Undergraduate Andrew Baker (Physics and Biology double major) is visualizing an RNA band on a polyacrylamide gel after staining it with a fluorescent dye that absorbs in the ultraviolet wavelength range. He is a member of Dr. Meredith Newby's group.

IDEaS

COLLEGE OF ENGINEERING AND SCIENCE FALL 2008

in this issue:

A Message from the Dean

As we were brainstorming for our third issue of IDEaS, thinking about the amazing things coming out of the College of Engineering and Science (CES), we simply couldn't ignore that much of our latest success has been inspired by the insight of many as opposed to the efforts of just one.

Keyword: collaboration.

Once we determined what our theme would be, I started examining the history of CES at Clemson University and came to the conclusion that the spirit of collaboration has been at the heart of this college from its inception. During a restructuring initiative in 1995, the college was formed when all of the engineering disciplines joined the chemistry, computer science, geological sciences, mathematical sciences, and physics and astronomy departments, as well as the School of Textiles. At the time, it was impossible to see how fortuitous this formulation would prove to be.

Over the years, we've taken advantage of our unique organizational structure to break down departmental and disciplinary boundaries, resulting in unique and productive research partnerships. We've also extended our philosophy of collaboration beyond academia to include distinctive industrial partnerships and state-sponsored programs that are designed to encourage this very kind of bridge-building.

> Most of our faculty see the value of collaboration and embrace it, with the results speaking for themselves.

Most of our faculty see the value of collaboration and embrace it, with the results speaking for themselves. In the past five years, CES research awards have risen by more than 40 percent, while the number of enrolled Ph.D. students has increased by nearly 60 percent. Add to this a 25 percent jump in published works and the quadrupling of citations, and one can see that success is eminent when we work together.

In this issue of IDEaS, we share stories about some of the most recent creative and dynamic collaborations that are taking place within the walls of CES and beyond. We included a feature about a foundation partnership that's making our astronomy program one of the best in the country. There's also a piece about faculty from the computer science and industrial engineering departments who are working together to advance virtual reality technology for testing and training applications. With gasoline prices going through the roof, it's fitting that we share a story about Clemson's partnership with an international tire manufacturer to research how to reduce automotive tire rolling resistance and improve fuel economy. We've also included stories about our bioengineering research and how it's leading to advances in health monitoring and diagnosis in addition to clinically relevant biomaterials technology and products for disease management.

What's especially inspiring is that, in all of these endeavors, Clemson students are playing critical roles, learning to serve as "ambassadors of collaboration" when they take their places in industry and academia and continue to prove that two (or more) heads are often better than one.

Sincerely,

Esin Gulari, Dean
College of Engineering and Science
Clemson University

Sharing Knowl Saving Lives

Collaboration is key for bioengineering professor Karen Burg.

She has been recognized through the years for her work on injectable tissue engineering, but if you ask her, all of that success is the result of teamwork.

"Often it takes a collision of different perspectives to have that 'Aha!' moment," says Burg of her research. Her collaborators include experts from every corner of Clemson University. "They'll say things that are just mundane facts in their own disciplines, and I'll say, 'Really? That's the missing key we've been looking for!'"

edge,

By Elizabeth DePasquale

With a proven track record in cooperative work, Burg fits her role perfectly as founding director of the new Institute for Biological Interfaces of Engineering (IBIOE).

The IBIOE has a complex and weighty mission: develop clinically relevant biomaterials technology and products for disease management and apply this research to patient care.

That statement boils down to Clemson professors from across the disciplines teaming up with their peers from neighboring institutions to improve lives through disease control.

"The IBIOE is transdisciplinary," says Burg. "It spans from engineering and physical science to life science and from business to clinical medicine. It's a lot of fun."

Clemson contributors from beyond the College of Engineering and Science (CES) include management and psychology professors. Carolinas Medical Center (CMC) is the major clinical collaborator, and the University of North Carolina (UNC) at Chapel Hill and UNC-Charlotte are partnering institutions.

"One of the things that attracted me to Clemson was the way people work across departments and colleges without even thinking about it," says Burg. "You want to have as many different perspectives as you possibly can."

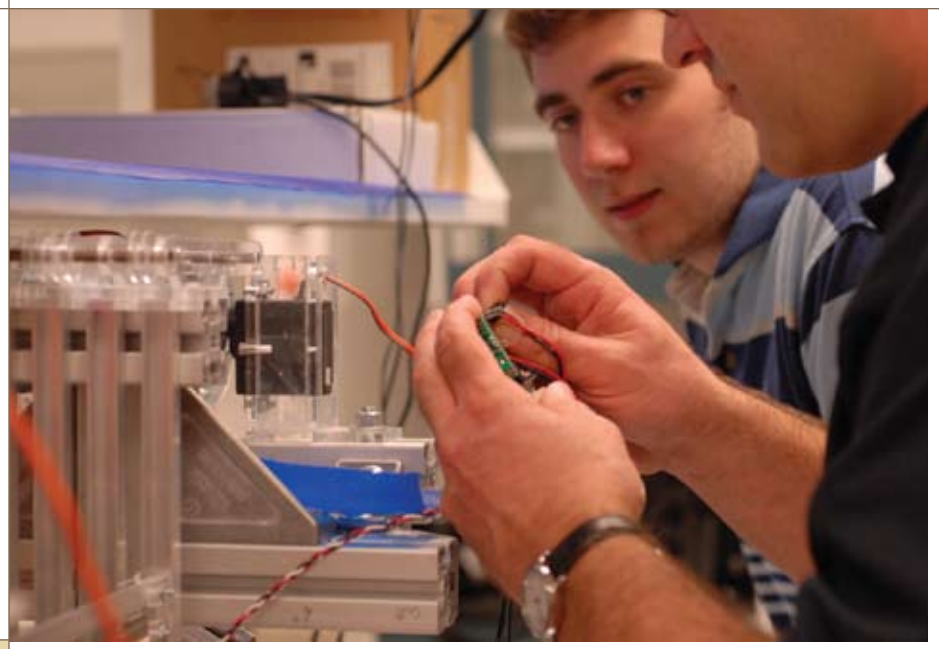
The IBIOE is a state-approved program that was recently awarded a highly competitive National Science Foundation (NSF) grant for $2 million. It is housed in the Rhodes Engineering Research Building on Clemson's campus.

"This grant is based on working relationships that already existed," says Burg. "We are often asked what we're doing differently to be cross-disciplinary. My comment is that we've always been this way; the institute infrastructure just allows us to work more efficiently on a much larger scale."

Some of those working relationships seem like unlikely pairings, including the one with biological sciences professor Amy Moran, who studies sea life in Antarctica that survives in oxygen-deprived waters. Through the IBIOE, her work finds common ground with Burg's breast cancer research.

"Cancer cells consume a lot of oxygen," says Burg, "and that's where we tie into Moran's work. Tumors thrive in oxygen-deficient parts of the body."

Another such connection is made with animal and veterinary sciences professor Steve Ellis, whose



The IBIOE has a complex and weighty mission: develop clinically relevant biomaterials technology and products for disease management and apply this research to patient care. That statement boils down to Clemson professors from across the disciplines teaming up with their peers from neighboring institutions to improve lives through disease control.

expertise is cow mammary stem cells. "He's studying mechanisms that are completely applicable to breast cancer," says Burg.

The NSF grant also leverages CES technologies developed by bioengineering researcher Thomas Boland, chemistry researcher Jason McNeill and electrical engineers Richard Groff and Timothy Burg, with the goal of characterizing complex cellular behaviors in cancerous tissue.

Beyond Clemson's campus, one team addresses Burg's focus on tissue engineering for bone implants. "We're working with an awesome surgeon at CMC on a bone plug that you can pop into a defect," she says of her work with Dr. James Kellam. "We're looking at different, clever ways of fixing the plug in the bone."

The list of collaborations continues, and each team is as incredible as the next. "We want two or more perspectives to collide and result in new, interesting research projects," says Burg.

"People like Ellis are getting involved in breast cancer research in ways they never were before," she adds, clearly pleased that her own field of study gains so much brainpower through the institute.

There are close to 50 members in the IBIOE, and that number continues to grow, so communications technology plays a major role in making this institute possible. Members connect through teleconferencing and less formally through the Blackboard System, which enables them to post and share information online.

With engineering and science operating under one roof, CES is uniquely structured to foster collaboration. Furthermore, Clemson's academic studies are clustered into emphasis areas to encourage the sharing of knowledge across departments. The IBIOE takes this strategy to a new level.

"One of the things that attracted me to Clemson was the way people work across departments and colleges without even thinking about it," says Burg. "You want to have as many different perspectives as you possibly can."

The result could be solutions for patients that might not have been discovered otherwise. With some teamwork and an open mind, the possibilities are endless.

For more information about the IBIOE, visit *www.clemson.edu/centers-institutes/ibioe*. ✻

WHEN TWO PROFESSORS FROM SEPARATE ENGINEERING DISCIPLINES COMBINED INTERESTS, IT TURNED INTO SOMETHING VIRTUALLY AMAZING.

The Best of Both Worlds.

By Ron Grant

Their partnership took root in work that was initiated in 2000 and has since become one of the most successful collaborative partnerships at Clemson University.

Andrew Duchowski, associate professor in the School of Computing, and Anand Gramopadhye, chair and professor of industrial engineering, are pursuing research in the areas of virtual reality, training and human

"We have effectively combined our knowledge of technological development as well as analysis of human behavior in a manner that enriches our understanding of both. But most importantly, we've enjoyed working with one another."

— Andrew Duchowski, associate professor in the School of Computing

performance modeling. The work has been used to identify strategies that improve human performance in aviation, maintenance and inspection domains.

The Duchowski/Gramopadhye collaboration has brought together faculty and students not only from computer science and industrial engineering but also from other disciplines at Clemson and other institutions. Beyond the College of Engineering and Science, faculty involvement has included the Clemson psychology department as well as a broader network of national and international collaborators from other universities such as St. Louis University, Embry Riddle, Tufts University, University of Tampere and University of Zurich. Industry leaders including Lockheed Martin, Stevens Aviation and Delta Air Lines as well as technical colleges and international institutes such as Max Planck have also joined in.

Important byproducts of the fruitful Duchowski/Gramopadhye collaboration include new courses and improvement of classroom instruction through the development of various synthetic environments for simulation. Courses such as eye tracking methodology, human-computer interaction and human factors in quality control help students understand the magnitude of what may result when they embrace collaboration in their experiments.

The Duchowski/Gramopadhye team has also resulted in the creation of two distinct but complementary laboratories on campus: the Virtual Reality and Eye Tracking Lab and the Advanced Technology Systems Lab; one housed in the computer science department and the other finding a home within industrial engineering.

Establishment of these two labs is indicative of the success Duchowski and Gramopadhye have achieved in securing $3 million in funded research from some of the nation's top funding agencies and competitive programs. Most impressive has been the impact of these funds on

both the scholarship and education mission of Clemson University. The funding has provided financial stipends and graduated seven doctoral students [five now working in academia and two in industry] and 24 master's students with several more still in the pipeline.

On the scholarship front, the collaboration has yielded more than 30 refereed journal publications and proceedings, book chapters and software that has been extensively used by industry and integrated into the classroom.

The spirit of collaboration has provided fertile ground for preparing students for research careers in academia and industry. Beyond scholastic publications, the students have also represented Clemson University at more than 25 national and international conferences. The impact of this collaboration has also yielded the premier international symposium on Eye Tracking Research & Applications – ETRA (now in its fifth biennial installment and 10th year).

Duchowksi and Gramopadhye are themselves effective ambassadors of collaboration, but the students they've placed in academia and industry carry Clemson's philosophy of cross-disciplinary pursuit to international settings.

