The Florida Engineer

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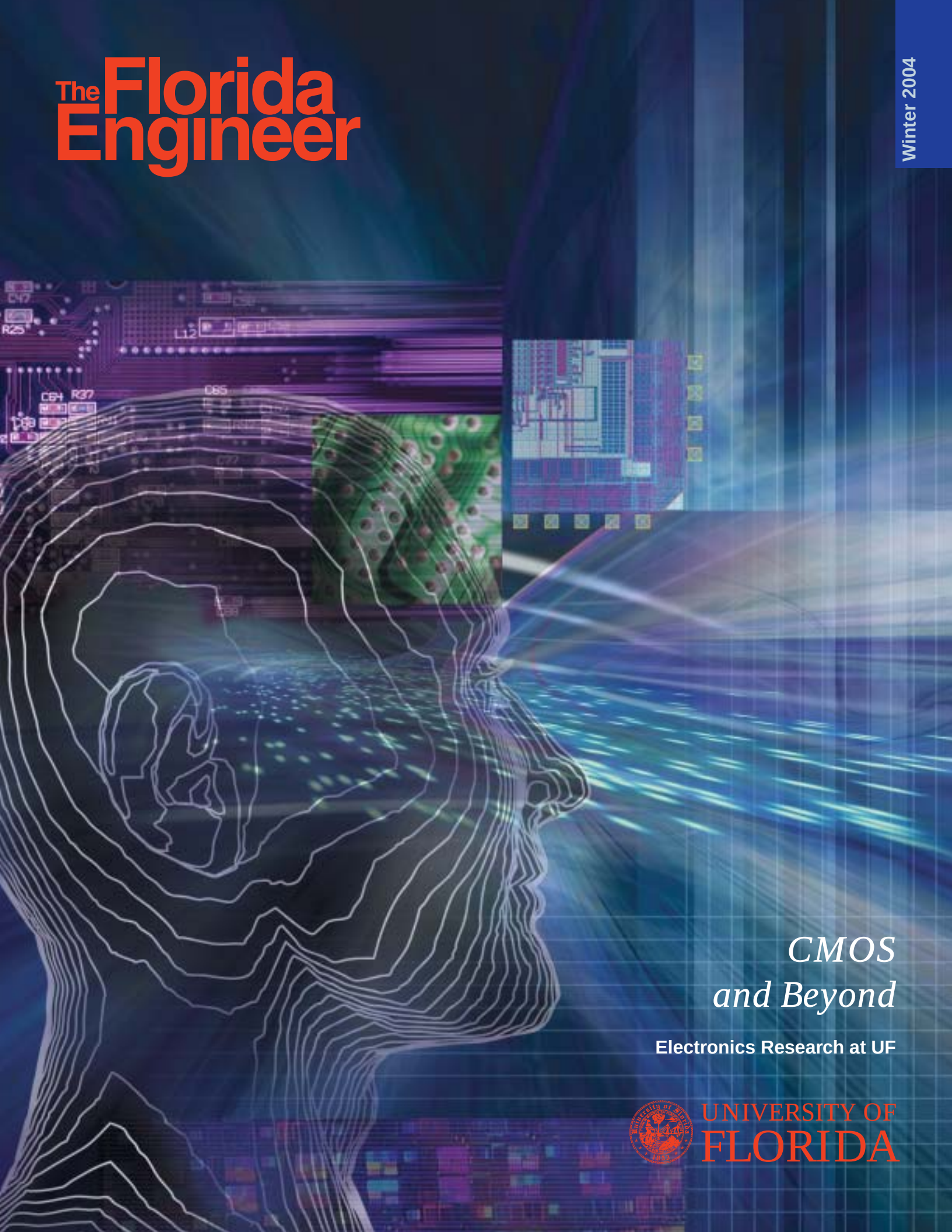

CMOS and Beyond

Electronics Research at UF

UNIVERSITY OF FLORIDA

Cover: New forms of signal processing are in the air – and on chips - at the Electrical & Computer Engineering department. ECE researchers have shown that wireless radio signals can be sent instantly across electronic circuits. Large area wireless networks can use less power by boosting messages through linked devices. Mind-machine devices can enable people with paralyzed limbs and improve speech recognition through cell phones and hearing aids. At the cutting edge, studies of the way the brain's neural signals fire in time may revolutionize computing, and one-directional carbon nanotubes may lead to ever faster electronics. Stories on all these are inside.

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The invention of the semiconductor transistor was a landmark event in the history of technology. It spurred an amazing sequence of engineering advances: integrated circuits, microprocessors, memory chips, very large scale integration, opto-electronics, to name a few. More importantly, in confluence with inventions in computer science and communications systems, it led to the information technology revolution. We are living through this revolution, so any assessment of its impact on our society and its evolution is likely to be wrong. Nevertheless, no one can question that the enormous strides in information technology are bringing about an incredible societal transformation in the way we live, conduct business, entertain ourselves, communicate with our fellow beings, and learn. It is also clear that the IT revolution is inherently global and derives its enormous power, at least in part, from its ability to "shrink" the world.

The field of electrical and computer engineering encompasses much of the knowledge at the center of this revolution. While we can be very proud of the field's achievements, scientists and engineers continue to work on exciting ideas that will continue the advancements and bring about ever faster changes in information technologies. For example, following the famous Moore's Law (named after Gordon Moore, who also co-founded the Intel Corporation), we have been able to reduce the size of the transistor and pack exponentially increasing numbers of transistors in a single chip. Emerging work in nano-electronics promises to accelerate this march down to the atomic and molecular level computing. While cell phones fundamentally altered the way we communicate, advances in wireless communications are likely to enable much more satisfying communications experiences such as real-time video transmission over cell phones. Advances in sensor and actuator technologies coupled with computing and communications are likely to make everyday devices from microwave ovens to tennis shoes much more "intelligent." While many lives have been improved by the use of biomedical devices such as pacemakers, tremendous advances in human health are likely in the future through the creation of implantable devices for sensing, communications, and signal processing. Distributed information systems, bridging language and other cultural barriers enabled through the use of advanced computing architectures, are likely to make our social and cultural lives richer. I am reminded of something former President Reagan said - you ain't seen nothing yet …

In this issue of *The Florida Engineer*, we profile our Department of Electrical and Computer Engineering. Our faculty and students are working hard to realize the world of tomorrow. We are also educating our students at all levels – undergraduate and graduate – in the fundamental principles behind these advances as well as the new challenges and opportunities. You will get a glimpse into our plans for future activities in these fields. After reading these articles, I hope you will share my excitement about the research and teaching activities taking place in the laboratories and classrooms in our ECE department.

As I write this essay, the news is filled with articles about outsourcing of information technology jobs overseas. This phenomenon coupled with the "dot com bust" has left many with doubts about the economic and business impact of the technology revolution. Given these trends, understandably, our students have a certain amount of trepidation about their future job prospects as these trends play out.

What does the future hold for us? We can take some lessons from history. In the 19th and 20th centuries, we saw an enormous decline in the number of people employed in agriculture as technological changes brought about dramatic increases in productivity. More recently, during the 1970s and 80s, we saw manufacturing jobs move overseas due to cheaper labor costs. Engineering work in the US in these areas focused on the more advanced and higher value added design work.

I suspect that something similar will happen in the field of information technology. As corporations take advantage of lower labor costs and move the more mature work overseas, engineering work in the US will move to higher value added high level systems design and architecture areas. Based on previous technological revolutions, it seems very likely that the golden age of information technology is yet to come. There is little doubt that new fields in electrical and computer engineering will spring from the advanced research activities in laboratories at research universities, including the University of Florida. Technological innovation, in conjunction with a dynamic culture of new business incubation, will create wonderful new opportunities. Some of these advances could create unforeseen disruptive technologies that will lead to major changes in the way we live and work. Thus, it is critical that our research enterprise retains its position as the best in the world so that we remain at the epicenter of these innovations and the subsequent business creation.

At the University of Florida, we are striving to expose our students to a state-of-the-art education, provide them with lifelong learning skills, and get them involved in cutting edge research. We hope these efforts will allow them to become leaders and innovators and grow as technologies change and evolve. The creativity of our faculty and students will continue to catalyze new industries that will become the new engines of economic growth and provide exciting and valuable job opportunities to our students.

Dean Pramod Khargonekar and Manuel Fernandez, Chairman, UF Board of Trustees

CHARGING AHEAD

Electrical & Computer Engineering Enters New Era

Professor Mark Law

When Professor Mark Law became chair of Electrical & Computer Engineering (ECE) last August, he took on a department challenged to grow by a university task force.

ECE should build on its existing strengths, said the 2002 Task Force on the Future of the University of Florida.

ECE in fact has many strong points, and Law, on the faculty since 1988, is very familiar with them. With his typical high energy, he quickly identified research areas that are strategically important.

Advanced computing and information systems "Professor José Fortes is attracting a tremendous amount of attention for his work. He is solely responsible for a 50 percent increase in the number of awards we won last year," Law says.

Radiofrequency and high frequency electronics "This lab, with Professor Ken O in charge, is really exciting. We have added a new faculty member there, Jenshan Lin, who is coming from Agere Systems."

Solid state electronics "We have revitalized this research area. We hired Ant Ural, who has been doing carbon nanotube electronics at Stanford, and Scott Thompson, who has been directing Intel's technology development for the past five years," Law says.

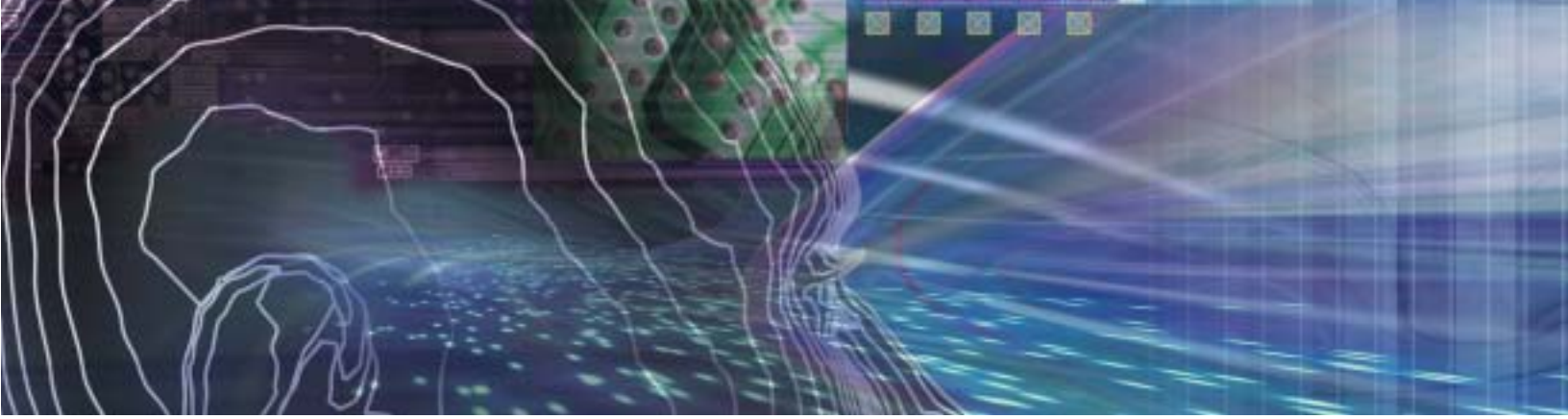
Wireless communications New faculty member Yuguang "Michael" Fang is leading the Wireless Networks Laboratory. His research team is working on linking individual wireless nodes to boost transmission performance.

