics and applied science.

Graduate study in physics and astronomy for either the Ph.D. or M.S. degree is a great opportunity for students who want

- to pursue a research career in physics, astronomy or closely related fields;
- to be expert teachers of these subjects; or
- to gain broad-based technical expertise for other careers.

Graduate students spend a good deal of their time engaged in forefront research, conducted under the mentorship of our world-class faculty. Most graduate students also teach physics and/or astronomy classes.

After graduation, our M.S. and Ph.D. recipients take diverse career paths. Some join faculty in research universities and teaching colleges. Others work in research positions at places such as national research laboratories, NASA, the Department of Energy, national observatories, and the U.S. Navy or Air Force. Graduates also work for numerous private companies in research and development or in management. Also, many of our international students return to positions such as these in their home countries.

Faculty Highlights

With a unique ion beamline and a $1.6 million NSF grant, **Chad Sosolik** will literally make "star stuff" in his lab. Sosolik acquired the grant in collaboration with **Sean Brittain**, **Rod Harrell**, **Jian Luo** and **Pete McNulty** to design a device that will allow scientists to strip atoms of their electrons, producing highly charged ions that – in nature – are created only in the bellies of stars.

At the heart of this new laboratory will be an electron beam ion trap, or EBIT, allowing scientists to trap the highly charged ions in an electromagnetic field. The ions are then released down a vacuum tube – the beamline – where they are focused on tiny targets for research projects that range from new semiconductor materials and cancer-fighting particle beams to basic scientific applications in astrophysics and the quantum mechanical tunneling of electrons.

The Clemson beamline, which will take two years to become fully operational, will be just the third EBIT-based beamline of its kind in the United States and one of only 17 EBITs on Earth. Other universities and research centers are working with Sosolik to establish collaborative arrangements that will bring exceptionally varied and high-level research to Clemson.

A telescope in the mountains of Chile will give Clemson astronomers an extra eye on the sky as part of an agreement arranged with 10 American colleges and universities. The Southeastern Association for Research in Astronomy, of which Clemson is a member, has invested approximately $250,000 to refurbish and upgrade a 0.6-meter telescope at the Cerro Tololo Inter-American Observatory in Chile.

The telescope, formerly operated by the Lowell Observatory in Arizona and closed in 1996, will now be remotely accessible via the Internet. According to professor **Dieter Hartmann**, this development has "opened up the other half of the sky."

Through the consortium, Clemson astronomers already have access to a 0.9-meter telescope at the Kitt Peak National Observatory near Tucson, Ariz. The addition of the Chilean telescope will allow researchers to view the night skies from both the Northern and Southern hemispheres – sometimes simultaneously – for approximately 30 days out of the year.

Student Achievement

Ramakrishna Podila, a Ph.D. physics student, has recently published research that challenges what scientists know – or think they know – about nanomaterials. Podila has been studying zinc oxide, a reasonably common compound that is widely used in plastics, ceramics and even sunscreen.

Electrical engineers recognize zinc oxide for its properties as a semiconductor. With computer components becoming smaller and smaller, many in the industry have believed they may exploit zinc oxide as a nanomaterial, helping to make micro-microchips.

That was before Podila's paper was published in the April 2010 issue of *Nano Letters*, an American Chemical Society journal devoted to nanoscience and nanotechnology.

Physics professor **Apparao Rao** is Podila's mentor in the research.

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*This degree program is jointly administered by the College of Agriculture, Forestry and Life Sciences and the College of Engineering and Science.

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