"The diverse backgrounds and the interests of our students enrich this experience for all of us," says Gramopadhye. "Our success can be measured by the fact that they have been highly sought by academic institutions for faculty positions and for research careers in industry. Their enthusiasm, interest and accomplishments motivate us to move forward."

Duchowski adds, "We have effectively combined our knowledge of technological development as well as analysis of human behavior in a manner that enriches our understanding of both. But most importantly, we've enjoyed working with one another." *

"Our success can be measured by the fact that [our students] have been highly sought by academic institutions for faculty positions and for research careers in industry. Their enthusiasm, interest and accomplishments motivate us to move forward."

— Anand Gramopadhye, chair and professor of industrial engineering

A Driving Force Behind Sustainability

By Susan Polowczuk

Reduce automotive tire rolling resistance and improve fuel economy. That's what a research team with the Clemson University International Center for Automotive Research (CU-ICAR) aims to do with $1.9 million that will develop new tire technology with Michelin North America, one of its founding partners. Michelin chose Clemson to conduct a significant portion of the research after a competitive bid process with various universities.

"This award is the direct result of academia and industry working together to create innovative solutions for one of the most pressing problems of our time, the global energy crisis," says Tom Kurfess, Clemson researcher on the project and director of the Carroll A. Campbell Jr. Graduate Engineering Center at CU-ICAR. "It's an important partnership because no one individual could accomplish this alone."

The project will engage the talents of more than 20 professors and graduate and undergraduate students working on manufacturing, design and integration issues.

"Improving rolling resistance directly relates to improved fuel efficiency and a reduction in CO_2 and other greenhouse gases," says Kurfess.

"This award is the direct result of academia and industry working together to create innovative solutions for one of the most pressing problems of our time, the global energy crisis," says Tom Kurfess.

CU-ICAR is an advanced-technology research campus where university, industry and government organizations engage in synergistic collaboration. With more than $200 million in commitments, it represents the ultimate public/private partnership, directly fueling a knowledge base critical to the automotive industry.

The center is strategically situated in the hub of the rapidly growing Southeastern automotive and motorsports economy, located along the Interstate 85 corridor between Charlotte, N.C., and Atlanta, Ga.

Michelin North America, one of CU-ICAR's founding partners, has invested $1.9 million to develop new technology that will reduce tire rolling resistance to improve fuel economy. More than 20 Clemson professors, across several disciplines, make up the cast of collaborators, including the mechanical engineering professors listed below.

Design:

John Ziegert, Timken Chair in Automotive Design and Development and professor of mechanical engineering

Georges Fadel, Exxon Mobil Employees Chair in Engineering and professor of mechanical engineering

Joshua Summers, assistant professor of mechanical engineering

Manufacturing:

Tom Kurfess, BMW Manufacturing Chair, professor of mechanical engineering and director of the Carroll A. Campbell Jr. Graduate Engineering Center

Laine Mears, assistant professor of mechanical engineering

Materials:

Paul Joseph, associate professor of mechanical engineering

The 250-acre "technopolis" is where BMW, Michelin, Timken, Sun Microsystems, SAE, Mazda and other corporate partners are joining with Clemson to focus on automotive research and other transportation and advanced manufacturing issues. A pioneer in automotive research, Michelin was one of the first partners in CU-ICAR, funding an endowed chair and associated laboratory in 2004.

The state of South Carolina is also a key partner, having created legislation to support economic development and innovation. For example, the Research Centers of Economic Excellence Endowed Chairs Program matches private funding to recruit top faculty. CU-ICAR has four endowed chairs created through the program. These professors, along with other faculty from the main campus, form the academic team for one of the nation's most exceptional master's and doctoral degree programs in automotive engineering. *

Intergalactic Integration

By Elizabeth DePasquale

Observing the night sky may seem like solitary work, but a successful astronomer networks. "The astronomical society is like a small town; everyone knows everyone else," says astrophysics professor Jeremy King.

Among the many relationships that are forged between institutions and fellow researchers, one of Clemson's most important partnerships is with the National Optical Astronomy Observatory (NOAO).

The National Science Foundation (NSF) awards contracts to NOAO to run the telescopes at Kitt Peak National Observatory near Tucson, Ariz. NOAO then holds a contract with Clemson University, offering at least 33 nights per year to students and faculty with Kitt Peak's 4-meter Mayall Telescope.

This contract is highly valuable. "Positive comments in the peer review process come back about our partnership with NOAO," says King. Those 33 nights mean telescope access for Clemson faculty and students that would otherwise have to be earned by submitting proposals to a national review board. They can also be traded for nights at national telescopes around the world."

"Because we're guaranteed this time with the telescopes, we're able to ensure that our master's and doctoral theses are attainable," says Ginger Bryngelson, a graduate student in the physics and astronomy department. "The NOAO deal is a big plus for prospective students because it can take years to get this kind of time on a telescope."

It was Clemson's unique relationship with the Seneca-based Curry Foundation that fueled the NOAO partnership. "Charles Curry, the head of the foundation, is a real astronomy and astrophysics fan," says King. Curry made the acquaintance of astrophysics professors Donald Clayton and Dieter Hartmann a few years ago, and over time this developed into a friendship with the physics and astronomy department.

The relationship with Curry has led to concrete benefits for Clemson, including $200,000 of Curry Foundation grants to date, which help fund the three-year agreement with NOAO.

Clemson's unique relationship with the Curry Foundation has fueled a partnership with the NOAO.

Curry has also established a fellowship program for Clemson's graduate students. "He wanted to see his foundation's funds used to attract students who might not otherwise come here, either for financial reasons or because of offers from other universities," says King. Bryngelson is a Curry Fellow, and the fellowship made Clemson's stipend more competitive against other schools she was considering.

Bryngelson is involved in collaborative research with Clemson graduate Peter Milne on the Super-LOTIS telescope at Steward Observatory in Arizona. "We use a lot of the same data from Super-LOTIS, and he's sort of adopted me into monitoring and gathering the data,

YOUR OLD CONTACTS.

Clockwise from left: Curry Fellow astrophysics graduate student Ginger Bryngelson; Brian Donehew fills the dewar for the 2.1m telescope at Kitt Peak National Observatory; An image taken by Bryngelson and Dr. Mark Leising using MOSAIC (an instrument) on the 4m telescope; Dr. Mark Leising and foundation director Charles Curry; the entrance to the 2.1m telescope at Kitt Peak National Observatory.

which helps with my research," says Bryngelson of the cooperative effort.

"There are a lot of students working on similar research, and they can share their data," she says. "The students looking at exoplanets are doing a lot of work with undergrads, and they're all going to a conference to present their work together."

King knows his department is succeeding when the graduate students are acting as mentors. "That's the hallmark, I think, of a good graduate program in the physical sciences."

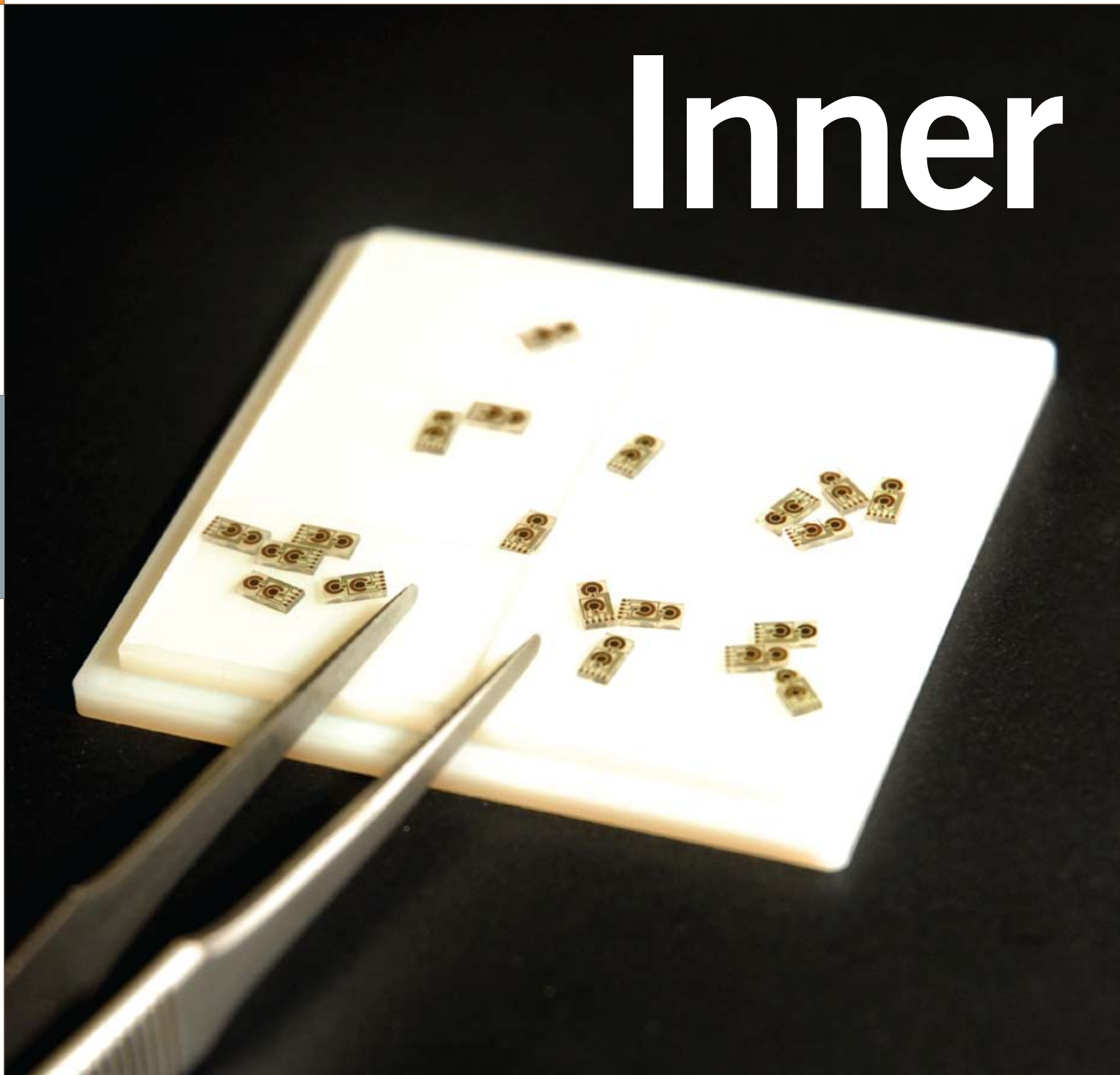
"A university should be developing social capital, not just intellectual capital," he says. "Students need to be connected, networking." Clemson's physics and astronomy department is fulfilling this requirement, collaborating on projects with Notre Dame, Indiana University and the University of Arizona.

In addition, the University of North Carolina (UNC) at Chapel Hill shares its resources with Clemson's students. UNC is part of a consortium with remote access to the SOAR telescope in Chile. "Instead of going to Chile, our students will go to Chapel Hill," says King, and from there they can give the telescope commands and collect data.

Astrophysics is, in King's words, "a really friendly endeavor." Rather than competitively racing toward results, astronomers tend to share data and converse. "It may be something about the basic nature of astronomy, because you can't patent the universe. No one owns this star or that galaxy, so instead the goal is to understand what's going on."

This collective pursuit of knowledge sets astrophysics apart among sciences, and makes it a positive and supportive field for Clemson's students. *

Inner



Space

By Susan Polowczuk

Anthony Guiseppi-Elie got hooked on science at the age of 14 when he received his first chemistry textbook from his older sister in Trinidad and Tobago.

"I was drawn to the collaborative nature of science. I immediately enjoyed working with classmates on problems. You could say I enjoyed the 'community' of science," recalls Guiseppi-Elie.