Computational NeuroEngineering Laboratory (CNEL) Headed by professors José Principe and John Harris, CNEL does multidisciplinary research into signal processing in neural networks. This well-established lab has won more than $2 million in awards over the past five years and is one of ECE's most successful research areas.

Law sees multidisciplinary research as essential to ECE's growth.

"My vision of electrical engineering is that there is an electrical component in almost everything. To really grow and move toward the future we need to collaborate more with other disciplines. There are incredible opportunities in the biological world, in chemistry, and in other product environments in the engineering college," Law says.

For example, he says, "I think there are more dollars spent on electronics in an automobile



than on any other component. So, even something that you associate as a classical mechanical engineering product is now over half electrical gear. I see that trend continuing."

Law is actively recruiting faculty to build up the research programs.

"We are going to work really hard to recruit some new people. I would like to hire five or six new people this year. We have had just over 40 faculty members for a long time. A lot of our peer schools have close to 100. We aren't going to get that big, but I think growth in the size of the department is going to do a lot for our reputation," Law says.

Because much of the research is done by PhD students, an immediate priority this year is revitalizing ECE's graduate program.

"The research is only as good as the students who are performing it, so we are going to be much more aggressive in recruiting PhD students. We need to bring students to campus, excite them about the program and the research possibilities, and make them competitive offers. It's what our competition is doing," Law says.

One way to get good graduate students is to encourage undergraduates to do ECE's dual bachelor's/master's degree program, he says.

"I see the master's increasingly becoming an entry level degree. And it pays off economically. The first year salary advantage for our master's students was $15,000. If I could tell the freshmen one thing, I would say think about getting a master's and keep your GPA up high enough to qualify for the program."

ECE is also offering more courses to diversify the bachelor's program.

"Students entering now have more options available in terms of courses they can take for specialization areas. The electrical engineering field has gotten very broad and the depth required to be a contributing engineer is a lot larger."

Some needed upgrades to ECE's physical plant will support the academic expansion, with $1.1 million authorized to renovate the Benton Hall clean room area. ECE will also share in a new physics facility for university-wide nanotechnology research. The result will be a state-of-the-art fabrication facility for advanced devices to be operated as an independent unit similar to the college's Major Analytical Instrumentation Center.

Law says he wants to improve the undergraduate teaching labs, to improve the laboratory experience and make it more relevant. He would also like to revamp the area between ECE's buildings, Benton and Larsen halls, to make it a pleasant gathering area.

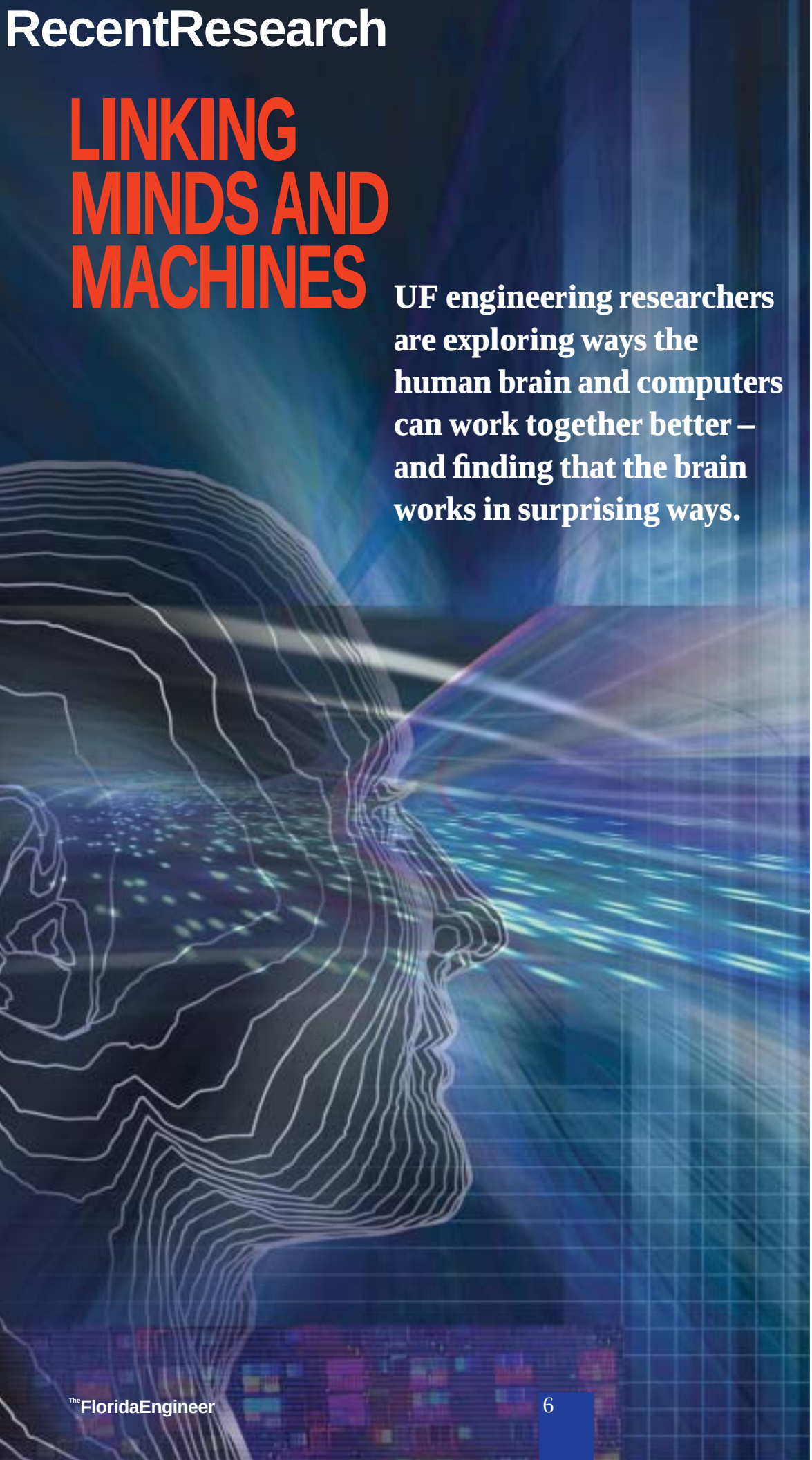
Alumni and industry are invited to participate in the department, too. Law envisions two advisory boards. One, made up of recent alumni and possibly company recruiting managers, would focus on curriculum issues. The other would be an overall advisory board composed of industry leaders and well-known academics from other institutions who might have past ties to UF.

"We need our alumni. We need their wisdom and perspective to help us develop our programs," Law says.

Martha Dobson

LINKING MINDS AND MACHINES

UF engineering researchers are exploring ways the human brain and computers can work together better – and finding that the brain works in surprising ways.



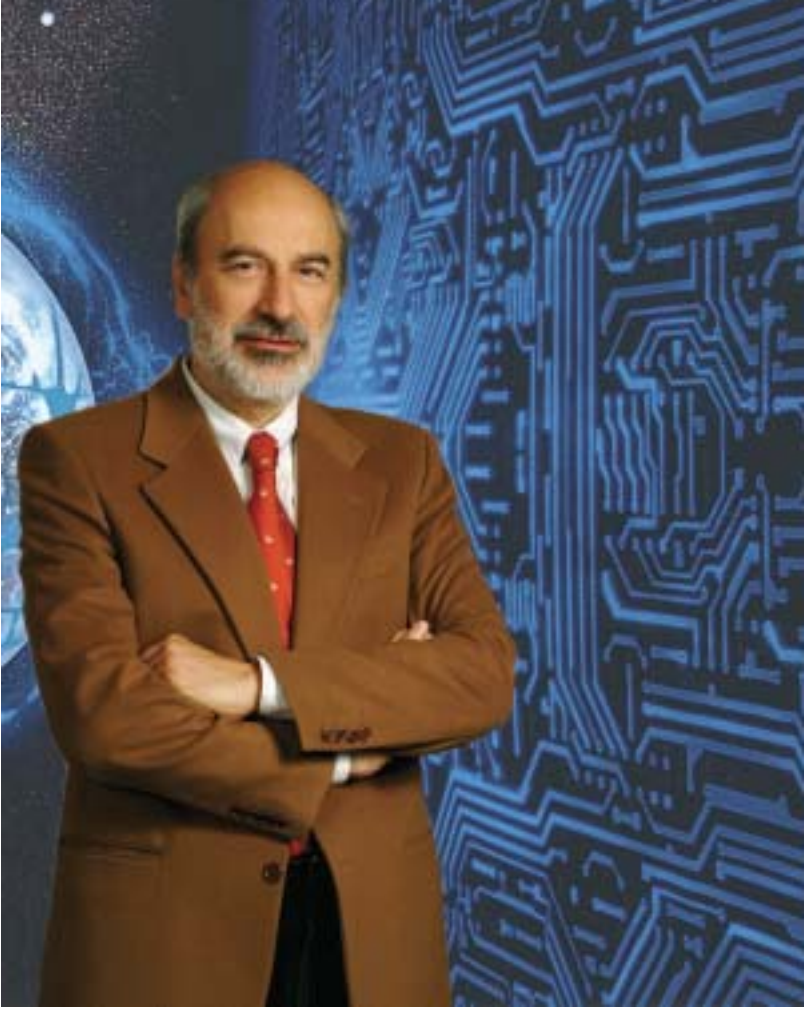
The Mind as Model

Computational neuroscience meets engineering at the Computational NeuroEngineering Laboratory (CNEL)

Engineering is a wonderful discipline because it invents reality, says José Principe.

"Technology changes the world. But sometimes engineering becomes a closed loop, repeatedly applying the same principles to solve problems. I think we are seeing some technologies reaching their full potentials, like silicon technology and digital computers. At CNEL, we are asking what will be the next step," says Principe, Electrical & Computer Engineering Distinguished Professor and CNEL's director.

Principe believes that biology brings fresh ideas to the picture. "We humans are living examples that there are other ways of creating intelligence and interacting with the environment. What we are trying to do is distill principles from biology and then apply them into engineering," Principe says.



Distinguished Professor José Principe

Some of CNEL's more theoretic research is intended to provide the foundation for its applied projects. One theoretical project is exploring a new way of adapting systems using information theory. Another theoretic project is nonGaussian, nonlinear, and nonstationary signal processing.

The silicon cortex project is translating the principles of brain functioning through nonlinear dynamics. As Principe explains it, "Nonlinear dynamics is going to be the conveyor belt between biological plausible computing and analog chips. This is important because we would like to understand how sensory systems like those in humans and animals are able to be so sensitive and specific. If we can achieve that, we can build and deploy very inexpensive sensors with the corresponding processing as low power appliances that we can just use in multiple applications. The idea is to put sensors together with signal processing on the same chip, and populate the world with these things. We are trying to use the principles of brain function to help us design and implement these small, low power devices in analog VLSI."

Even CNEL's more practical endeavors push the limits of the possible. The team is helping to design better system identification and controllers for NASA's LoFlyte unmanned, jet-powered hypersonic aerial vehicle. LoFlyte's flight control system, as announced by NASA in 1996, consists of a network of multiple-instruction, multiple-data neural processors that continually alter the plane's responses. The UF team is trying out new ways of using locally linear models that can self-organize to switch when the system state varies over time.

In the clinical domain, CNEL is part of a UF team studying epileptic seizure prediction, funded by NIH. The researchers are interested in understanding and measuring the interdependencies between brain areas with the goal of deriving signal processing algorithms to predict seizure activity. Patients could carry low power, portable computers that would help them predict, and activate means to avoid, epileptic seizures.

CNEL is also a participant in an extensive, multi-university brain-machine interface project that has the potential to improve the way paraplegics interact with the world. Researchers have experimented successfully with translating the neural signals that occur when a subject intends to move an arm into a set of electronic signals that can move a robotic arm where the subject wants to reach.