As the director of the Center for Bioelectronics, Biosensors and Biochips (C3B) at Clemson University, the Dow Chemical Professor of Chemical and Biomolecular Engineering and professor of bioengineering still taps into the community of science today. His interest and collaborations in bioelectronics research have led to the development of an implantable biochip that measures chemistry within the body.

The biochip is about the size of a grain of rice and measures and relays vital information such as lactate and glucose levels in the event of a major hemorrhage, whether on the battlefield, at home or on the highway.

The development of this device is funded with a $1.6 million Department of Defense award through the Peer Reviewed Medical Research Program. It is a joint study with the Department of Molecular Pathology at the University of Alabama at Birmingham; Telesensors Inc. in Knoxville, Tenn. (provider of design expertise); and Minnesota-based Digital Angel (facilitator of production of the devices in large quantities). Cross collaborations with a five-member faculty group from Clemson — researchers in mechanical engineering, bioengineering, electrical engineering, chemical engineering and chemistry — round out the Physiologic Status Monitoring Biochip team.

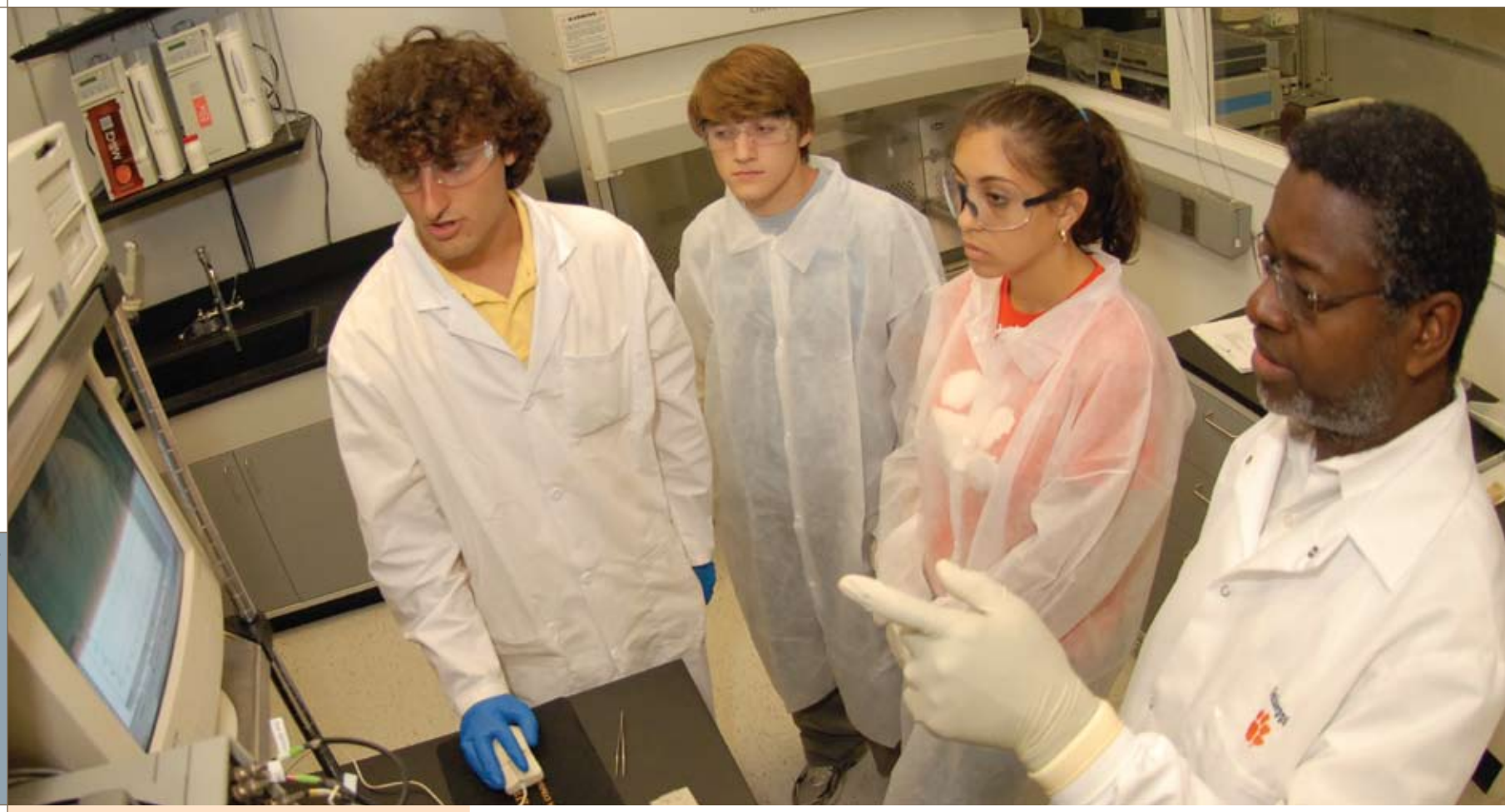
Ideally, with the biochip, first responders would inject it into a major muscle of a wounded victim, immediately commencing the data-gathering process.

"Right now, we have to take tissue samples from a patient and send them to a lab to await results," explains Guiseppi-Elie. "Moreover, from the time of first contact to the time of delivery to a higher echelon of care or trauma center, we are without critical data. We lose a large percentage of patients to bleeding. Getting vital information, such as how much oxygen is in the tissue, back to emergency room physicians and medical personnel can often mean the difference between life and death. Our goal is to improve the quality and expediency of care."

He adds the device has other long-term potential applications, such as monitoring astronauts' vital signs during long-duration space flight and reading blood sugar levels for diabetics.

Clemson scientists have formulated a gel that mimics human tissue and reduces the chances of the body rejecting the biochip, which has been a problem in the past. It is estimated the biochip is five years away from human trials.

Current goals of the research team include lengthening the life of the biochip from the current FDA approved three- and seven-day term now used in diabetics to one that will last six months, says Guiseppi-Elie. The other challenges are how much power to put



The Center for Bioelectronics, Biosensors and Biochips (C3B) is located in the Clemson University Advanced Materials Center in Anderson, S.C. A university center for molecular bioanalytics and biometrology, it operates as an Industry/University Cooperative Research Center. The center focuses on the development of platform technologies that are of mutual interest to the industrial consortium members and faculty while providing education and training opportunities for science-, technology-, engineering- and mathematics-oriented high school students, science teachers, undergraduates, graduate students and postdoctoral trainees.

For more information about C3B, visit *www.clemson.edu/c3b*.

into it and whether the body can be a source of energy to keep the chip powered.

The biochip has some detractors, mainly due to ethical concerns regarding the potential ability to 'track' humans.

"With any new technology, we have the collective responsibility to be vigilant with how it is used," says Guiseppi-Elie. "These devices do have the potential to be used for tracking. It's being done already with dogs and cats, even Alzheimer's patients. This is the positive side of the research. Concern for the negative side should not stop technology development where the potential benefits can be tremendous."

Dr. Guiseppi-Elie (far right) collaborates with undergraduate members of his team: Steve Finley (chemical and biomolecular engineering), Chris Briere (electrical engineering) and Meena Mirdamari (bioengineering).

Collaboration on the biochip continues as commercial partnerships are being pursued to fuel the research. Guiseppi-Elie acknowledges that collaboration is what initiated his passion for science all those years ago in Trinidad and Tobago, and it's the same thing that keeps him going today.

He says, "We love to see a body of work like this spawn new perspectives, and we welcome the community to join us in pursuing new avenues." *

News and notes

Civil engineer receives international honor

Clemson University professor of civil engineering **Charng Hsein Juang** has been awarded the Chair Professorship at National Central University (NCU), a major research university in Taiwan.

Juang is known internationally for his innovations in the field of geotechnical engineering. His work on liquefaction, brace excavation and slope stability is widely cited. His research in geomechanics and earthquake engineering has been funded by such agencies as the National Science Foundation and the U.S. Geological Survey.

The initial appointment of the chair professorship is for a three-year term and provides funding to support the holder's visit to NCU.

Chemical engineer studies carbon fibers for nuclear reactor safety

Carbon fibers that are only one-tenth the size of a human hair but three times stronger than steel may hold up to the intense heat and radiation of future nuclear power generators, providing a safety mechanism. The "Gen IV" power-generating reactors are being designed to provide low-cost electricity, but with a built-in safety mechanism current reactors do not have.

The Department of Energy has awarded Clemson University chemical engineering professor **Amod Ogale**, deputy director of the Center for Advanced Engineering Fibers and Films, a $450,000 grant to research carbon fibers embedded into a carbon matrix that do not melt in extreme temperatures for potential use in Gen IV power generators.

"One proposed design of the next generation of nuclear plants will consist of a helium-cooled generator that will operate in the range of 1,200 to 1,800 degrees Fahrenheit," Ogale says. "A critical safety requirement for this reactor is that it can shut down safely in the event of a malfunction where coolant flow is interrupted. Steel alloys currently used internally in reactors melt at the peak temperature of 2,500 degrees Fahrenheit, where carbon-fiber composites do not."

Ogale and his team will study the neutron-radiation damage effects on carbon fibers.

CoES researchers receive NSF CAREER Awards

The Faculty Early Career Development (CAREER) Program offers the National Science Foundation's (NSF) most prestigious awards in support of the early career-development activities of teacher-scholars. Four Clemson faculty were honored with CAREER Awards this spring.

Mechanical engineering professor **Yong Huang**, director of the Clemson Advanced Manufacturing and Systems Integration Laboratory, received an NSF CAREER Award for his work with laser-assisted living cell-printing research. The safe and efficient implementation of cell printing may enable its wide application in both organ printing and rapid prototyping of cell-based products, which may someday assist in production of on-demand human organ manufacturing for organ transplant patients.

Clemson biophysicist **Pu-Chun Ke** has earned his NSF CAREER Award for research of the self-assembly of carbon nanomaterials in living systems and how they impact human health and the environment. In his research, Ke discovered that certain mammalian colon cancer cells contract when cell membranes interact with nanoparticles. This experiment offered a first-hand look at how nanomaterials interact with cell membranes and may trigger toxicity. His research also looks at how nanoparticles coated with different matter react in different aquatic solutions and in the food chain.

Krishna P.C. Madhavan, assistant professor of engineering and science education in the School of Computing, won his NSF CAREER Award for research on how cyber-tools and cyber-environments better enable learning in engineering disciplines. Madhavan's research looks at how virtual environments that focus on cutting-edge engineering problems can be better designed to produce positive learning outcomes for engineering students. The larger vision of his work is to bridge the gap between advanced engineering research and the engineering curricula where the focus is on students and how they learn.

Assistant bioengineering professor **Xuejun Wen** received his NSF CAREER Award for the work he is doing to improve the survival of transplanted cells. Since cell transplantation may be used for the treatment of many diseases, such as diabetes, heart infarction, liver damage, spinal cord and brain injury, Parkinson's disease and stroke, his novel strategy may lend itself to a variety of applications. Cell transplantation treatment is hampered by the typically low viability of transplanted cells. This may be caused by lack of blood vessel support, inflammatory response, immune response, local microenvironment and other factors. Wen's strategy will address these difficulties in hopes of improving the long-term survival and functionality of transplanted cells.

CU-ICAR partners with first Asian OEM: Mazda

The Clemson University International Center for Automotive Research (CU-ICAR) has announced Mazda North American Operations, headquartered in Irvine, Calif., will be the first Asian original equipment manufacturer (OEM) to partner with CU-ICAR.

The Mazda Foundation will provide an initial pledge of $30,000 for the Mazda Annual Graduate Fellowships program. The fellowships are performance-based and renewable for up to three years for a potential total of $90,000. In addition, the company will donate a CX-7 crossover SUV, drive trains, subassemblies and other components to be used as learning tools by Clemson students and faculty.

As part of the agreement, three $10,000 fellowships will be provided to graduate students majoring in automotive engineering through the mechanical engineering department.

"We are thrilled to affiliate with this dynamic new research facility with support from both the Mazda Foundation and Mazda North American Operations. The work that the CU-ICAR graduate students undertake now will lay the foundation for groundbreaking advancements in the automotive industry in the future," says Robert Davis, senior vice president, Product Development and Quality, for Mazda North American Operations and a 1985 Clemson graduate.

World-renowned bioengineers record history of medical inventions

To commemorate the contributions of bioengineers that have helped so many since the 1960s, Clemson University hosted the Society for Biomaterials (SFB) History Summit in early 2008. The society's founders and past presidents, an international group, gathered to record an audio history of the society and origins of bioengineering inventions and devices from the last four decades.

"This was an unprecedented gathering of the greatest minds in bioengineering," says **Martine LaBerge**, chairwoman of the department of bioengineering and president of the SFB. "It is a great honor for Clemson University to host this memorable event where the enthusiasm of participating past presidents and founders of the SFB is only surpassed by their dedication for a field that is the cornerstone of medical technology today."

The outcome of the summit will be the audio recording and the publication of a monograph that captures the historical background of the society to be shared and built upon by present and future bioengineers.

School of Materials Science and Engineering director recognized

Kathleen Richardson, director of the School of Materials Science and Engineering, has received a rare double honor.

She has been elected to the grade of Fellow of the Society of Photo-Optical Instrumentation Engineers. Richardson was recognized for making important technical contributions to the field of optical materials science and engineering, in particular to understanding the properties and performance of infrared glass and other optical materials. Her efforts have been commended in studying ion-exchange-strengthened laser glass, infrared glass material development and photo-induced structural modification of amorphous materials.

She also was recognized for her longstanding contributions to optical science and engineering education, especially for her efforts with K-12 and undergraduate student research.

Mechanical engineering chair recognized as ASME Fellow

Imtiaz Haque, department chair and professor of mechanical engineering, has been named a Fellow of the American Society of Mechanical Engineers.

Haque has conducted research on the dynamics of vehicle systems since 1975, contributing to a fundamental understanding of the behavior of rail and automotive systems.

With industry leaders and faculty at Clemson, Haque has led the effort to develop an exceptional graduate program in automotive engineering along with the development of the CU-ICAR campus. This has resulted in a unique curriculum that is currently ranked as a top international automotive engineering program in the country.

Two Clemson students receive Google Scholarship

Two students from the School of Computing received the 2008 Google Anita Borg Memorial Scholarship: **Sally Wahba**, a second year Ph.D. student from Cairo, Egypt; and **Yvon Feaster**, a senior in computer information systems from Clemson.

The Google Anita Borg Memorial Scholarship was created to encourage women to excel in computing and technology and become active role models and leaders. Scholarships are awarded based on the strength of candidates' academic background and demonstrated leadership. Wahba and Feaster both received a $10,000 scholarship for the 2008-2009 academic year. Remaining finalists received $1,000 each.

Three-peat: Top Ph.D. computer graphics innovator nabs NVIDIA Fellowship

For the third year in a row, **Jay Steele**, a Ph.D. student in computer graphics in the School of Computing, has received the prestigious NVIDIA Fellowship Program award for his work to solve complex visual-computing challenges. NVIDIA Corp. is recognized as a world leader in visual-computing technologies.

Steele's research centers on the use of Lattice-Boltzmann computational-modeling methods to chart fluid flows and high-performance computing with graphics-processing units (GPUs). These methods allow accelerated computation of realistic lighting, which improves the realism of rendered scenes. An example of an application is the development of realistic virtual renderings of trees.

CoES students named Goldwater Scholars

Two Calhoun Honors College students have been named Goldwater Scholars. **Julee Alaina Floyd** is a junior majoring in chemical engineering, and **Shannon Edd**, also a junior, is majoring in mechanical engineering.

Bradley Collins, a junior honors student majoring in computer engineering, received an honorable mention.

The Goldwater Scholarship Program honors Senator Barry M. Goldwater and fosters and encourages outstanding students to pursue careers in the fields of mathematics, the natural sciences and engineering. It is the premier undergraduate award of its type in these fields.

Digital production arts graduates help win Oscar for best visual effects

Graduates of Clemson University's digital production arts program (DPA) are part of a team that won the Oscar for visual effects for the movie *The Golden Compass*.

The digital artists who graduated from Clemson and worked on the movie are: **Rachel Drews '06, Marc Bryant '99, Wil Whaley '99, Josh Tomlinson '02 and student Mikki Rose.**

Clemson digital artists worked on the movie with Rhythm & Hues' visual effects supervisor Bill Westenhofer, who received the 2008 Academy Award for Achievement in Visual Effects for *The Golden Compass*.

"It is a great honor to be a part of the team that won an Oscar for Best Visual Effects for *The Golden Compass*," Drews says. "I am only one of many, many visual effects artists who worked on the film from Rhythm & Hues, and I am pleased to already be working with the best in the industry. My degree in digital production arts at Clemson gave me the technical and production knowledge base, as well as the connection to the people in the visual effects industry.". *

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

Martine LaBerge, Ph.D.
Department Chair
(864) 656-5556
laberge@clemson.edu
www.ces.clemson.edu/bio

Dr. Delphine Dean and undergraduate students Matt Cupelli and Laura Wiles measure electrical conductance of alginate gels doped with nanoparticles.

Bioengineering's major research efforts focus on:

- Biomaterials
- Tissue Engineering
- Biointerfaces
- Biomechanics
- Biomolecular Engineering
- Biophotonics

Exciting, meaningful research is coming out of each area. For example, one team recently received $2 million in total grants to study radiation-induced bone loss. Both the National Institutes of Health and a branch of the National Aeronautics and Space Administration contributed the funds to study bone loss that occurs both clinically, as a result of radiation cancer treatment, and aeronautically, as a result of weightlessness in space flight.

The National Science Foundation awarded another Clemson team $2 million to develop engineered treatment for the study of breast cancer, particularly causes and characteristics during progression and treatment. The study will use tissue engineering technology based on inkjet printing — developed at Clemson — to create identical tissue samples that can be used to build cause-and-effect models.

Faculty

The bioengineering faculty has more than doubled over the past five years to 19 full-time faculty members. The latest additions include:

- Richard Swaja, former senior science adviser at NIBIB, as professor of bioengineering and director of the Bioengineering Alliance of South Carolina,
- Delphine Dean, assistant professor of bioengineering, who conducted her graduate work in the laboratory of Professor Alan Grodzinsky at MIT, and
- Ning Zhang, assistant professor of bioengineering, who obtained a doctoral degree in bioengineering from the University of Utah under Professor Patrick Tresco.

A search is on for the new $4 million Hansjörg Wyss Regenerative Medicine Endowed Chair in Orthopaedics, which was funded equally by the state of South Carolina and the Wyss Medical Foundation. Searches are also under way for two junior-level, tenure-track faculty members in the field of biomaterials science and engineering.

Facilities

Clemson's strong commitment to bioengineering has resulted in a $12 million allocation for a 29,000-square-foot addition to Rhodes Engineering Research Center. The three-story building will provide state-of-the-art undergraduate laboratories for tissue engineering, bioinstrumentaton and biomechanics. Classrooms will be equipped with the latest long-distance learning capabilities and research laboratories where undergraduate and graduate education will be integrated.

Building is also under way for the Clemson Translational Bioengineering Research Center, a 30,000-square-foot space located on the Greenville Hospital System's Patewood Campus. The center, a partnership between Clemson University and the Greenville Hospital System, will focus on bioengineering research and delivering new medical and surgical products to the market more quickly.

Clemson University is known as the international birthplace of the field of biomaterials — the building blocks of medical devices. The Society for Biomaterials (SFB), the premier professional society in the field of bioengineering, began at Clemson in 1974. In 2008, department chair and professor Martine LaBerge is serving as president of SFB, which has become the leading professional society in the biomaterials/bioengineering field and has more than 1,000 members from academics, industry, government and medical clinics.

Biosystems Engineering

William H. Allen, Ph.D.
Department Chair
(864) 656-4077
whallen@clemson.edu
www.clemson.edu/agbioeng/bio/home.htm

Justin Montanti conducts research in Dr. Caye Drapcho's lab on algae to produce high value oils for use in pharmaceuticals or as biodiesel for fuel.

Research Interests

Clemson's biosystems engineering program is focused primarily on three areas of research that when combined:

- create alternative bioproducts and energies (biofuels),
- protect our water and environment, and
- increase the productivity and profitability of agriculture without harming the environment.

Bioprocessing/Applied Biotechnology

Clemson researchers are developing ways to improve the biological production of nutraceuticals and pharmaceutical compounds and creating biomaterials and biofuels using natural and modified microorganisms. Biofuels, particularly biodiesel, from biomass and aquatic organisms is currently a topic of significant research. Ongoing research also includes hydrogen from biomass via fermentation pathways as well as electrical energy from microbial fuel cells. A recent $800,000 grant will purchase research equipment to study the derivation of ethanol from cellulosics (switchgrass, sorghum and wood residues). A $14 million pilot plant is being planned in Charleston.

Natural Resources/Environment

Water management and water quality are major thrusts. Clemson researchers are focused on nearly every aspect of keeping water (surface runoff as well as ground water) safe from chemical or biological pollutants, wastewater treatment, land use and low-impact development, best management practices for erosion and storm-water control, watershed modeling to provide predictive models, bacteria modeling (the single most important cause of water impairment in South Carolina) and population dynamics in waterways and aquatic environments.

Agriculture

Growing healthier, hardier crops and maintaining livestock herds with low environmental impact have become complex science. Research in this department includes:

- precision agriculture technology to increase productivity and profitability of crops while minimizing environmental impacts,
- site-specific control of crop insects and diseases,
- irrigation design and control, especially as implemented for sensor-based agricultural methods, and
- livestock waste management and alternate uses of wastes, such as energy production.

Facilities

Biosystems engineering has several research facilities, including a fiber-quality lab, an agricultural/chemical/biological lab, aquaculture facilities and a biotechnology analytical lab. Facilities are located on campus in McAdams Hall, the Biosystems Research Complex and the Clemson Aquaculture Facility. 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.

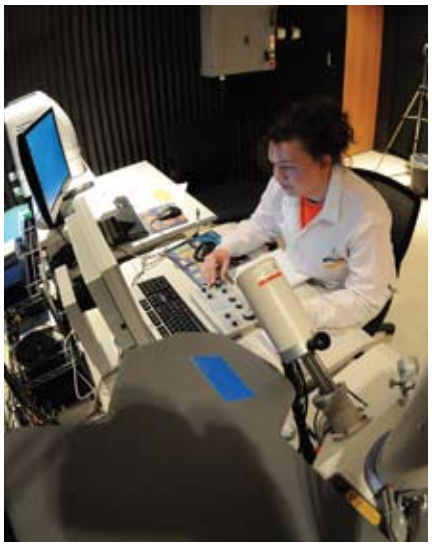
New Faculty

The biosystems engineering department has 15 faculty members. Anand Jayakaran, from The Ohio State University, recently joined the team. His research will include watershed modeling, low-impact storm-water management and developing broad-based research initiatives that examine the impacts of development on the hydrology of coastal plains watersheds. His research focuses on how hydrologic and sedimentologic regimes are impacted by land development in coastal plain watersheds. With increased demands on the South Carolina coast, the need for low impact strategies in the development of land is significant. Jayakaran conducted doctoral and postdoctoral research on low gradient modified stream systems in the agricultural Midwest. His graduate research contributed in part to the adoption of alternative stream management techniques in Ohio. Jayakaran has a strong interest in understanding the fluvial geomorphology of coastal streams and incorporating natural channel design in managing storm-water channels.