CNEL is collaborating with Eminent Scholar José Fortes and the ACIS lab on bio nano-lattice computing. The goal is to seek a wholly new way of doing computation. Computer memory is a well-understood building block for computation. Bio nano-lattice computing could provide an ideal implementation medium for another type of memory, content-accessible memory, a system that does not require an explicit address. It would operate very much like a human brain by directly accessing content.

CNEL's contribution is to model the interface between the micro and nano scales as a stochastic process and avoid the bottleneck of precise geometry as currently pursued in chip design. The analogy came from the human brain, where the local connectivity, if not random, is probably very close to it. The connections between neurons are made early in life, but the synaptic connections evolve and adapt.

"This is the type of thing that our knowledge of biology can bring into the process," Principe says, "and take engineering past today's technological plateau."

Martha Dobson

Unlocking the Power of the Brain

Associate Professor John Harris

John Harris says his research is inspired by the brain. There are many pattern recognition problems that the brain is just amazingly good at and computers are very poor, says Harris, an ECE associate professor and co-director of the Computational NeuroEngineering Laboratory (CNEL) with ECE Distinguished Professor José Principe.

"When artificial intelligence first started 50 years ago, people thought intelligence was playing chess and doing integral calculus. As time went on, we programmed computers that could do these things better than the best humans. But they still don't have intelligence," Harris says.

Programmers have found that writing programs for skills people learn early in life is much more difficult. The things we learn in the first two years of life - speech recognition, how to talk, how to move, muscle control - are the most difficult things to build into computers.

There is a lot of speculation about how the brain is organized. It may begin by working very randomly, but in the adaptation process information can be stored. The key is that brain function is a very distributed process. The mission of Harris' research at CNEL is to study this process, to understand how it works well enough to take the ideas and embed them in engineering systems.

"I'm basically trying to replicate the skills we learn during the first two years of life, things that any two year old can do. It's humbling when you think of it," says Harris, who can see this play out daily in his own children, ages 2 and 4.

Harris points out that there are engineering advantages to be gained from biology, particularly in power efficiency. A brain uses only about 12 watts of power, incredibly low for all the processes going on. A Pentium, for example, may use 50 to 100 watts of power to do much less processing than the brain. So, one research focus for Harris is to build very large scale integration (VLSI) analog circuits, which work in a manner much more similar to brain processes than digital processing.

Subthreshold analog circuits run at lower power than digital electronics, by six orders of magnitude, but can simulate brain function in another, more important way. "The biggest realization that we have made is that the brain computes using timing events," Harris says. Neurons fire as discrete events along a continuous timeline. Time can also be an analog function and is one important element shared with how the brain does computation.

The concept is complex. Usually, analog represents things in terms of voltage. For example, light intensity at a given point is one voltage. A neighboring point that is darker has a lower voltage. Light, therefore, is a

continuous range of voltages. As technology scales, the available voltage range shrinks. As Harris explains it, the researchers decided to use time instead of voltage because time does not shrink. If an image takes 30 milliseconds per frame, it doesn't matter what the voltage is.

"We have more room in the time domain. We don't have the constraints we do with voltage," Harris says.

To test the concept, Harris and his graduate assistant built an imaging sensor that has an extremely wide dynamic range using pulses in time. The sensor has a 140 dB dynamic range, so that in a single image, the ratio of brightest to darkest is much larger than in conventional CMOS images. A digital camera can't produce a picture showing both bright sun and shadow at the same time. Film, too, has a limited dynamic range.

In the prototype, the pixels in an image fire like neurons. The brightest pixels in the image fire first and request to be scanned off-chip sooner. Darker ones are quiet and come up later. A digital processor converts the time signals to a gray scale so they can be seen.

Representing information as spikes in time at the sensor and the processing level has excellent potential for use in nanotechnology because it can be scaled to work at that level.

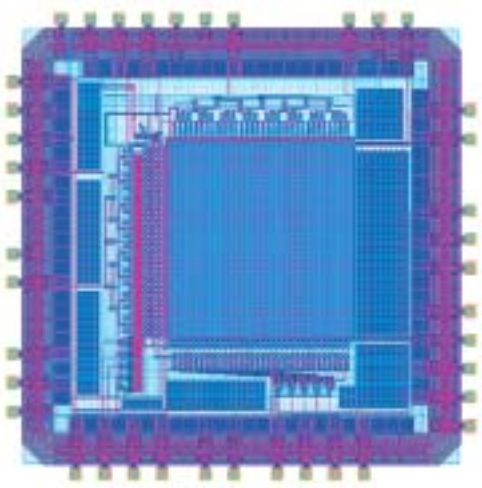
CNEL is researching this concept with Eminent Scholar José Fortes and the Advanced Computing and Information Systems Laboratory. The major problem with scaling down to the nano level is power consumption. Gradually the voltage used in computing has been scaled down as the circuits become smaller. But as voltage shrinks, the power margin needed for computation is lost. With nanotechnology, the voltage will shrink even more, which makes time-based analog systems attractive.

Building reliable components at the nano level likely will also present difficulty. Understanding the biology of the brain may offer insight because it is estimated that we each lose an average of 10,000 brain neurons every day.

For engineers, that is an amazing fact, Harris says. "How can you build a system where randomly 10,000 of your fundamental units just drop out? It's very difficult for us to think about computation when the elements themselves are failing. How does biology work in the face of these failures? There will be some big breakthroughs once we understand it," he says.

CNEL researchers have made some significant breakthroughs already. The team is part of a multi-university project developing a chip that interfaces directly with the brain with the goal of enabling a paralyzed person to control a robot arm with transmitted brain signals alone. The chip, which has worked successfully in the laboratory, measures neural activity and transmits it as electronic signals to the robot arm receiver.

Prototype 32x32 pixel, spike-based CMOS imager designed by Associate Professor John G. Harris and his PhD student Xiaochuan Guo. This chip, based on biological principles, can capture images with a dynamic range up to 140 dB, over three orders of magnitude improvement compared to conventional CMOS imagers.



Understanding how the brain handles speech signal processing has been important to two other CNEL research projects. One project in collaboration with Motorola aims to improve cell phone speech quality. It uses the fact that people hear loudness based on a critical band pass filter complex. Loudness, very crudely put, is how many filters get activated by sound wave energy. If all the energy goes into one filter, the sound is not as loud as if the energy spreads over all the filters. In processing speech, the algorithm widens the appropriate places in the frequency domain to hit more of these critical bands and make the sound louder even though its energy remains constant.

CNEL has also developed a tool to improve speech intelligibility. When people try to hear speech along with noise interference, the first sounds lost are consonants like the letters b, d, or t. There is no problem hearing the "e" sound at the end of the consonant, but the plosive sound in front is hard to hear. The researchers have found a way to boost the spoken sounds that is very attractive for hearing aids.

"As an engineer, I work within reality," Harris says. "By understanding biology, I can make the realities work better."

Martha Dobson

One Step Beyond

Creating virtual computing systems

Computer-created virtual reality is now commonly used in special effects films and computer-based games. The Advanced Computing and Information Systems laboratory (ACIS) in the Electrical & Computer Engineering department is reaching beyond that to create virtual computing systems.

ACIS is the brainchild of José Fortes, professor and College of Engineering BellSouth Eminent Scholar. He came to UF two years ago to explore new systems of computing and information processing. To do that, he and his colleague Assistant Professor Renato Figueiredo have put together a laboratory with hundreds of high-performance computers and seven terabytes of computer storage (1 terabyte = 1000 gigabytes). The ACIS lab allows ACIS researchers to investigate virtual computing systems that consist of very large numbers of virtual machines emulated by physical computers.

"We are the only lab in the country, so far as I know, that has the capability of creating virtual systems with very, very large numbers of virtual machines - in the thousands. The research that we do looks at how we can use the virtualization technology to do distributed computing," Fortes says. More than $7 million in equipment grants from IBM and the National Science Foundation helped create the ACIS laboratory. ACIS has also received over $5 million in research awards in its two-year history.

In addition to distributed computing, ACIS research explores systems for distributed information processing and for biologically-inspired computing in the context of nanotechnology, or nanocomputing.

Fortes explains that distributed computing essentially covers everything to do with linking computers on networks such as the Internet to collaborate on information processing tasks. Together, the computers can solve problems of far greater complexity.

The distributed computing project ACIS has developed is called In-VIGO. It enables scientists, particularly in engineering and in physics, to link resources around the world, providing them with the ability to run simulations and to use computational tools to study new materials, devices, computers, and models of all kinds.

Fortes says that the In-VIGO project has resulted in one particularly important web-based application called nanoHUB, which focuses on enabling web-based usage of computational tools to investigate nanoelectronics technology. The Nanotechnology Simulation Hub (nanoHUB) is supported and sponsored by the multi-university NSF center, Network for Computational Nanoelectronics (nCn), which is led by Purdue University. The nCn center asked ACIS to provide the software necessary for the computational part of the center.

"The nCn center does studies in physics and materials, and in mathematics needed to do modeling. One relatively small component, relative to the size of the center, is determining how all the scientists can be provided with computational services and capabilities. They trust us to do that," Fortes says.

The work in distributed computing led ACIS naturally into a very large distributed information processing project called Transnational Digital Government. This project mostly handles information, databases, text, and images – bits of information rather than numbers.

Fortes describes the project as one of their most challenging.

Transnational Digital Government involves researchers from seven universities: UF, Carnegie Mellon, U. of Colorado, U. of Massachusetts, NC State, one university in the Dominican Republic and one in Belize. It also involves the Organization of American States, which coordinates the political aspects of the project. The goal is to create a framework to enable different national governments to work together to solve a problem affecting all the countries.

Eminent Scholar José Fortes, Assistant Professor Renato Figueiredo, and ACIS lab System Administrator Bill Noffsinger

The project is currently studying the problem of monitoring the impact of illicit drugs on society. Typically, problems like illicit drugs know no boundaries. It's a challenge for governments to get a handle on them. The first step to solving the problems is monitoring how bad the situation is. Governments have to officially collect data, do surveys, and satisfy international agreements; then they need to share that data, exchange views, and coordinate actions to eliminate or minimize the problem, Fortes says.

Coordinating the information is complicated because the people doing it use different languages and may be unfamiliar with computer equipment. They may not know how to type, so they try to talk to the computer or terminal. They often have very different communications infrastructures. In the US, the Internet is almost everywhere. In other countries, they barely have dial up lines. It's up to the research team to make everything work together.

The bottom line is that each person on the team has a specific focus: Fortes and Distinguished Professor Stanley Su at UF are working to create a computing infrastructure that government agencies can use to generate, gather, and analyze data. This work benefits greatly from the ACIS lab expertise on distributed computing.

The connection to nanocomputing is more serendipitous. "Our distributed computing work entails designing, developing, and implementing software to make different computers work together. Some of the people who use our software are working in nanotechnology, and other collaborators work on biologically-inspired signal processing. Because of our collaboration with them, we are in a good position to put together nanotechnology, bio-inspired computation, and computer architecture," Fortes says.

A brain uses intervals of time to do computation, Fortes explains. If all the electrical pulses that go around a brain are monitored, it doesn't really matter whether the pulses are sharp or wide, tall or short. What matters is when they occur, relative to each other or in relation to a fixed point in time. Most likely, Fortes says, both are relevant.

Fortes' collaborators include UF professors José Principe, John Harris, and William Eisenstadt who are specialists in biomedical signal processing, analog circuits, and hardware interconnect modeling, respectively. "We are investigating how such a use of time could be made for computing, and whether or not that is something that could be used in future nanoelectronic technology. If we can understand how that happens in the brain, which works in an analog manner, perhaps we can make it work in a digital world," Fortes says.