The latest faculty addition is Hamid J. Farahani, who comes from Colorado and Aleppo, Syria, where he was employed by the International Center for Agricultural Research in the Dry Areas. Farahani will conduct research at the Edisto REC where he will bring irrigation expertise to the sensor-based agriculture program that is developing there. One of the leading programs of its type in the world, Edisto REC seeks to develop and utilize cutting-edge engineering technologies to optimize agricultural production and sustainability by maximizing profitability while minimizing negative environmental impacts.

Chemical and Biomolecular Engineering

Jim Goodwin, Ph.D.
Department Chair
(864) 656-6614
jgodwi@clemson.edu
www.ces.clemson.edu/chemeng



Located in Anderson, S.C., the Advanced Materials Research Laboratory is the headquarters for research by many departments of Clemson's College of Engineering and Science. The 111,000-square-foot facility houses laser and chemistry labs in addition to Clemson's Electron Microscope Facility.

The Department of Chemical and Biomolecular Engineering allows students to specialize in many different research areas such as advanced materials, including polymers, energy, biotechnology and chemical processing. Strong departmental research programs exist in biosensors, polymer processing, rheology, fiber and film formation, supercritical fluids, separation processes, kinetics and catalysis, and membrane applications. The research activities of these groups cover most of the traditional branches of chemical engineering as well as several of the newer areas, including advanced materials, bioseparations, biofuels, hydrogen from water, fuel cells and molecular simulation. Research interests of the faculty range from purely theoretical topics to the analysis and improvement of full-scale industrial processes.

Faculty Highlights

- "Synthesis of Biodiesel via Acid Catalysis," written by Edgar Lotero, Jim Goodwin, David Bruce, Dora Lopez, Yijun Liu and Kaewta Suwannakarn and published in *Industrial & Engineering Chemistry Research* in 2005 [2005; *44*(14); 5353-5363], was the most accessed article in that American Chemical Society journal for 2007. Goodwin's activities in this area have been recognized by researchers in the industry and have established his group in the forefront of biodiesel synthesis research. He is also editor of the Elsevier international journal *Catalysis Communications*.
- Anthony Guiseppi-Elie was given the Distinguished Lecture Award in Biomedical Nanotechnology (December 2007) by the Institute of Bioengineering and Nanotechnology, Singapore. He was also featured in *South Carolina Business*, the monthly magazine of the S.C. Chamber of Commerce, for bringing biomedical companies to South Carolina. Guiseppi-Elie was also appointed guest editor of *Nanobiotechnology*.
- Douglas Hirt has been named chair of the Bioplastics Special Interest Group (SIG) for the Society of Plastics Engineers. The Bioplastics SIG will provide a unified forum for promoting open exchange of scientific and engineering knowledge related to polymeric materials that are fully or partially biobased with a "cradle-to-cradle" emphasis.
- Scott Husson was selected to co-chair the 2009 North American Membrane Society conference in Charleston, S.C. His research on membrane biosepara-

tions has been recognized by three new research grants in 2007 from the NSF and ACS. He also received the 2007 Murray Stokely Award for Excellence in Teaching.
- Mark Thies has accepted an invitation to join the editorial board for *The Journal of Supercritical Fluids*, the pre-eminent journal for supercritical fluids research. The American Carbon Society has selected Clemson University as the site for Carbon 2010, the largest international conference in the world devoted to carbon. Thies will serve as the conference chair, and Amod Ogale will serve as the technical session chair.
- The Ph.D. dissertation by Santanu Kundu and advised by Amod Ogale won the 2007 Best Dissertation Award given by *Elsevier-Carbon Journal*. Ogale has numerous research projects funded by the Department of Defense (DoD), the Department of Energy, the NSF and industrial companies to develop nanocomposite carbon fibers. He is one of only three academics invited to present at the 2008 First Persh Conference on Carbon Fibers, organized by the DoD. Ogale was also elected to the 2007 advisory board of the American Carbon Society and recently began serving on the 2007 editorial board of *Carbon Letters*.

Facilities

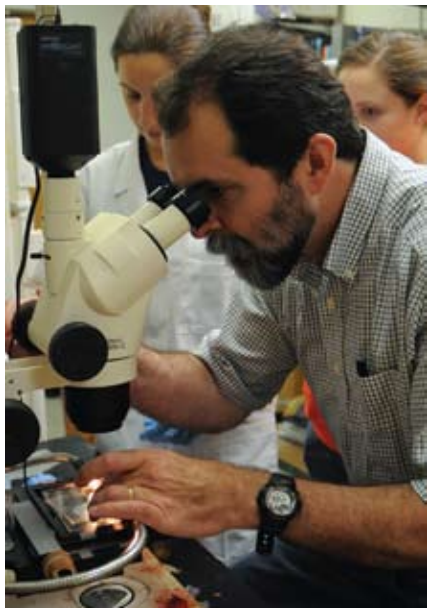
Earle Hall is home to the Department of Chemical and Biomolecular Engineering. A current major renovation to remodel the high-bay wing of this building is adding more than 6,000 square feet of labs, offices and undergraduate research space.

Clemson's Center for Advanced Engineering Fibers and Films (CAEFF) has conducted research at the cutting edge of computational materials design since 1998. With major support from the National Science Foundation, the center has state-of-the-art modeling polymer processes beyond any existing model in the world. CAEFF supports South Carolina's growing knowledge-based economy by promoting a transformation from trial-and-error development to computer-based design of fibers and films.

The Center for Bioelectronics, Biosensors and Biochips (C3B), located in the Advanced Materials Center of Clemson University, focuses on the interface of chemistry, microelectronics, materials science, biology and medical technology to develop sensors that mimic or measure biological functions.

Chemistry

Stephen Creager, Ph.D.
Department Chair
(864) 656-4995
screage@clemson.edu
chemistry.clemson.edu



Bill Pennington has been honored with the Class of 1940 Douglas W. Bradbury Award. This award is given to a Clemson faculty member who has made outstanding contributions to the Calhoun Honors College. As evidenced by his long-term commitment to the Honors Program and recommendations from students, faculty and administrators, he is a most deserving recipient of this award.

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

- Jeff Anker joined the chemistry faculty as assistant professor of chemistry in fall 2008. He earned his B.S from Yale University and his Ph.D. from The University of Michigan with Raoul Kopelman, working on magnetically modulated fluorescence-based sensors. After graduation, he was an NIH postdoctoral fellow at Northwestern University with Richard Van Duyne, where he developed plasmonics-based nanosensors to measure chemical concentrations and binding kinetics. Anker's research uses a combination of optical spectroscopy and nanoparticle devices to study chemical and biophysical processes, with special attention to bioanalytical applications of multifunctional plasmonic and fluorescent sensors and effectors. He is also a member of the Center for Optical Materials Science and Engineering Technologies (COMSET).
- Melanie Cooper is being inducted as a Fellow of the American Association for the Advancement of Science. A prestigious honor bestowed upon members by their peers, Fellows are recognized for meritorious efforts to advance science or its applications. Cooper was nominated in recognition of her contributions to curriculum development and research on teaching and learning in introductory chemistry courses.
- Dennis W. Smith Jr. was selected by the Board of Directors of the Missouri State University Alumni Association to receive the Outstanding Young Alumni Award. Since the inception of the award in 1985, only 25 individuals have received this recognition. The Outstanding Young Alumni Award recognizes graduates of Missouri State University for extraordinary achievement in their personal and professional endeavors.
- Darryl DesMarteau, Tobey-Beaudrot Professor of Chemistry, received the 2007 Faculty Mentoring Award, which recognizes the importance of peer mentoring to the ultimate career success of junior faculty and to the enhancement of the college as a whole.
- Shiou-Jyh Hwu, professor and interim department chair of chemistry, is the 2007 recipient of Clemson's Faculty Achievement in the Sciences. This award is given to faculty in recognition of high achievement during the preceding year, including accomplishments, distinctions and awards within the past three years.
- Lourdes Echegoyen, lecturer in the department of chemistry, was this year's winner of the Award of Excellence in Teaching in the Sciences, recognizing her outstanding effort and accomplishment among the college's science faculty. Echegoyen has been described as a dedicated and effective teacher with the ability to entertain, engage and inform students all at the same time.
- John Huffman received a standing ovation when Faculty Senate President Charlie Gooding presented the Alan Schaffer Faculty Senate Service Award to this former senator and longtime senate supporter. Huffman, a research professor, was active on many standing and ad hoc committees throughout his senate career.

Facilities

A major renovation is planned for Hunter Hall, where the chemistry department is located. The renovation will provide space to house high-end instrumentation facilities, including NMR spectroscopy, X-ray crystallography, optical spectroscopy and mass spectrometry.

Civil Engineering

Nadim M. Aziz, Ph.D.
Department Chair
(864) 656-3002
aziz@clemson.edu
www.clemson.edu/ce

Senior Ben Linduff installs displacement transducers to measure displacements of a test specimen composed of the brick veneer and wood framing representative of traditional residential construction. The research project focuses on the performance of brick veneer during high winds and changes in detailing that could improve its performance.

The Department of Civil Engineering at Clemson University is one of the 20 largest civil engineering departments in the United States. It offers undergraduate and graduate course work in the major fields of civil engineering, including structural engineering, transportation engineering, hydraulics and hydrology, geotechnical engineering, construction materials, and construction engineering and management.

The department also offers graduate programs leading to the M.S. and Ph.D. degrees with specializations in applied fluid mechanics, construction engineering and management, construction materials, geotechnical engineering, structural engineering and transportation systems.

- The Clemson University civil engineering department was ranked No. 14 among civil engineering departments in public universities that offer a doctoral program, according to *U.S.News & World Report*. This ranking is based on the opinion of engineering deans and senior faculty in engineering colleges throughout the country.
- About 90 percent of Clemson seniors take the FE exam. Their pass rate in October 2006 was 86 percent, compared to the national pass rate of 71 percent. Their pass rate in April 2007 was also 86 percent, compared to the national average pass rate of 76 percent.

Faculty Highlights

Two faculty members joined the civil engineering department in August 2007.

- Nigel Berkeley Kaye obtained his Ph.D. from Cambridge University and worked as a postdoctoral research associate at Imperial College in London. Last year, he was a lecturer in the civil engineering department at Clemson University. Kaye's teaching and research interests are in fluid mechanics.
- N. (Ravi) Ravichandran obtained his Ph.D. from the University of Oklahoma and continued to work there as a postdoctoral research associate. His teaching and research interests are in computational geotechnical engineering.

Clemson's civil engineering undergraduate program is ranked 14th among public engineering schools (whose highest degree is a doctorate) and 24th in a list that includes private and public schools. Clemson's Steel Bridge and Concrete Canoe teams earned invitations to national competitions in 2008. This is the 13th consecutive year for Steel Bridge and the 15th consecutive year for Concrete Canoe, which finished seventh overall.

Robert Nowack officially retired in May 2008 after 60 years of teaching. "PB," as he is known to many, started teaching at Clemson in 1947 and has taught multiple generations of the same family. In 1999, he was awarded an honorary doctorate in recognition for his service to his students and the University. Nowack holds the distinction of being an alumni professor, a title held by only a few.

Facilities

Lowry Hall is the home of the civil engineering department. It houses faculty and staff offices, undergraduate laboratories and graduate research labs. Additional specialized research laboratories are located just a short distance from campus. The Wind and Structural Engineering Research Facility, for instance, is a state-of-the-art facility supporting experimental research on the performance of buildings, bridges and other structures.

School of Computing

Larry F. Hodges, Ph.D.
Director
(864) 656-3444
cpsc@cs.clemson.edu
www.cs.clemson.edu

Digital production arts graduate Rachel Drews shows off the Oscar won by Rhythm & Hues for *The Golden Compass*. She is one of 12 Clemson alums working for the award-winning special effects company.

Clemson's School of Computing was created from the existing computer science department to enable the University to respond more effectively to emerging areas within the broad field of computing and to develop academic programs that will prepare students for a society in which computing has become so essential.

Students who seek careers in computing require core knowledge of the fundamentals of hardware and software system design, but they must also understand the application domain and its culture to solve problems. They find that what they learned in computer science must be complemented by knowledge of other domains (finance, architecture, insurance, civil engineering, construction). The School of Computing expands the conceptual framework for teaching and research to encompass these complementary domains.

The school is organized by focus areas:

- Computational Arts
- Computer Science
- Informatics (Cyberinfrastructure and High-Performance Computing)
- Computational Science
- Human-Centered Computing

The school also offers an interdisciplinary program, the Master of Fine Arts degree in Digital Production Arts (DPA). There are very few programs like this in the country. DPA is a professional degree program aimed at producing technically savvy, artistically talented graduates who are sought after by the growing electronic arts industry, particularly by those companies engaged in special effects within the entertainment and commercial video, film and gaming industries. The recent advent of dramatic special effects in film, television and games has created an unprecedented demand for educational programs leading to careers in the field. To fill this need, the DPA program offers a blend of instruction from art, computer science, computer engineering, graphic communications, performing arts, philosophy and psychology, together with newly designed courses targeted at production techniques specific to the animation effects industry. Graduates now hold positions at Pixar, DreamWorks Animation, Industrial Light & Magic (Lucasfilms) and Rhythm & Hues, among others.

Clemson is in the midst of substantially upgrading its data center by investing $46.5 million over the next five years to build a totally new IT infrastructure that promises increased storage, bandwidth and CPU resources.

Faculty

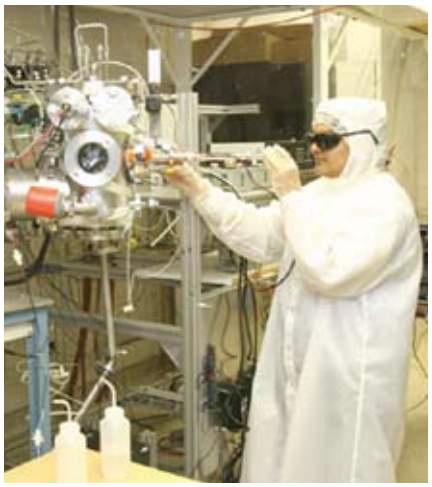
The school has 31 full-time faculty members with plans to hire 15 more. New hires include Professor Larry Hodges, who became school director on July 1, and Professor Donald House, who began as leader of the Computational Arts Division on August 15. Both faculty and students have recently received several prestigious awards. Doctoral student Michael Murphy has been awarded a three-year Graduate Research Fellowship by the National Science Foundation. Professor Jason Hallstrom and doctoral student Andy Dalton received the Best Testbed Award at the third IEEE CREATE-NET International Conference on Testbeds. Professors Sebastien Goasguen and James Martin have received an IBM Faculty Award for their project, Autonomic Virtualized Infrastructure, and Professors Robert Geist and James Westall have received an IBM Faculty Award for their project, VCL Supercomputing.

Facilities

The school supports numerous state-of-the-art instructional labs with more than 600 CPUs. Research labs hold specialized equipment including blade-servers, eye-tracking workstations, a large display wall, a high-performance (16.5 TFLOP) computing system built from graphical processing units (GPUs) and a motion-capture system for building animations and analyzing human motions. High-speed wireless access to the Internet is available throughout campus. The University has a 10 Gbps Internet connection, and school researchers are deploying an experimental, 4.9GHz WiMAX campus network to support both academic research and joint projects with public safety and law enforcement agencies.

Electrical and Computer Engineering

Darren Dawson, Ph.D.
Department Chair
(864) 656-5924
ddarren@clemson.edu
www.ece.clemson.edu



The next generation of laptops, desk computers, cell phones and other semiconductor devices may get faster and more cost-effective with research from Clemson's Rajendra Singh, D. Houser Banks Professor of Electrical and Computer Engineering and director of the Center for Silicon Nanoelectronics at Clemson University. Singh and his team have developed a new process and equipment that will lead to a significant reduction in heat generated by silicon chips or microprocessors while speeding up the rate at which information is sent. The researchers say the patented technique has the potential to improve the performance and lower the cost of next-generation computer chips and a number of semiconductor devices, which include green energy conversion devices such as solar cells.

Clemson University has maintained a traditionally rich background in fundamental and applied engineering as the research areas have focused onto increasingly narrower 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.

ECE has an enrollment of 360 undergraduate students, sophomores and above, and 140 resident graduate students in two separate degree program areas: electrical engineering and computer engineering. As one of the larger departments on campus, ECE plays a major role in degree production, in sponsored research activity and in service to the community.

The graduate programs offer a variety of opportunities for development through research, specialized formal course work and teaching experience. The department offers the Master of Engineering, the Master of Science and the Doctor of Philosophy degrees in both electrical engineering and computer engineering. Currently there are about 50 students in the Ph.D. program and about 90 students in the M.S. and M.Engr. programs. Approximately 100 of these students receive financial support in the form of fellowships, industrial grants, teaching assistantships and research assistantships.

Research

ECE research activities center around four primary focus areas:

Communications — The communications research focus area includes the wireless communications program, applied electromagnetics, computer networks and digital signal processing.

Electronics — The electronics group has active research projects in the areas of semiconductor devices and materials, metal organic chemical vapor deposition of electronic materials, power electronics, microwave measurements, microwave circuits, integrated circuit design, dielectrics, organic semiconductors and the development of computer-aided VLSI tools.

Computer Systems Architecture — Computer systems architecture represents the primary research interests of the computer engineering faculty and includes computer architecture, high performance computing, computer security and software engineering.

Intelligent Systems — The intelligent systems group has active research projects in the areas of computer vision, sensor fusion, sensor networks, robotics, image processing, nonlinear estimation and control, and power systems.

Faculty

ECE graduate studies and research programs include a spectrum of activity reflecting the interests and expertise of the faculty. Particularly noteworthy across the faculty are the breadth of education, the balance between experience and youth, the record of recent publications and the research funding obtained in recent years. More than 30 faculty members teach and perform research in a broad range of topics in electrical and computer engineering, and many are known nationally and internationally. Among them are IEEE Fellows, two endowed chairs and seven named professors. Additionally, several young faculty members have won prestigious national and international awards and grants.

Facilities

Research programs and laboratories include the Center for Semiconductor Device Reliability Research, electromagnetics laboratories, Clemson Electrical Power Research Association, Image Processing and Artificial Intelligence Research Laboratory, Instruction-Level Parallelism Laboratory, Parallel Architecture Research Laboratory, Power Quality and Industrial Applications Laboratory, Radar Systems Laboratory, Robotics and Mechatronics Laboratory, Speech Processing Laboratory and a Wireless Communications Program. The department occupies more than 20,000 square feet of research space with approximately 9,000 square feet located in the state-of-the-art Fluor Daniel Engineering Innovation Building.

The College of Engineering and Science is well-equipped with networked workstations and personal computers that serve as the foundation for course computing needs as well as the backbone of computing support for the research programs. In addition, a variety of workstations and dedicated computers are maintained in various research laboratories throughout the ECE department.

Engineering and Science Education

Melanie Cooper, Ph.D.
Interim Department Chair
(864) 656-2541
cmelani@clemson.edu
www.clemson.edu/ese

What was originally an indoor swimming pool is now known as the "sandbox classroom," a state-of-the-art instruction facility that inspires experimental learning on a massive scale.

The College of Engineering and Science broke new ground with the establishment of the Department of Engineering and Science Education (E&SE). The new department focuses on improving educational methods and curriculum at the university level and also assists in improving K-12 education in math, science and engineering. K-12 outreach activities will recruit students into engineering and science at Clemson and elsewhere.

There are only two other departments like this in the country: one at Purdue University and another at Virginia Tech. But Clemson's program is unique in that it combines math, science and engineering.

E&SE has begun offering graduate-level courses for Clemson engineering and science students preparing for academic careers. It will ultimately grant M.S. and Ph.D. degrees in engineering and science education.

One of the new teaching innovations introduced to Clemson by E&SE and designed to improve the educational methods of the college is the adaptation of the SCALE-UP (Student-Centered Activities for Large Enrollment University Programs) approach to engineering and science classes. With this approach, a professor is more of a facilitator and coach than a lecturer. Students work in groups where learning occurs by guided inquiry instead of passive instruction. Initial data on student success in SCALE-UP classes shows real promise.

The foundation for this new department is Clemson's general engineering program, where all engineering students spend their freshman year. This program provides the opportunity to learn about different engineering disciplines and academically prepare for declaring a major beginning with the sophomore year.

Engineering at Clemson has a strong track record of external funding for engineering education research and publications in peer-reviewed journals in the field.

Faculty

Full-time E&SE faculty conduct research in one or more of the following areas: active learning environments, the integration of technical research and undergraduate education, development of future engineering and science educators, and building curriculum-based K-12 outreach programs. They also teach in the general engineering program for first-year students.

Facilities

The latest addition to the department's facilities is the Holtzendorff Teaching with Technology Experimental Classroom, also known as the "sandbox classroom." Originally an indoor swimming pool, this unique facility opened its doors in December 2007.

The classroom is called a sandbox because instructors and students explore the use of technology in teaching and learning with an adventurous and curious spirit similar to that of children who explore and learn about their world in a sandbox. Interactivity, spontaneity and collaboration are encouraged in this unique environment.

Accommodating 90 students at 10 round tables equipped with power, Internet and video connections, the classroom also features a Sympodium™ that enables the instructor to write with digital ink on the computer screen. A wireless control system manages lighting and projects computer screens, allowing the instructor to walk freely around the classroom to engage students.

Environmental Engineering and Earth Sciences

Tanju Karanfil, Ph.D, P.E., BCEE
Department Chair
(864) 656-3276
tkaranf@clemson.edu
www.ces.clemson.edu/eees

A gift of nearly 200 acres on the Commonwealth of Dominica from John D. Archbold serves as an outdoor laboratory where Clemson students and scientists work with island citizens to address pressing land-use concerns. One of Dr. Shelie Miller's projects involves recycling waste tires and other trash to build new playgrounds.

Top: Sam Sarkar, Christa Jordan, Dr. Shelie Miller, Hanna Bornholdt, Nikki Dodd.

Bottom: Catherine Cotrupi, Laura LaFlamme

Research efforts in environmental engineering and earth sciences (EEES) reflect a comprehensive and highly interdisciplinary approach to environmental issues. Areas of focus include process engineering (targeted at water, wastewater and air treatment, and soil and groundwater remediation), environmental health physics (ABET/ASAC accredited), environmental chemistry, environmental fate and transport, sustainable systems and environmental assessment, environmental radiochemistry and hydrogeology. A snapshot of current research projects includes sustainable methods for waste tire processing, formation of halonitromethanes and iodo-trihalomethanes in drinking waters and wastewater effluents, adsorption of synthetic organic compounds by various carbonaceous sorbents, numerical modeling of contaminant mass transfer during thermal treatment of solvents in fractured geologic media, biostimulation and bioaugmentation to treat chlorinated solvents in groundwater, the role of microbial activity in lead corrosion of drinking water, development of an *in situ* method for detection of tritium, assessing the toxicity of metal oxide nanoparticles to wildlife, and modeling the biogeochemical processes responsible for the enhanced transport of plutonium in groundwater.