Fortes is not trying to duplicate what a brain does. "A good analogy is flying. When people build planes, they are not replicating the bird, but they are using inspiration from their understanding of how a bird flies to build an airplane.

"It appears that time is a fundamental aspect of computation. It is not well understood how time is used. It is not clear how we can make it into an engine, but if we succeed, it could become very important in the future," Fortes says.

Martha Dobson

Radiofrequency electronic research at UF is helping create

WIRELESS CONNECTIONS – (VERY) NEAR AND FAR

Transmitting from Your Local Microdot

Tiny, high-frequency radios are happening in Florida

Ken O says he is looking for the "holy grail."

His goal is not a legendary artifact. O and his research team are aiming for something really amazing - a cheap, micro-size single chip radio that can broadcast at 100 Gigahertz up to 25 feet on several frequencies. O, an electrical engineering professor, works in radiofrequency (RF) electronics, which are used in the integrated circuits that make wireless devices like cell phones and PDAs possible. In the future, O believes, almost everything will have a wireless communication function. Machines will be talking to machines.

A wireless signal will even start your coffee brewing.

The current holy grail version under development is a single-chip radio that will be about 3 mm by 3 mm in size. The chip called mnode will include the antenna, the transmitter, the clock that times it, and the power source. It will be disposable. It will communicate up to about 5 meters away.

Professor Kenneth O

The single-chip radio project is being sponsored by DARPA and carried out in cooperation with Motorola Labs, in Plantation, Fla. This program is being managed by Industry Professor Joe E. Brewer who is a member of O's research group in the Electrical & Computer Engineering (ECE) department. It is the next generation of the single chip wireless system O and his team created three years ago. That system featured the first antenna ever integrated onto a silicon chip, which the team developed for the Semiconductor Research Corporation. The system was for communication within an integrated circuit. The signal went a distance of 22 mm, to a receiver also placed on the chip. Antennas are already on circuit boards, especially in wireless local area network (LAN) cards. O and his team took it one step beyond by placing the antenna on the chip itself.

O and his team started working on the new generation of faster, better, cheaper RF electronics about 10 years ago. RF was considered a "mature" technology back then, O says, using small but separate components in radios, pagers, and similar devices. Around 1994, the devices began to be built with integrated circuits, which reduced the number of components and drove prices down.

O, who had then just arrived at UF, began looking at CMOS technology to build RF integrated circuits. CMOS (complementary metal oxide silicon) technology is commonly used now to build microprocessors and memory chips.

Next will be the disposable radio, O hopes. Two additional factors must come into play to accomplish this. First, the radio needs a power source. Right now, an external power connection is the likely solution. In the near future, however, the radio may be powered by a thin film battery integrated into the chip. Batteries like this are being researched at other institutions.

Second, the crystal timing device has to be integrated into the chip. Motorola Labs is working on this as a subcontractor on the three-year, $3.5 million project from DARPA.

A separate, but highly relevant, area of research for the RF team is multi-standard, multi-frequency band radio. O points out that radio applications use different frequency bands, standards, and protocols around the world. Future devices need to be able to communicate to any kind of radio.

The disposable radios will need to function at low voltage, so this area is also being studied by the RF team. As the devices get smaller and faster, the power supply voltage will also decrease. The team is working on power circuits of .1 to .3 volts, far lower than the 3 volts used by cell phones.

The antennas on chips will also be used in another area, RF ID tags. Simply, the tags will serve to replace bar codes and have broad applications for security purposes. The tags can carry far more information than a bar code and can be embedded invisibly into a product. ECE Associate Professor Jenshan Lin is leading the effort to develop tags that are as small as 2 x 2 mm.

ECE is also building programs on testing RF integrated circuits. The cost of RF testing is becoming a significant part of overall integrated circuit costs, and reducing the cost of testing is a key. This activity is spearheaded by ECE associate professors William Eisenstadt and Robert Fox.

RF CMOS has found a strong place in industry, O says, and he believes that ECE has done a lot to make industry comfortable with the technology. He cites work by his graduate students who are now working with companies on products that use CMOS, including Texas Instruments, RF Micro Devices, and Intersil.

The ECE connection with Intersil (now part of Conexant) is unique, and O points to it as an example of the benefit UF research can have in Florida's communication industry. Intersil, a Palm Bay spinoff of Harris, dominates the wireless LAN market. Intersil sponsored a PhD student whose mission was to do their RF CMOS research work as the basis for his dissertation. O reports the collaboration was highly successful, and was an important factor in the company switching its manufacturing of newer generations of radios to CMOS technology.

O hopes the RF radio project with Motorola Labs will be equally productive. It's an incredible interaction between the university and industry, he says, to bring together these kinds of creative ideas.

Martha Dobson

Associate Professor Yuguang Fang

Solitary cell phone users may find that there is **Strength in Numbers**

Wireless devices – cell phones, PDAs, and the like – seem to be ubiquitous these days. But gaps in the infrastructure and competing technologies mean that wireless communications aren't as effective as they might be. Electrical engineer Yuguang (Michael) Fang is researching ways to boost and enhance wireless services.

Fang, an associate professor in Electrical & Computer Engineering, has received the prestigious National Science Foundation CAREER Award to work on intelligent resource management and integrated services for wireless mobile networks.

The problem, Fang says, is that all the different wireless technologies overlap, but don't work together in harmony. The differences in the technologies create bottlenecks in providing seamless wireless services to users on the move. Intelligent resource management in the wireless mobile networks has become a critical issue. Fang and his students are developing intelligent resource allocation schemes by taking user mobility information and resource availability into consideration so that the best services can be provided.

One solution, he says, is to gang up cell phones and other devices so they work together. In a wireless network, multiple communications devices in close proximity form a natural distributed antenna array. If nearby devices transmit and receive signals in a cooperative manner, then the system performance can be significantly improved.

The key is knowing where the devices are relative to each other. Like all devices that transmit radiowaves, mobile phones can be tracked. If a group of mobile phone users can be shown to move around in a predictable manner near a base station, the network signals coming through the base station can be allocated among the group members to overcome weak areas.

The ability to boost signals would be important in military situations like Iraq, where there is no infrastructure and a hostile environment, Fang says. Fang has received a highly competitive Young Investigator Award from the Office of Naval Research to develop a framework for network protocols for tactical military applications. The goal is to develop a device and energy

aware routing protocol (DEAR) that would take advantage of heterogeneous networked devices with different capabilites and design a secure protocol for reliable data delivery (SPREAD). The solution is to create a wireless ad hoc network that can send messages the enemy cannot intercept. Security could be achieved by transmitting message segments (or shares) of the entire message over multiple routes. Spreading the transmissions over many devices would also optimize battery power usage.

To date, the NSF, ONR, and other funding agencies have invested more than $2 million in Fang's research, which may ultimately result in a more efficient all-access wireless system. Development of the technology to do this might have been further along, Fang says, had it not been slowed down because of the telecommunications downturn. Fang hopes that some of the surviving companies will push the technologies further. Meanwhile, Fang and his colleagues, ECE assistant professors John Shea and Tan Wong, and over 25 graduate students will work together to close the gaps.

Martha Dobson

Nanotubes – the New Shape of Electronics

Assistant Professor Ant Ural

Carbon nanotubes are the newest trend in electronics research. They are the special interest of Electrical & Computer Engineering's newest assistant professor, Ant Ural. Ural joined the faculty in November 2003 and will do research into nanomaterials integration with ECE's Device and Physical Electronics laboratory.

Ural began exploring the use of nanotubes while doing postdoctoral work at Stanford University. His specific interest is in developing organized nanotube architectures for molecular-level electronics.

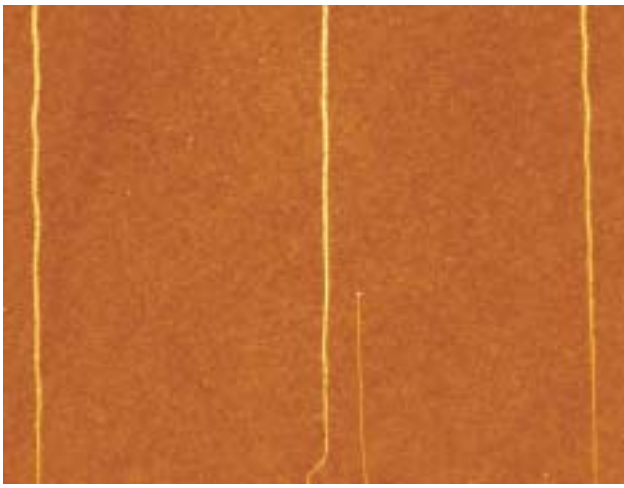
Ural explains that electronic chips and integrated circuits have constantly been shrinking for years, but as is well known, they are reaching the physical limitations of size and cost. A new research thrust is investigating how electronics can be built from the bottom up, using nanomaterials with suitable electronic characteristics.

Carbon nanotubes have demonstrated excellent electronic characteristics in experiments. However, the way nanotubes are created does not make them automatically suitable for electronics. Nanotubes are typically grown in a bundle. The resulting tubes are not identical, but can have different diameters and structure. This matters because the way nanotubes conduct electricity depends on their structure. To be useful in electronic circuitry, nanotubes need to be uniform and directional.

Ural's research is on the directional growth of single-walled carbon nanotubes built on a silicon substrate. He creates the nanotubes by flowing gases such as methane or ethylene at high temperatures – 900 degrees C – over the substrate which is covered with nucleation sites, made from transition metals, which are iron, nickel, or similar materials. The nanotubes grow from the nucleation sites, which serve as anchors for the tubes.

Directional growth is obtained by adding an electric field during the growth phase. The tubes can be persuaded to grow in one direction, following and aligning with the electric field. Nanotubes are sensitive to mechanical deformation, Ural says. Mechanical deformations affect their electronic characteristics. Ural believes the use of nanotubes in electronics will likely complement silicon technology in roles such as sensors.

Martha Dobson



Atomic force microscopy image of 10-microns-long single-walled carbon nanotubes (yellow color) on oxide aligned by an electric field applied in situ during chemical vapor deposition growth.

AIRBORNE LASERS AIM AT UNDERWATER DANGERS

Airborne mapping may soon probe new depths thanks to an advanced laser system based on single photon technology. UF civil engineers are developing a new, unique Coastal Area Tactical-mapping System (CATS) in cooperation with the Navy, Dynetics, Inc. and Optech International to map land and underwater surfaces in coastal surf zones.

CATS will be a new generation airborne laser scanning system able to penetrate water in surf zone, which could make it invaluable to Marine expeditionary forces needing to detect mines for a planned landing. Based on an initiative sponsored by Congressman Cliff Stern and Senator Bill Nelson, the US Congress has provided $2 million for the first year of the program.

The goal is to make an expendable, small, low-powered laser scanning system that could be deployed on an unmanned aerial vehicle over a coastal landing zone, says Professor Ramesh Shrestha, a researcher in geosensing systems engineering, who is leading the team.

The laser pulses should be able to penetrate the surf zone about 10 or 15 feet deep, which is where most mines are placed during low tides. This would enable the Navy to know precisely what would be waiting in a landing zone so they could remove the mines before the Marines land. CATS could also detect small land mines, provided they are not buried.

Airborne laser swath mapping (ALSM) is accomplished with an aircraft-based laser firing tens of thousands of pulses of light every second at the ground. A sensor in the aircraft detects the pulses

Professor Ramesh Shrestha

bounced back from the topography. The round-trip travel time of each pulse translates into a precise range which, when combined with aircraft position determined by GPS and the orientation by Inertial Measuring Unit (IMU), provides three-dimensional coordinates of ground points. Post-processing of the measurements produces high quality, three-dimensional, digital topographical maps.