Faculty

The department has 20 full-time faculty members, several active emeritus faculty members, more than 20 adjunct faculty and more than 70 graduate students. Excellence in environmental engineering has been a tradition at Clemson University for many years. It is the only program in the nation with three faculty members who have been honored with the prestigious Founders Award by the Association of Environmental Engineering and Science Professors. Currently, five faculty members serve on the editorial or editorial advisory boards of five journals. The department houses four National Science Foundation (NSF) CAREER Award recipients, the most prestigious awards of NSF in support of the early career-development activities of teacher-scholars. EEES faculty also published five books in the past decade.

The latest faculty additions include:

- Shelie Miller, assistant professor, who received her Ph.D. from the University of Illinois-Chicago where she also served as a doctoral resident with Alcoa Inc., conducting life cycle assessments of petroleum lubricants and soybean oil.
- Brian Powell, assistant professor, who recently completed postdoctoral studies in the chemical sciences division at Lawrence Livermore National Laboratory.
- Treavor Kendall, assistant professor, who completed postdoctoral studies at Harvard University and is currently investigating the chemical dynamic of mineral surfaces in contact with aqueous solutions, organics and biological materials.
- Stephen Moysey, assistant professor, who received his Ph.D. in geophysics from Stanford University and is currently developing advanced quantitative tools to predict groundwater flow and transport processes.

Facilities

The environmental engineering and science program is housed in the Linvil G. Rich Environmental Research Laboratory, which contains 42,000 square feet of laboratories, offices, classrooms and meeting space. Specialized laboratories are available for radiation detection, organic separations, molecular biology, adsorption and chemical oxidation, and bench-scale continuous flow bioreactors. Analytical instrumentation includes several gas chromatographs (GCs), GC/MS/MS, ICP/MS, atomic absorption spectrometer, atomic force microscope, high performance liquid chromatograph with UV/VIS, diode array and fluorescence detectors, ion chromatograph and organic carbon analyzers. The geological sciences program also has excellent laboratory space on the main campus.

Industrial Engineering

Anand K. Gramopadhye, Ph.D.
Department Chair
(864) 656-5540
agramop@ces.clemson.edu
www.ces.clemson.edu/ie

Dr. Mary Beth Kurz works with Lindsey Grooms and Lisa Slagh, using genetic algorithms to locate a hospital in a city while taking multiple conflicting measures into account. This exercise is part of their Creative Inquiry project.

Clemson University is home to the only industrial engineering (IE) program in the state of South Carolina. Nationally recognized, the department offers teaching, research and outreach that emphasize the discovery and application of knowledge in key information-technology-driven emphasis areas.

A major research and teaching area for the department is production and service systems, focusing on applications of operations research. Related course work, available at undergraduate and graduate levels, includes fundamentals of operations research, production planning and control, supply chain design, quality and reliability, and facility planning and design.

The IE program also includes education and learning systems research, studying the work of faculty and students in the development, application and evaluation of alternative approaches to the delivery of engineering subject material. The research seeks to design educational delivery systems to make more effective and efficient use of faculty and facility resources as well as identify ways to assemble and present engineering materials that will increase the relevance of the educational experience while enabling a greater number of students to successfully complete degree requirements.

Another facet of IE research is the study of human factors, especially within applications of hybrid systems, user-centered design, computer-supported collaborative work, knowledge engineering and industrial ergonomics. Research encompasses aviation inspection systems, computer-supported cooperative work, human/computer interaction, hybrid inspection, industrial ergonomics and the ergonomics of space flight.

Faculty Highlights

The Fluor Corp. has made a $2 million matching commitment to Clemson University to create the Fluor Endowed Chair of Supply Chain and Logistics in the IE department. The $2 million award matches $2 million from the South Carolina Centers of Economic Excellence program for a $4 million total endowment. Establishing this chair allows a world-renowned leader in supply chain research to champion activities in education, research and industry outreach at the Research Center for Economic Excellence in Supply Chain Logistics. The endowment will also support students and associated educational programs.

Fluor Corp. recently made a $2 million commitment to create the Fluor Endowed Chair of Supply Chain and Logistics for the industrial engineering department.

Scott Shappell's research is focused on the human factors associated with transportation and accidents. Shappell is the co-creator of the Human Factors Analysis and Classification System (HFACS). HFACS is a system-safety model that effectively bridges the gap between human error theory and applied human error analysis. Originally developed for use with U.S. Navy and Marine Corps aviation accidents, HFACS has been used by a number of other aviation organizations in the United States and around the world. Applications have also been made in a variety of other industries including mining, chemicals, oil, manufacturing and medicine. What makes HFACS particularly unique is its ability to identify data-driven interventions.

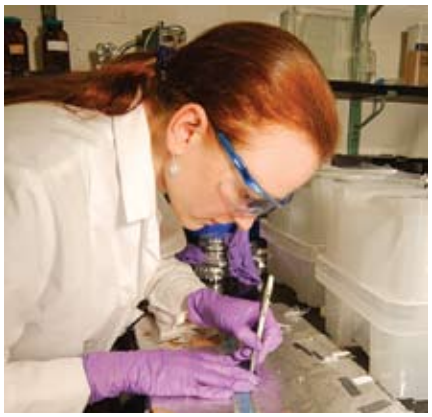
Facilities

The National Science Foundation has selected Clemson University as a research site for the Center for Engineering Logistics and Distribution, an Industry/University Cooperative Research Center. The selection has the potential to affect the flow of raw materials, scheduling production and distributing finished goods for everything from homeland security and disaster preparedness to automobile production and distribution.

The Clemson Institute for Supply Chain Optimization and Logistics brings together an interdisciplinary group of faculty from four different colleges at Clemson University and provides tangible products and services that support economic development in South Carolina.

School of Materials Science and Engineering

Kathleen Richardson, Ph.D.
Director
(864) 656-0549
richar3@clemson.edu
www.clemson.edu/mse



The school's on-campus presence for teaching and research is primarily housed in Sirrine and Olin halls. Laboratories in the advanced fiber, metal, ceramic and polymer research areas include:

- Weaving Laboratories
- Nonwoven Laboratories
- Dyeing, Finishing and Printing Laboratory
- Clemson Apparel Research Facility
- Composites Fabrication
- Physical Testing Laboratory
- Fiber Physics Laboratory
- Electrical/Electronic Fiber and Fabric Properties Laboratory
- Extrusion and Rheology
- Analytical Laboratories
- Advanced Metallic and Composites Group

Research in the School of Materials Science and Engineering (MSE) is as diverse as its faculty interests. Faculty in MSE 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 department in CES 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. As a result, this school's expenditure per faculty member was $459,000 in 2006, resulting from a blend of public and private research support.

Clemson's School of Materials Science and Engineering 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 of class and lab focus is a key part of the Clemson MSE curriculum.

Faculty

The MSE school consists of 18 full-time faculty, three research faculty, and 14 administrative and technical support staff. This includes two new hires and one joint hire with the School of Architecture in 2006-07. MSE anticipates the hiring of three new faculty positions, including two of South Carolina's Research Center of Economic Excellence Endowed Chairs: the $8 million J.E. Sirrine Textile Foundation Endowed Chair in Advanced Fiber-Based Materials and the $10 million J.E. Sirrine Textile Foundation Endowed Chair in Optical Fibers.

Facilities

The school and its faculty participate in the following Clemson research centers:

- The Center for Optical Materials Science and Engineering Technology (COMSET) is headquartered at the Advanced Materials Research Laboratory, a $21 million complex in the Clemson University Advanced Materials Center. The 111,000-square-foot research facility houses laser and chemical labs and the University's Electron Microscope (EM) facility. COMSET is recognized as a global leader for innovation and education in the science and technology of optical materials. Since it began in 2000, it has garnered more than $40 million in research funding.
- The director of the University's EM facility, JoAn Hudson, holds a research faculty appointment in MSE. One of the most outstanding EM facilities in the country, this is a critical resource to MSE team members and other researchers.
- Clemson Apparel Research (CAR) was established to revitalize the domestic sewn-products industry through the application of advanced technology and management practices. It is now a premier national resource for high-performance textiles and related materials research and applications. CAR's fast-turn manufacturing and supply chain optimization solutions are being applied to other industries.
- The Clemson Conservation Center focuses on the science of conserving and preserving archeological finds and other historic treasures. One of their current projects is the conservation of the *H.L. Hunley*, a Civil War submarine that sat at the ocean floor for 130 years before it was found and brought up.
- The National Brick Research Center is an industry-funded organization providing research, education and service to producers and users of clay bricks and other ceramic materials (tile, mortar and ceramics).

Mathematical Sciences

R.L. Taylor, Ph.D.
Department Chair
(864) 656-6187
rtaylo2@clemson.edu
www.math.clemson.edu

Marilyn Reba received the Clemson University 2008 Award for Innovative Excellence in Teaching, Learning and Technology. She was presented the award at the Fall 2007 Teaching with Technology Symposium and was designated as Clemson's nominee for the Ernest L. Boyer International Award for Excellence in Teaching, Learning and Technology.

The Department of Mathematical Sciences at Clemson provides major contributions to the instructional and research mission of the University. Enrollments average 5,000 to 6,000 students per semester in more than 300 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 (37 national and international talks in 2006-2007), national and international professional involvement of the faculty, and funded research ($1.5 million in 2006-2007).

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 students graduated with bachelor's degrees in the mathematical sciences in 2006-2007. In addition, the department awarded 28 master's degrees and eight Ph.D. degrees during the past year.

Faculty Highlights

The American Statistical Association named Robert Lund a 2007 Fellow. The nation's pre-eminent professional statistical society recognizes outstanding contributions such as innovative research in applied probability, statistical climatology and time series analysis as well as stellar leadership in the field of statistical science. Individuals are nominated for the honor by other members and must have an established reputation. Lund becomes the fourth Clemson faculty member to receive this award, joining professor emeritus Ted Wallenius, department chair Robert Taylor and visiting professor W.J. Padgett.

Clemson currently has 60 smart classrooms interspersed around campus that 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.

For the fourth 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 2008 competition serves the region's brightest high school math students, covering areas of the Southeast, including Atlanta, Ga., and Charlotte, N.C.

Teams of high-school students work together at the Clemson Calculus Challenge. The Department of Mathematical Sciences is eager to encourage the study of calculus in high school; prizes of this annual competition include $500 scholarships to Clemson University.

Mechanical Engineering

Imtiaz Haque, Ph.D.
Department Chair
(864) 656-2482
sih@clemson.edu
www.ces.clemson.edu/me

(From left to right) Teresa Earnhardt, founder and chairwoman, The Dale Earnhardt Foundation; Casey Appleman, 2008 Dale Earnhardt Motorsports Scholarship winner; Imtiaz Haque, Clemson mechanical engineering department chair; Dick Baker, executive director, The Dale Earnhardt Foundation. Photo courtesy of Dale Earnhardt Inc.

The Department of Mechanical Engineering has one of the largest academic programs in the state of South Carolina with 574 undergraduate students and 175 graduate students. The department has seen unprecedented growth in the last three years with 13 new faculty joining its ranks, the creation of a graduate program in automotive engineering that focuses on systems integration to meet the challenges of the global automotive marketplace, and the construction of a 90,000-square-foot, unique facility to house the new program.

Funded research activities put this department at the cutting edge in various fields. The research is distributed across nine major disciplines:

- Automotive Engineering
- Bioengineering and Biomaterials
- Design
- Dynamics and Controls
- Fluid Mechanics
- Materials and Materials Processing
- Manufacturing
- Solid Mechanics
- Thermodynamics, Heat Transfer and Combustion

Newly developed focus areas include lightweight engineering design for reduced energy consumption in automobiles, development of novel computational and experimental techniques to address fluid flow and combustion problems at different scales, development of new biomaterials and biomanufacturing processes, energy management using control and thermal management techniques, and dynamics, control and measurements in MEMS and NEMS. Computational research makes use of a supercomputing cluster to study microscale phenomena using atomic-level molecular dynamics simulations. These simulations have recently identified novel pathways by which buckyballs and other man-made nanoparticles may be able to enter human cells. The department is also the birthplace of materials formed by chaotic advection.

Faculty

The department includes 33 tenure-track faculty, seven ASME Fellows, one SME Fellow, two Presidential Faculty Fellows, five NSF CAREER awardees, one NSF PECASE awardee, one member of the European Academy of Engineering and 10 associate editors/members of the editorial boards of national/international journals. The department holds three of the largest endowed chairs in the country — each valued at $10 million.

Facilities

This year saw the opening of the Campbell Graduate Engineering Center, built on the 250-acre Clemson University International Center for Automotive Research campus in Greenville, S.C. This center houses state-of-the-art facilities for automotive research that include a 7-post shaker in a climactic chamber, a 500-horsepower chassis dynamometer, a 500-horsepower engine dynamometer and a full-scale coordinate measuring machine. The center also offers graduate-level classes and research opportunities, allowing students to work with industry partners such as BMW, Michelin, Timken and the Society of Automotive Engineers — all with facilities located on the same campus.

On the main Clemson campus, 23 state-of-the-art labs support the department's research interests. They include experimental, computational, design and material processing labs.

Dale Earnhardt Inc. announces scholarship winner

Casey Appleman of Davidsonville, Md., a rising senior majoring in mechanical engineering, received the Dale Earnhardt Motorsports Scholarship at a presentation at DEI headquarters in Mooresville, N.C.

The Dale Earnhardt Foundation funds the annual undergraduate scholarship honoring the memory of Dale Earnhardt Sr. for students interested in motorsports and automotive engineering. The foundation will grant $13,000 annually for a three-year undergraduate scholarship to a student in the College of Engineering and Science. Scholarship winners are eligible for internships.

Physics and Astronomy

Peter Barnes, Ph.D.
Department Chair
(864) 656-3419
peterb@clemson.edu
physicsnt.clemson.edu

Dr. Mark Leising, a Clemson astrophysics professor, is serving as principal investigator for an NSF project to build and reinforce a program of forefront astronomy research at South Carolina State University.

Physics, the most fundamental of the natural sciences, forms the basis of study upon which the other branches of science are founded. Clemson's physics department focuses on teaching the fundamentals of astrophysics, biophysics, nanomaterials, and surface and interface nanoscience. Additional subjects include atmospheric and space, materials, single molecule, solid state and surface physics.

Clemson has reached an agreement with the National Science Foundation-funded National Optical Astronomy Observatory, providing guaranteed access to 10 percent of the observing time per year on the Kitt Peak National Observatory 4-m Mayall telescope. Since the mid-1970s, the Mayall 4-m has been a groundbreaking workhorse of the U.S. national observatory system, which includes the new giant twin Gemini 8-m telescopes in Hawaii and Chile. This three-year agreement allows Clemson graduate students and faculty abundant access to world-class telescopes in the Northern and Southern hemispheres and allows astronomers the opportunity to exchange half of their 4-m time for nights on nearly every other optical telescope in the U.S. national system. The agreement was made possible by a $100,000 grant from the Charles Curry Foundation based in Seneca, S.C.

Faculty Highlights

- Don Clayton, professor emeritus of physics and astronomy, joined the Clemson faculty in 1989 and is a leading scientist in nuclear astrophysics, gamma ray astronomy and nuclear isotopic clues to the origin of the solar system. The American Astronomical Society credited him as generating one of the most important astrophysics research papers of the 20th century. He also brought international recognition to Clemson as an inductee of the American Academy of Arts and Sciences, which honors leading intellectuals from around the world in every field and profession. He graduated from Southern Methodist University in 1956 and received his Ph.D. in physics from California Institute of Technology in 1962.
- Terry Tritt delivered an address at the Alan MacDairmid Memorial Nano Energy Summit in Dallas at the world-renowned NanoTX '07 Conference. Tritt focused on the challenges in alternative energy, specifically how billions of dollars could be saved every year if energy lost from hot engines could be captured and converted into electricity via thermoelectric devices. Most recently, Tritt received the 2008 Governor's Award for Exellence in Science, honoring his achievements and contributions to science in South Carolina.

Clemson astrophysicists to collaborate with S.C. State to boost minority Ph.D.s

Clemson University astronomy researchers will collaborate with South Carolina State University (SCSU) to build and reinforce a program of forefront astronomy research at SCSU as part of a $2 million-plus National Science Foundation award.

"Our goal is to pave a pathway for SCSU students and others from historically black institutions to obtain doctorates in physics and astronomy at Clemson and elsewhere," says Mark Leising, astrophysics professor and principal investigator on the project at Clemson. "These students are hugely underrepresented among doctoral students in the physical sciences."

Leising says Clemson's role is to collaborate with SCSU, provide research projects and observing opportunities for their students, and prepare and mentor those who come to graduate school.

"There are bright students interested in science at universities like SCSU, but few go on to get doctorates and become leaders in the physical sciences. Our experience is that students who get the chance to participate in forefront research, discovering new knowledge rather than just reading about it, are more likely to pursue a career in science," says Leising.

Clemson will offer the expertise of its astronomy faculty and access to observing facilities, including its part of the 36-inch diameter SARA telescope along with some of its time on the 4-m diameter Mayall telescope, both on Kitt Peak in Arizona. Students will research the largest explosions in the universe, the production of the elements in stars, the formation of solar systems and exotic double-star systems.

Department Contacts

Bioengineering
401 Rhodes Research Center
Box 340905
Clemson, SC 29634-0905
www.ces.clemson.edu/bio
Dr. Martine LaBerge, Chair

Biosystems Engineering*
221 McAdams Hall
Box 340312
Clemson, SC 29634-0312
www.clemson.edu/agbioeng/bio/home.htm
Dr. William H. Allen, Chair

Chemical and Biomolecular Engineering
127 Earle Hall
Box 340909
Clemson, SC 29634-0909
www.ces.clemson.edu/chemeng
Dr. Jim Goodwin, Chair

Chemistry
219 Hunter Laboratories
Box 340973
Clemson, SC 29634-0973
chemistry.clemson.edu
Dr. Stephen Creager, Chair

Civil Engineering
110 Lowry Hall
Box 340911
Clemson SC 29634-0911
www.clemson.edu/ce
Dr. Nadim Aziz, Chair

School of Computing
100 McAdams Hall
Box 340974
Clemson, SC 29634-0974
www.cs.clemson.edu
Dr. Larry Hodges, Director

Holcombe Department of Electrical and Computer Engineering
105 Riggs Hall
Box 340915
Clemson, SC 29634-0915
www.ece.clemson.edu
Dr. Darren Dawson, Chair

Engineering and Science Education
104 Holtzendorff Hall
Box 340902
Clemson, SC 29634-0902
www.clemson.edu/ese
Dr. Melanie Cooper, Interim Chair

Environmental Engineering and Earth Sciences
L.G. Rich Environmental Laboratory
342 Computer Court
Anderson, SC 29625
www.ces.clemson.edu/eees
Dr. Tanju Karanfil, Chair

Industrial Engineering
110 Freeman Hall
Box 340920
Clemson, SC 29634-0920
www.ces.clemson.edu/ie
Dr. Anand Gramopadhye, Chair

School of Materials Science and Engineering
161 Sirrine Hall
Box 340922
Clemson, SC 29634-0922
www.clemson.edu/mse
Dr. Kathleen Richardson, Director

Mathematical Sciences
O-110 Martin Hall
Box 340975
Clemson, SC 29634-0975
www.math.clemson.edu
Dr. R.L.Taylor, Chair

Mechanical Engineering
100 Fluor Daniel Building
Box 340921
Clemson, SC 29634-0921
www.ces.clemson.edu/me
Dr. Imtiaz Haque, Chair

Physics and Astronomy
118 Kinard Laboratory
Box 340978
Clemson, SC 29634-0978
physicsnt.clemson.edu
Dr. Peter Barnes, Chair

* This degree program includes courses in the College of Agriculture, Forestry and Life Sciences, as well as the College of Engineering and Science.

CLEMSON UNIVERSITY

INQUIRY, DISCOVERY IN ENGINEERING AND SCIENCE

IDEaS

FALL 2008

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

On the cover: Dr. Karen Burg mixes the expertise of her colleagues from other disciplines and universities and applies it to her breast cancer research. Read more about her research methods and how they've benefitted her work on page 2.

Right: Meena Mirdamadi, a senior majoring in bioengineering, sorts biochips in Dr. Anthony Giuseppi-Elie's lab. Find out more about the biochip and how it's going to impact health care on page 12.

Contributors

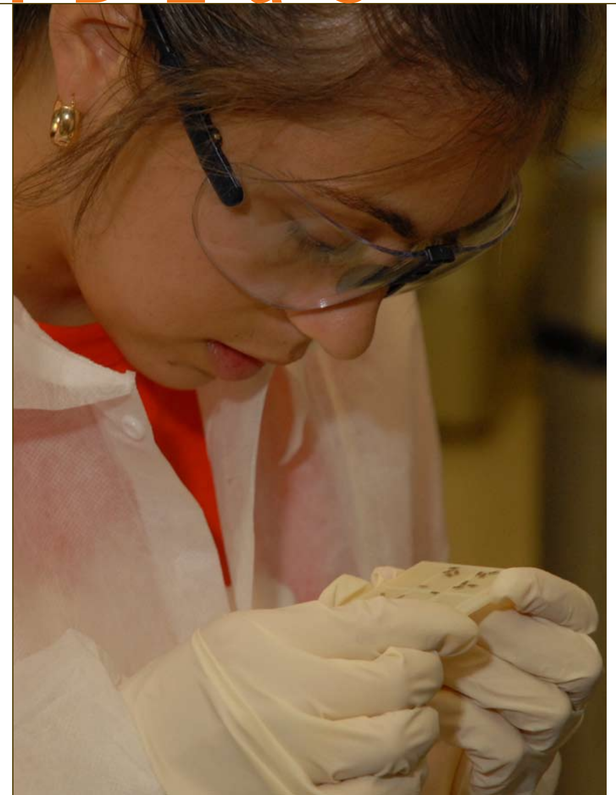
EXECUTIVE EDITORS
Esin Gulari
Ron Grant
Rebecca Shepherd

DESIGNERS
Dave Dryden
Christine U. Prado

PHOTOGRAPHERS
Craig Mahaffey
Patrick Wright

WRITERS
Elizabeth DePasquale
Ron Grant
Susan Polowczuk
Rebecca Shepherd

CLEMSON UNIVERSITY



College Contacts

College of Engineering and Science Administration
Dr. Esin Gulari
Dean
College of Engineering and Science

Dr. R. Larry Dooley
Associate Dean
Research and Graduate Studies

Dr. E.R. (Randy) Collins
Professor and Associate Dean
Undergraduate and International Studies

College of Engineering and Science
109 Riggs Hall
Box 340901
Clemson, SC 29634-0901
www.ces.clemson.edu

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

CLEMSON UNIVERSITY

CLEMSON UNIVERSITY
Office of the Dean
109 Riggs Hall
Box 340901
Clemson, SC 29634-0901

Nonprofit
Organization
U.S. Postage
PAID
Clemson, SC
Permit No. 10

IDEaS

COLLEGE OF ENGINEERING AND SCIENCE FALL 2008

Highlights from our departments