The CATS system is the next step in laser scanning which will be able to penetrate shallow water because of the 0.53-micrometer wavelength of the light derived from the frequency doubled NdYAG micro laser. This advanced technology will enable CATS to operate with much less power and fit into a small space such as in a unmanned aerial vechicle.

"Our current ALSM system uses return signals of thousands of photons per pulse which requires a lot of power," Shrestha says. "Thousands of photons are needed because the current sensor is not sensitive enough to detect single photons. The single photon system, in theory, will be able to detect every single photon fired that comes back. The ability to detect a single photon is what makes the equipment very small," Shrestha says.

Among academic institutions UF has led the way in ALSM research for past six years. Most notably, it was the only university invited by the Department of Defense Joint Precision Strike Demonstration (JPSD) Group to participate in mapping the World Trade Center site after the Sept. 11, 2001 attack.

UF has operated its own airborne laser mapping system, jointly owned with Florida International University, for about five years. The system has been used in more than 50 projects to support local, state, federal agencies, and private companies. The success of the program has led the National Science Foundation (NSF) to fund a new Center for Airborne Laser Mapping (NCALM) to be operated jointly by UF and the University of California, Berkeley.

NCALM – The Potential is International

NCALM is intended to provide research-grade data collected by airborne laser swath mapping to scientists doing NSF-funded studies of land forms, hydrology, erosion, land slides, sinkholes, and beach storm damage, Shrestha stated when the center was announced in the summer of 2003.

"NSF is supporting the facility so that scientists on projects will not have to purchase or hire their own equipment for gathering data. The effect is to spread support for geoscience research over many projects on a nationwide basis," Shrestha says.

UF's Civil & Coastal Engineering department and UC-Berkeley's Earth & Planetary Sciences department will manage the center. Initial funding is $1.2 million for a two-year period. Co-investigators on the project are Bill Carter, adjunct professor at UF, and Professor Bill Dietrich at Berkeley.

NCALM has gone right to work, providing data on several active fault lines in the Mojave Desert.

Shrestha says half a dozen or more researchers have already applied to the NSF for NCALM support. "We would like to have 20 universities involved annually. The potential contribution to research is really international," he says, mentioning that he has had inquiries from researchers in more than one European country already.

Shrestha hopes that NSF will fund a laser mapping system identical to the one at UF for permanent use on the US west coast because there is so much geologic activity there. For now, NCALM's only laser mapping system is based in Florida.

Florida Benefits, Too

The benefits of airborne laser swath mapping began in Florida, with a study of beach erosion from Hurricane Opal for the Florida Department of Environmental Protection (FDEP) and mapping of a section of the Interstate I-10 corridor for the Florida Department of Transportation (FDOT), and continue to come back to the state. The FDEP is currently funding a five-year research program to map all of the state's beaches. The work is being done in phases, beginning this year with a stretch of northeast Florida Atlantic coast beach extending 105 miles south from the Florida/Georgia state line. In 2004, the target will be the entire Panhandle coast.

Ideally, Shrestha says, Florida's entire coastline should be mapped every year, and the researchers have proposed this. Even better, he says, would be to map the beaches seasonally because changes occur that often. "The state economy relies heavily on beaches. The entire coast could be mapped for less than a million dollars a year," Shrestha says.

The impact of UF's laser mapping research is remarkable, especially considering the team has only three faculty members, plus a postdoc and one PhD student. But the level of expertise is unique.

Bill Carter came to UF after 20 years with NOAA, and 34 years ago he was a member of a team that used laser ranging to measure the distance from an observatory on earth to retro-reflectors placed on the moon by Apollo 11 astronauts. Later he led the construction of a second-generation observatory in Hawaii to range to five reflector packages put on the moon by US and Russian lunar missions.

Clint Slatton, a new joint faculty member of Civil & Coastal Engineering and Electrical & Computer Engineering, is an imaging specialist who combines adaptive signal processing and pattern recognition methods with laser swath mapping and the new photon-counting system.

Mark Lee is a postdoc who recently completed his PhD at UF, whose dissertation dealt with combining airborne laser bathymetry and hyperspectral imaging for benthic mapping of shallow coastal water.

Michael Sartori is a research associate and professional surveyor and mapper who has more than five years of hands-on experience in planning, collecting, processing, and analyzing ALSM observations.

Recruiting is under way for another faculty member who will be joint-appointed with UF's Geological Sciences department in fall 2004.

Martha Dobson

Agricultural & Biological Engineering

C. Direlle Baird, professor emeritus, received a 2003 Special Recognition Award from the American Society of Agricultural Engineers. As former chair of ABE, Baird helped develop a new packaging science degree, a biological engineering option, and minors in precision agriculture and information technology.

Rush Choate, professor emeritus, received a 2003 Lifetime Service Award from the American Society of Agricultural Engineers for his service and contributions to the agricultural engineering profession. Choate contributed to the groundbreaking of Frazier Rogers Hall in 1954, personally recruited agricultural engineering students at high schools and community colleges, and served as acting chair of ABE three times.

Byron French, associate professor, received the 2003 North American Colleges and Teachers of Agriculture John Deere Award for Teaching Excellence.

Jim Jones, distinguished professor, was named a "Highly Cited Researcher" by Thomson ISI® (founded as the Institute for Scientific Information®). Jones demonstrated great influence in his field as measured by citations to his work. Jones was also selected to receive a 2003 Distinguished Engineering Alumni award by Mississippi State University.

Jasmeet Judge, assistant professor and associate director of the Center for Remote Sensing, received a $400,000 research grant from the National Science Foundation geosciences directorate. The grant will support investigations on how remotely sensed observations can be used to improve model prediction of soil moisture and groundwater recharge.

Carol Lehtola, associate professor, received a North American Colleges and Teachers of Agriculture Teaching Award of Merit and a USDA Secretary's Honor Award in 2003. The USDA award is for Lehtola's role in developing the national Extension Disaster Education Network (EDEN).

Allen Overman, professor, was recognized for Outstanding Service by the American Society of Agricultural Engineers. He has shown dedication, not only to the Florida state section, but also as professor and major adviser for ABE.

Glen Smerage, associate professor, was recognized by the American Society of Agricultural Engineers for 25 years of service.

Biomedical Engineering

William Ditto, professor and chair, was named a Fellow of the American Physical Society.

Chemical Engineering

Timothy J. Anderson, associate dean for Research and Graduate Programs and professor, received the 2003 ASEE Annual Conference & Exposition Best Paper Award for a paper he coauthored titled "Demographic Factors and Academic Performance: How Do Chemical Engineering Students Compare with Others?"

Fan Ren, professor, and John C. Zolper, Defense Advanced Research Projects Agency, published a new book, *Wide Energy Bandgap Electronic Devices*, World Scientific. The book provides a summary of the current state-of-the-art in SiC and GaN and identifies future areas of development.

Civil & Coastal Engineering

Robert J. Thieke, assistant professor, received the ExCEEd (Excellence in Engineering Education) Career Award for Excellence in Teaching from the American Society of Civil Engineers.

Electrical & Computer Engineering

James Fitzgerald, assistant chair and associate in engineering, retired in August 2003 after 23 years of distinguished service. Martin A. Uman, distinguished professor and director of the International Center for Lightning Research and Testing, presented Fitzgerald with an engraved clock as a token of thanks and appreciation for his leadership, commitment, and concern for the overall welfare of the department. Fitzgerald, now an emeritus faculty member, began working for the university in 1970 and joined the ECE department in 1980.

Vladimir A. Rakov, professor and co-director of the International Center for Lightning Research and Testing, was named a Fellow of the Council of the American Meteorological Society "for outstanding contributions to the atmospheric or related oceanic or hydrologic sciences, or their applications, during a substantial period of years." He also was named a Fellow of the Institute of Electrical and Electronics Engineers and was appointed a member of the National Fire Protection Association Committee on the Standard for the Installation of Lightning Protection Systems (NFPA 780). Rakov gave an invited lecture on "A Review of Ten Years of Triggered-Lightning Experiments at Camp Blanding, Florida" at the International Conference on Nonlinear Phenomena in Environmental Research, Nizhny Novgorod-Moscow, Russia, Sept. 6-12. He also served on the program committee for this conference. Rakov was invited to join the Underwriters Laboratories Standards Technical Panel (STP) for Surge Protective Devices. This panel covers the Standard for Transient Voltage Surge Suppressors (UL 1449), which will become a national standard when approved by the American National Standards Institute (ANSI).

Vladimir A. Rakov and **Martin A. Uman**, professors and co-directors of the International Center for Lightning Research and Testing, published a new book, *Lightning: Physics and Effects*, Cambridge University Press, 2003. The book is the first monograph that covers essentially all aspects of lightning, including lightning physics, lightning protection, and the interaction of lightning with a variety of objects and systems as well as with the environment.

Environmental Engineering Sciences

Gabriel Bitton, professor, was awarded the title of Docteur Honoris Causa (honorary doctorate) by the National Polytechnic Institute of Lorraine, France and by the French Foreign Affairs Ministry. The ceremony was held Nov. 24 in Nancy, France.

Joseph J. Delfino, professor, presented a paper titled "Pollution of Waters and Sediments by Organic Contaminants in Sub-Tropical Florida, U.S.A. Watersheds" to the 13th Stockholm, Sweden Water Symposium, August 11-14, 2003. The symposium, part of the annual Stockholm Water Week, was on drainage basin security, balancing production, trade, and water use.

Industrial & Systems Engineering

Elif Akcali, assistant professor, received the 2004 M. Eugene Merchant Outstanding Young Manufacturing Engineer Award in Dec. 2003. This award recognizes her significant achievements and leadership in the field of manufacturing engineering as a young engineer.

Panos Pardalos, professor and co-director of the Center for Applied Optimization, was an invited plenary speaker at the annual AMASES conference of the Italian National Association for Mathematics Applied to Economics and Finance, in Cagliari, Italy on Sept. 4. His talk was titled "On the structure and dynamics of financial networks." He also gave an invited lecture on "Recent advances and trends in deterministic global optimization" at the Argonne National Laboratory on Sept. 9.

Edwin Romeijn, associate professor, Ravi Ahuja, professor and co-director of the Supply Chain and Logistics Engineering Center, Jim Dempsey (College of Medicine, Radiation Oncology department), and Arvind Kumar, ISE PhD student, were named winners of the 2003 Pierskalla Best Paper Award of the Health Applications Section of INFORMS for their paper "A column generation approach to radiation therapy treatment planning using aperture modulation." The award was presented Oct. 20 at the INFORMS conference in Atlanta.

Mechanical & Aerospace Engineering

Carl Crane, professor, was named a Fellow of the American Society of Mechanical Engineers.

Nicolaie D. Cristescu, graduate research professor, published a new book, *Mechanics of Elastic Composites*, with co-authors Eduard-Marius Craciun, University of Constanta, Romania, and Eugen Soos, Emeritus Institute of Mathematics Romanian Academy, Romania, Chapman & Hall/CRC. The book offers a complete, authoritative presentation of the advanced theory behind elastic composites.

Peter Ifju, associate professor, is the new associate editor for the *Journal of Experimental Mechanics*.

John Schueller, professor and associate chair, was named a Fellow of the Society of Automotive Engineers.

Edward Walsh, professor, presented a paper titled "A Flight Test Engineering Program" at the recent AIAA/ICAS International Air & Space Symposium and Exposition which had the theme The Next 100 Years and celebrated the centennial of flight. The symposium was held in Dayton, Ohio, the home of the Wright Brothers who designed and built the aircraft that performed the world's first sustained, controlled, heavier-than-air powered flight in 1903.

John Ziegert, professor, was named a Fellow of the American Society of Mechanical Engineers.

Nuclear & Radiological Engineering

Alireza Haghighat, professor, chair, and director of the UF Transport Theory Group was named a Fellow of the American Nuclear Society.

Professor W. Emmett Bolch, Jr.

Professor W. Emmett Bolch, Jr., died December 27, 2003, at age 68. Bolch came to the University of Florida in 1966 to join the faculty of Environmental Engineering Sciences, then a new department in the College of Engineering.

Bolch was born in Lenoir, N.C. He studied pre-engineering at Southwest Texas State Teacher's College. He later transferred to the University of Texas at Austin, earning a BS degree in civil engineering in 1959. Upon graduation, he was commissioned as a lieutenant in the U.S. Air Force and served as a sanitary and industrial hygiene engineer at Lackland AFB in San Antonio, Texas.

In 1962, he returned to the University of Texas at Austin to obtain an MS degree in radiological health. He received his PhD degree in health physics in 1967 from the University of California at Berkley under a US Public Health Service Fellowship.

Bolch directed a variety of research programs in radiological health including a 20-year contract with Florida Power Corporation for environmental surveillance of the Crystal River Nuclear Power Plant. He received two departmental and one college Teacher-of-the-Year awards; he was a registered Professional Engineer in the state of Florida; and in 2002 he was named a Fellow of the national Health Physics Society.

Bolch was the father of Professor Wesley E. Bolch of the Nuclear & Radiological Engineering department at the University of Florida. He is also survived by his wife, Sandra; his daughter, Elizabeth; and his mother, Gladys.

HOWARD T. ODUM (1924 – 2002) AWARDED HONORARY DOCTOR OF SCIENCE

The University of Florida awarded the late Dr. Howard T. Odum, graduate research professor emeritus, the honorary degree of Doctor of Science, posthumously, in recognition of his extraordinary career as a leader in the field of environmental sciences. The award was given at the December commencement ceremony.

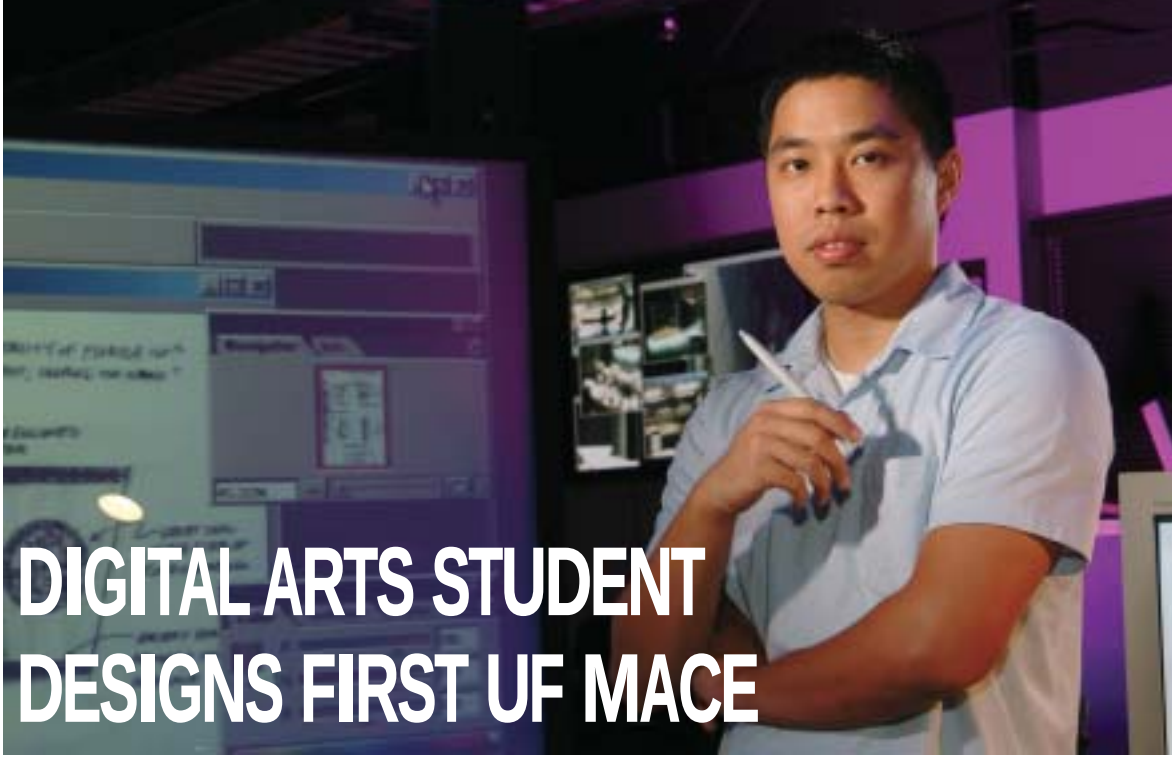
Odum was one of the most creative minds in the fields of ecology, environmental science, systems ecology, environmental policy, and energy studies. The fact that it is so difficult to pin down his field is testimony to his creative genius.

In 1950, Odum came to UF as an assistant professor in biology. After spending four years at UF, in quick succession over the next 11 years, Odum was a faculty member at Duke University, the director of the University of Texas Marine Sciences Center, and chief scientist at the University of Puerto Rico's Nuclear Sciences Center. He returned to UF in 1971 and was appointed graduate research professor in Environmental Engineering Sciences. In 1973, he founded UF's Center for Wetlands and directed the center for nearly two decades. In 1991, he also founded and was director of UF's Center for Environmental Policy.

It was at Florida, during his 31-year tenure, that ideas generated from the study of many systems during his earlier career began to mature into a generalized theory of energy systems and the biosphere. He pioneered research on the recycling of wastewaters in wetlands, developed the concepts of "net energy" of renewable and non-renewable energy sources, and created the field of "emergy" analyses. He also initiated two separate academic fields of study – ecological economics and ecological engineering. Odum published 14 books, 11 of which were written during his tenure at UF.

Odum was awarded numerous honors while at UF, including the 1976 Institute de la Vie Prize, Paris; the 1976 University of Florida Presidential Medal; distinguished service awards from the Universities of North Carolina and Puerto Rico; the Distinguished Service Award from the American Institute of Biological Sciences; an Honorary Doctor of Science degree from The Ohio State University, election to the Royal Swedish Academy of Sciences, and the prestigious Crafoord Prize – the equivalent of the Nobel Prize in ecological sciences – from the Royal Swedish Academy of Sciences.

Mark Brown, associate professor



DIGITAL ARTS STUDENT DESIGNS FIRST UF MACE

The University of Florida unveiled its first official ceremonial mace this December at the closing ceremonies of the UF sesquicentennial. Trung Lac, a 2003 digital arts and sciences (DAS) graduate, designed the mace, which was built as a cross-campus cooperative project.

A competition open to all UF faculty, staff, and students was held to select the mace design. The original thought was that possibly ideas from several entries would be combined into a final design. The selection committee was so pleased with Trung's design that they decided to use it without changes. Trung received a $250 prize for the design.

The mace design motif expresses the concept that UF Gators help shape the world. Trung says he drew inspiration from the brick facades of campus buildings and from the UF gator logo. He also researched UF's history for ideas to apply to the design.

Construction of the mace drew on the talents of many UF departments. Mechanical & Aerospace Engineering used its rapid prototype machine in the Center for Intelligent Machines and Robotics to model some full scale parts of the mace. The machine built the model by depositing ABS plastic one 0.010" thick layer at a time from bottom to top.

The wood staff was constructed in the Art department from a cherry tree homegrown in Gainesville and cut, by necessity, some 15 years ago. The Physics department machine shop created the metal acorn at the bottom as well as the metal rings and center of the staff. The Chemistry department machine shop fabricated the metal cone. The metal is aluminum.

The metal center of the staff has a pattern reminiscent of the bricks used in campus buildings. The rings are incised with the names of all the UF presidents, both permanent and interim. The rings are loose and jingle when the mace is moved. The globe and gator at the top are the plastic of the original prototype, covered with gold and silver leaf.

Trung Lac originally was a mechanical engineering major, but switched to digital arts and sciences, through the Computer & Information Science & Engineering department track. He was a member of the first DAS graduating class.

"I love being creative and I love to draw. I also love the technological aspect of art, too," Trung says.

Trung is Vietnamese. He was born in Malaysia during an enforced layover while his parents were on their way to the US. He lived for a while in San Francisco, then moved to Gainesville. His father works for the university. Trung's brother also graduated from UF, and he hopes to interest his sister in attending UF.

Trung is currently working in retail in Winter Park while hoping to get into the animation industry. He is primarily interested in doing 2D hand-drawn animation.

"My ambition is to become an animation director and bring some of the animation industry to the East Coast. I enjoyed my time at UF," Trung says. "I want to do whatever I can out in the world to make UF proud."

Martha Dobson

Outstanding Achievements Honored at Fall Commencement

The College of Engineering recognized several individuals for exceptional achievement at the fall 2003 Engineering commencement ceremony.

Two engineering students received University of Florida Outstanding Leadership Awards. Bodhi Rader, BS in Digital Arts and Sciences through the Computer & Information Science & Engineering department, earned the Outstanding Male Leader Award for his exceptional leadership and mentoring skills as a member of the Air Force Reserve Officer Training Corps. Marisa Arvesu, BS in Industrial & Systems Engineering, received the Outstanding Female Leader Award for demonstrating outstanding leadership qualities as team leader for numerous class projects and as president of the Institute of Industrial Engineers student chapter.

For academic excellence, the College of Engineering selected Carrie Ross, BS in Materials Science & Engineering, for the Gator Engineering Four-Year Scholar Award. Alisa Marchionno, BS in Environmental Engineering, received the Gator Engineering Two-Year Scholar Award.

In addition to student accomplishments, the University of Florida awarded the late Dr. Howard T. Odum, graduate research professor emeritus in Environmental Engineering Sciences, the honorary degree of Doctor of Science, posthumously, in recognition of his extraordinary career as a leader in the field of environmental sciences. For the full story, see page 20.

Patricia Casey

Bodhi Rader

BS in Digital Arts and Sciences through the Computer & Information Science & Engineering department

Outstanding Male Leader Award

Marisa Arvesu

BS in Industrial & Systems Engineering

Outstanding Female Leader Award

Carrie Ross

BS in Materials Science & Engineering

Gator Engineering Four-Year Scholar Award

Alisa Marchionno

BS in Environmental Engineering

Gator Engineering Two-Year Scholar Award

ECE SENIOR RECEIVES INTEL GRANT

Intel Corp. selected electrical engineering senior Nicole Staszkiewicz this fall to receive a $2,000 grant from the Intel Student Research Contest for Undergraduate Students. The grant will help support her research on gallium nitride based MEMS sensors. She is working on the project as part of the University Scholars Program at UF under the mentorship of electrical engineering professor Mark Law.

Her project is about microelectromechanical systems, or MEMS, which are revolutionizing the parameters of communication between and among integrated circuit chips. MEMS are small electromechanical devices fabricated using thin film and semiconductor processing technologies. MEMS make possible communication between circuits and other components. The devices are smart, allowing the interaction of many systems whether they are chemical, biological, or other forms.

When MEMS microsystems are placed on an integrated circuit, they give eyes and arms to the circuit as well as adding some decision-making capability. MEMS can sense and control the environment by feeling out the surroundings and making decisions based accordingly. A MEMS device placed on a chip has the ability to interplay smartly with other devices and systems, allowing an interdependent control of environment. This intelligent approach to networking is groundbreaking, and Staszkiewicz proposes to research sensors by first modeling a gallium nitride-based device in a computer simulation, and then building a working model.

As a participant in the University Scholars Program for 2003-04, Staszkiewicz will be invited to publish her paper with the Journal of Undergraduate Research and to present at the 2004 University Scholars Symposium at UF. She has been a participant of the University Honors Program and named to the College of Engineering Dean's List. She intends to pursue a master's degree at UF.

Courtesy UF News and Public Affairs

EXXONMOBIL MINORITY OUTREACH PROGRAM CELEBRATES TENTH YEAR

L-R Truman Bell, ExxonMobil Education Program Officer; Dean Khargonekar; Margie Williams, Student Affairs Program Assistant; John Schellenberger, ExxonMobil Security and Controls Manager

Of the 68,000 US students who earn bachelor's degrees in engineering annually, only about 8,000 – 11 percent – are black, Hispanic, or other minorities.

Considering that the minority population is growing far more quickly than that of whites, those figures raise the troubling prospect of a decline in engineering graduates at a time when engineers are crucial to the nation's technology-dependent economy. That could put the US behind other nations with growing technology economies such as China, Korea, and Japan.

Last November, the College of Engineering and ExxonMobil marked the 10th year of a unique collaboration effort that has shown success in addressing the problem. The Gator Engineering Outreach Program - the only such ExxonMobil-university collaboration in the country – brings hundreds of minority and low-income middle and high school students from all over Florida each year to visit and tour the engineering college.

Jonathan Earle, the college's associate dean for student affairs, said the outreach program is aimed at students age 12 to 18 who have ability in science and math, but lack motivation or exposure to careers in technical or scientific fields.

Students have visited from as far away as Miami and as near as Gainesville. For some, the visits are more than just a first look at a university. "For many of these students who visit the campus from inner city schools in particular, the first time they leave their communities is when they come out on these tours to visit this campus," Earle says.

The visits begin with a welcome and a talk on the crucial role of technology in today's society. The students get advice on how and when to prepare if they expect to study engineering or other technical or scientific fields. UF engineering students, some who have backgrounds similar to those of the visitors, also talk about engineering and their experiences at UF. The students next divide up and tour the engineering departments, with each group visiting at least two labs. After lunch, they return to their school.

Although the program is not intended as a recruitment tool, the college's undergraduate minority enrollment has increased significantly since it was started, Earle says. Today, nearly 19 percent, or over 800, of UF's 4,400 engineering undergraduates are minorities, including more than 5.5 percent black and 12.5 percent Hispanic students. That compares to 3.9 percent black and 6.5 percent Hispanic students a decade ago, Earle says. "I think what the program has done for us is provide exposure for youths who might never receive it otherwise," Earle says.

ExxonMobil provides $30,000 annually to cover the costs of the program. "ExxonMobil is proud to partner with the University of Florida to attract the brightest minds to math, science, and engineering," says Truman Bell, education program officer at the ExxonMobil Foundation. "By partnering with the University of Florida, ExxonMobil and the Gator Outreach Program can help prepare a diverse range of students for fulfilling and successful careers, particularly in the field of engineering."

Earle says that more progress is needed at UF and all other universities. Today, he says, Japan graduates over 100,000, India over 150,000, and China over 200,000 engineers annually. To remain competitive on a global scale, the US needs to keep up with these numbers. The scarcity of minority students among US engineering graduates represents a missed opportunity.

"We have this tremendously underdeveloped resource that we have to begin tapping into," he says.

Aaron Hoover

Former UF President Charles E. Young

Intel Donates $2 Million to Engineering College to Honor UF President Young

The Intel Foundation, the philanthropic arm of the California-based microprocessor manufacturing company, made a $2 million gift in December to the University of Florida College of Engineering in honor of retiring UF President Charles E. Young.

The gift will fund a permanent faculty position, the Intel/Charles E. Young University Chair, in the Electrical & Computer Engineering (ECE) department.

"Charles Young has been a member of Intel Corporation's board of directors for over 30 years. To honor our long association, we are proud to establish a chair in his name in Electrical & Computer Engineering," said Craig Barrett, chief executive officer of Intel and chairman of the Intel Foundation board of directors. "Dr. Young has played a key role in Intel's success over the years. We know that this chair established in his name will serve to expand his positive energy and influence by supporting talented ECE faculty at the University of Florida."

Young served as UF's president since 1999 and as a director on Intel Corp.'s board of directors since 1974. He retired from UF on Jan. 5.

Electrical & Computer Engineering, which has a current enrollment of 760 undergraduates and 516 graduate students, is nationally known for its research in solid-state technology and devices, electronics and computer engineering, and the Intel gift will help take that research to the next level, UF officials said.

"Intel's gift is a meaningful tribute to Dr. Young's many contributions and the vision he has provided for Intel and UF," said engineering Dean Pramod Khargonekar. "We are now extremely anxious and optimistic to begin the process of recruiting a world-class scholar to strengthen the ECE department's ongoing research and education programs in computer engineering and semiconductor electronics."

Intel's gift is one of the largest ever received by UF to create a university chair. The gift is eligible for a dollar-for-dollar match through the state of Florida's matching gifts program.

The Stokes Professorship

The late Dr. Charles Anderson "Andy" Stokes and his wife, Constance, established an endowed professorship in Chemical Engineering at the University of Florida to "represent the values of the profession in the broadest context and provide a role model for students embarking upon a career in chemical engineering that will demand responsiveness to societal needs."

Mark Orazem currently holds the Stokes Professorship in Chemical Engineering. A large part of the funding associated with the professorship supported Orazem's sabbatical leave in Paris, France, during which he began writing a textbook on impedance spectroscopy, an important but often poorly understood experimental technique. He is collaborating on the book with Dr. Bernard Tribollet, a scientist working at the Centre National de la Recherche Scientifique in Paris. He is also organizing the 6th international symposium on electrochemical impedance spectroscopy to be held in Florida in May 2004.

"The professorship provided much needed flexible support which enabled key aspects of this activity," Orazem says.

Impedance spectroscopy is an experimental technique in which an oscillating signal is used to elicit the response of an electrochemical system. Analysis of impedance response provides the basis for new generations of sensors used in applications ranging from corrosion detection to measurement of glucose levels in blood. Orazem's research group has used impedance to study delivery of therapeutic agents through skin, corrosion of pipeline-grade steel, and electronic processes in large bandgap semiconductors.
A memorial tribute to Andy Stokes follows on page 26.

DR. CHARLES A. "ANDY" STOKES

In Memory

Dr. Charles Anderson "Andy" Stokes of Naples, Florida, died September 27, 2003 at the age of 87.

Andy Stokes was a native Floridian, born on October 28, 1915, in the hamlet of Mohawk in Lake County, where his family had settled in the 1880s. His parents were Harry K. Stokes, a Lake County commissioner for 28 years, and Laura Chapman Stokes.

Andy grew up in Lake County's backwoods and was educated in the public schools of Clermont. He studied by the light of kerosene lamps and warmed himself in winter by the oak wood fire in the kitchen cook stove and the hearth. He was to grow up to become one of this country's leading experts in energy and fuels.

Andy graduated as class valedictorian from Clermont High School in 1933. He obtained a Bachelor of Science degree Cum Laude in chemical engineering from the University of Florida in 1938. He played trumpet in Duke Bernard's "Troubadours" dance band, waited tables, and worked summers on a Florida Department of Highways survey crew to pay his way through school.

He left Florida for the first time on the day of his graduation to attend the Massachusetts Institute of Technology, where he obtained his Doctor of Science in chemical engineering in 1951. While in Boston he met his wife of 65 years, Constance Wickes Currier of Newport, Rhode Island.

At MIT, Andy served as an instructor and assistant professor from 1940 to 1945. He volunteered as a "dollar-a-year" man in Washington, D.C. as part of the War Production Board effort, and went to work for the Cabot Corporation as Director of Research and Development. He stayed with Cabot until 1955, becoming a leader in the field of carbon black manufacture. He also became vice president and director of Petrocarb, a Cabot subsidiary.

During the Korean War, he helped found Texas Butadiene and Chemical to manufacture top grade aviation fuel synthetically from natural gas liquids for the emerging synthetic rubber industry. He served as vice president and technical director until 1959. In 1960 he became vice president of Columbian Carbon Company, in Princeton, N.J. When this company was acquired by the Cities Service Corporation, he became vice president for technology and planning of the Cities Service Chemical Division. He also served on the board of directors of three Cities Service subsidiary companies.

In 1969, he formed Charles A. Stokes, Sc.D. Inc. and the Stokes Consulting Group to provide expertise to energy companies and the synthetic fuels industry. His expertise came into increasing demand with the first major oil crisis of 1973 and the rising interest in a national energy policy. An early project was the first in-depth study of how to manufacture fuel methanol from eastern bituminous coal, funded by the DuPont de Nemours Company and the U.G.I. Corporation.

The Stokes Group and Charles A. Stokes, Inc. went on to advise such clients as Air Products and Chemicals, Alberta Gas Chemical, Alco Standard Corporation, Amoco, Bayer AG and Mobay Chemical, the California Energy Commission, Davy Power Gas (Kvaerner), the Electrolux Corporation, Fluor Daniels Corporation, International Synthetic Rubber (ANIC), the Israel Institute of Mining and Industry, Methanex Corporation, Monsanto, Nynas Petroleum, the Polymer Corporation, Public Service Marine, Inc., Southern California Gas, the US

Departments of Commerce and Energy, the US International Trade Commission and many others.

During this time Stokes co-founded and developed the World Methanol Survey, still published today under different ownership. He chaired for many years the University of Pittsburgh International Conference on Coal Gasification and Liquefaction, known today as the Pittsburgh Coal Conference. He organized and chaired many technical sessions at the annual World Methanol Conference and was considered to be one of the world's leading experts on methanol manufacture and marketing.

In 1976, Andy moved his business to Naples, Florida, where he practiced full time until November 2001. He maintained a part time practice until August 2003.

In Naples, he focused on alternative and renewable energy technologies, including solar energy and the conversion of biomass and waste to energy. He helped develop a process to produce power and synthesize gas from biomass. He assisted and invested in the development of a Florida solar thermal equipment company. He provided his expertise free of charge to state and county governments, particularly Collier County, to assist with difficult environmental problems relating to the management and disposal of municipal wastes. In October 2003, the Collier County commission recognized Andy for his extensive public service.

Most recently, Andy worked intensively on an international development project with a European client to bring clean fuels and safe appliances to poorer households in underdeveloped countries. He provided free consulting to several national governments seeking to develop energy resources, and addressed the difficult issue of reducing carbon emissions to the atmosphere. He remarked that he was serving people who depended on the same fuels he had as a youth in the backwoods of Florida. He spearheaded an effort to equip Habitat for Humanity homes in Florida with solar water heaters and donated a number of these heaters to Habitat.

Andy wrote many technical articles for journals and encyclopedias. His work appears in basic reference works such as the Encyclopedia Britannica, Kirk-Othmer Encyclopedia of Chemical Technology, Encyclopedia of Chemistry and McGraw Hill publications. He was an inventor with many patents.

Andy was a registered professional engineer in Florida, Massachusetts, and New Jersey. He served on the US Coast Guard Transportation Advisory Committee. He had many affiliations, including the American Chemical Society (Life Member); the American Institute of Chemical Engineers (Fellow); the American Solar Energy Society; the Florida Engineering Society; the Florida Solar Energy Center; the Founders' Club of the Petrochemical Industry; the Industrial Research Institute; the MIT Center for Technology, Policy and Industrial Development; the National Society of Professional Engineers; the University of Florida Chemical Engineering Advisory Committee; and the University of Pittsburgh.

Andy received many awards, including an honorary degree from UF in 1951. He was voted New Jersey Engineer of the Year in 1977 and Florida's Engineer of the Year, Calusa Chapter, for 1984-5. The Florida Engineering Society recognized him for outstanding technical achievement in 1979 and he was named Outstanding Alumnus of the University of Florida Chemical Engineering department for 1990.

Andy and Connie established a scholarship fund in the Center for the Study of Technology and Policy at MIT. They also provided a scholarship fund at the University of Florida and in 1996 established an endowed professorship in chemical engineering which would "represent the values of the profession in the broadest context and provide a role model for students embarking upon a career in chemical engineering that will demand responsiveness to societal needs."

Andy recently donated a conservation easement on the Stokes family land to Lake County to assure that a little bit of "Old Florida" would be preserved.

Andy and Connie lived in many communities, including Cambridge, MA, Pampa, TX, Wellesley Hills, MA, Houston, TX, Greenwich, CT, Princeton, NJ and Naples, FL. Andy is survived by Connie and their three sons, Jeffrey of San Diego, CA, Harry of Gettysburg, PA, and Christopher of Memphis, TN, and five grandchildren. Andy was a devoted father who loved to do things with his family. He camped with his sons and took them canoeing on the wilderness waterways of Florida and the Northeast. Connie taught him to be an accomplished sailor, and he spent many happy days sailing with his family and friends.

Courtesy of the Stokes family Andy Stokes wrote an entertaining reminiscence of his time at UF. It appears on the web at http://www.che.ufl.edu/history/gradrecollections/stokes.html.

Your Gifts That Count

Corporate and private donations are vital to the continued upward progress of the College of Engineering.

The college wishes to express its thanks for the following:

The Lockheed-Martin Student Support Program
$400,000

Lockheed Martin has been very generous with its contributions, says Jonathan Earle, associate dean. Lockheed Martin created an endowment in 1998 for student services programs in the college with a $400,000 commitment, which received $200,000 in state matching funds. Particular emphasis has been on programs and services that attract and retain minority students through the baccalaureate degree.

Currently, in addition to specific support provided to individual student organizations, Lockheed Martin provides college-wide financial sponsorship of scholarships, the STEPUP program, EFTP, Engineering Day, Engineering & Science Fair, and other student support activities.

"We are certainly grateful and appreciative of Lockheed Martin's involvement in our college," Earle says.

Ford Motor Company Fuel Cell Laboratory
$250,000

Ford awarded $250,000 in 1999 to the College of Engineering to support the Ford Fuel Cell Research and Training Laboratory. The funds were used to purchase state-of-the-art equipment and instrumentation as well as other fuel cell related technology which are housed in a new 9,000 square foot facility. The grant also supports graduate fellowships and scholarships for students in the program.

J. Crayton Pruitt Gift to Biomedical Engineering
$2,000,000

St. Petersburg heart surgeon J. Crayton Pruitt donated $2 million in 2000 to the Biomedical Engineering graduate program. The donation provided the core funding to launch Biomedical Engineering as an independent department. A significant portion of the donation has beed used for recruiting faculty: two offers have been tendered to faculty candidates and more offers will be made soon, with hope of achieving a total of five new faculty this year. Some of the gift has also been applied to recruiting students and to planning a new Biomedical Engineering building.

Pruitt is the inventor of an arterial shunt widely used in vascular surgery today. His donation is an expression of his interest in biomedical engineering and of his appreciation for UF College of Medicine surgeons who performed his life-saving heart transplant.

The Thomas O. Hunter Scholarship Fund
$100,000

The Thomas O. Hunter Scholarship was created in 1998. It is open to undergraduate and entering students throughout the college. Emphasis is given to demonstrated leadership, economic need, and academic excellence. Preference is given to graduates of Putnam County, Fla., high schools. Hunter is a native of Interlachen, Fla., which is in Putnam County.

Thomas Hunter is senior vice president of Sandia National Laboratories, Albuquerque, N.M. He graduated from the College of Engineering in 1966 with a B.S. in mechanical engineering. He is a member of the Dean's Advisory Board and received the Distinguished Alumnus Award from the University of Florida in 2001.

The James E. Dykes Scholarship Fund
$100,000

The James E. Dykes Scholarship is open to students in the Electrical & Computer Engineering department. The scholarship was established in 1997 by Jim Dykes and his wife, Yvonne. Dykes earned his B.S. in electrical engineering in 1962. He served as the founding chairman of the college's Engineering Advisory Council. He is a former senior executive of several companies in the semiconductor field, including Intellon in Ocala, Fla.

COLLEGE HONORS GRAND GUARD

The College of Engineering honored its Grand Guard at the 2003 Grand Guard Reunion held Oct. 2-4. This distinguished group of alumni includes all Gators who graduated 50 or more years ago. UF's Alumni Association hosts the weekend festivities each fall. This year, the Grand Guard joined its Alma Mater in celebrating UF's sesquicentennial as the class of 1953 celebrated its 50th anniversary and induction into the Grand Guard.

Some of this year's events included the president's welcome reception and dinner, guest speakers, campus tours, a cocktail reception, dinner, and dancing at the induction ceremony, and the home football game UF vs. the University of Mississippi.

On Friday Oct. 3, the College of Engineering hosted 18 alumni at the Grand Guard reunion luncheon at Emerson Alumni Hall. Dean Pramod Khargonekar presented an overview of the college. Grand Guard members spoke about World War II, their careers, and memories of the college.

Maxwell G. Battle, Sr. BSCE 52
John G. Burrows, Jr. BSIE 53
Frederick R. Crowley BME 53
Roland L. Fraser BEE 50
James A. Henderson, Jr. BIE 51
Raleigh F. Keeter BEE 49
Jeff R. Kirkpatrick BCE 52
Virgil D. Martin BSEE 53
Robert S. Mogyorosy BIE 51
Robert L. Olive BME 50
William F. Roberts BANE 50
Alfred D. Schmidt BME 42
C. Vernon Shaffer BEE 44, MSE 60
Norman Singletary BS 50 (Eng. Science)
Curtis H. Stanton BME 40
Cyrus Q. Stewart, Jr. BSME 49
Yu-Sun "Tom" Tang PhD 52 (Chemical)
James C. Williamson BSCE 53

Patricia Casey

1968

Douglas M. Darden, PE, BSCE, ME, was elected to the board of directors of the Florida Engineering Society. He represents the Ridge Chapter of FES. He was also selected as the 2002 Engineer of the Year by the Ridge Branch. Darden is a licenced professional engineering in Florida, five other states, and Washington, DC. He is the founder and chairman of the board of Envisors, LLC, of Winter Haven. Since 1975, Envisors has provided civil and environmental engineering, surveying, and planning services to public and private clients throughout Florida.

1981

Gordon D. Ziecina, PE, MSCE, joined TEI Engineers & Planners as a senior project manager in the Traffic Engineering department in TEI's Sarasota office. He has worked for more than 24 years in signal system timing, intersection improvement, street lighting, timing plan implementation, and the design and construction of traffic related data collection sites. He has also been involved in numerous computerized traffic signal systems in Florida. He is a member of the Institute of Transportation Engineers.

1982

Rear Admiral Richard E. Cellon, CEC, USN, MSCE, has taken command of the Naval Facilities Engineering Command, Atlantic Division, in Norfolk, VA. Cellon was previously commander of the Naval Facilities Engineering Command, Pacific Division, in Pearl Harbor, HI. Prior to that, he was commanding officer of NAVFAC Southern division in Charleston, SC. Cellon is a 1978 graduate of the U.S. Naval Academy, with master's degrees from UF and the Naval War College. He also attended the Wharton School's Advanced Management Program at the University of Pennsylvania. He is a registered Professional Engineer in California, a member of the Acquisition Professional Community, and a Seabee Combat Warfare Officer.

1996

Amy Y. Lee, MBA, BSME, is manager of New Business Development for a subsidiary of The Carlyle Group. In this role, she is involved in strategy development, business growth, new products, and marketing. Previously, Lee was market analysis manager and product manager for the same company. After graduating from UF, she was a sales engineer with Eaton Corporation. Her industry involvement has included power transmission, HVAC and building systems, and solid state motor controls. Lee earned her Master of Business Administration degree, and is a member of the National Honor Society. She and her husband live in Wisconsin.

1998

John L. Avery, MSAE, BSAE 96, has joined Lockheed Aircraft as a senior structural engineer on the Joint Strike Fighter project. Previously, he was a design engineer with Scaled Composites in Mojave, CA, where he was involved in the design and building of state-of-the-art composite aircraft for both military and private applications. While with Scaled Composites, he designed, built, and successfully test flew his own aircraft, the "Walrus."

2001

Jason K. LaRoche, MS ISE, has left the Intel Corporation in Santa Clara, CA. He has moved to Philadelphia to join the national rowing team training camp to prepare for the 2004 Olympic Games. During his training he is working with AmerisourceBergen.

Friends We Will Miss

1922 **Anson Borden Dewolf**, BSME, of Brooksville, FL, died September 1, 1986
1923 **Lawrence H. Cobb**, BSEE, of Milton, FL, died April 1, 1967
1929 **Robert H. Glass**, BSCE, of Boston, MA, died October 1, 1986
Pettus K. Wilson, BSEE, of Tallahassee, FL, died December 15, 1999
1930 **William R. Clarke**, BCHE, of Cleveland, GA, died January 27, 2003
1931 **William E. Dean, Jr.**, BSCE, of Atlanta, GA, died December 1, 1965
Frederick E. Leggett, BSEE, of Tampa, FL, died June 1, 1977
1932 **Clark P. Douglass**, BSAE, of Tampa, FL, died October 1, 1982
1933 **Gerald W. Hostetler**, BSEE, of Elkhart, IN, died December 15, 1989
1935 **Delmont E. Wood II**, BSME, of East Lake Weir, FL, died November 3, 1998
1937 **James C. Burgoyne**, BSCE, of Atlanta, GA, died August 1, 1981
Charles A. Stokes, BSCHE, of Naples, FL, died September 27, 2003
Linwood A. Walters, Jr., BSCHE, of Miami, FL, died May 8, 1991
Richard E. Warren, BSME, of Jacksonville, FL, died January, 1979
1939 **George B. Ashmore**, BSCE, of Orlando, FL, died October 5, 2003
1941 **A. Darby Jones**, BME, of Tampa, FL, died June 1, 1999
1942 **John W. Carefoot**, BSCHE, of Olympia, WA, died July 1, 1976
Joseph N. Green, BSIE, Lake Placid, FL, died March 20, 1995
1945 **Hans W. Schrader**, BEE, of Gainesville, FL, died August 4, 2003
1947 **Francis R. Claro**, BIE, of Williston Park, NY, died March 28, 2000
Edwin C. Douglas, of Stone Mountain, GA, died November 18, 2000
Albert L. Fox, BME, of Largo, FL, died October 26, 1989
Isaac M. Huddleston, BCE, of West Palm Beach, FL, died August 31, 1989
Kenneth R. Pollock, BCHE, of Fort Myers, FL, died October 11, 2003
Col. Charles W. Putnam, BCHE, of Lakeland, FL, died July 25, 2003
1948 **Frank H. Breen**, BSCE, of Jacksonville, FL, died November 26, 1981
George Breisch, BSME, of Clearwater, FL, died August 15, 1991
John R. Ferguson, BSCE, of Marrero, LA, died June 30, 2003
Theodore H. Malone, BSCE, of Interlachen, FL, died September 16, 2003
Richard K. Penn, BSIE, of Reading, PA, died April 1, 1974
1949 **David F. Bryan** of Edinburg, TX, died March 25, 2002
Earl W. Jeter, BME, of Atlantic Beach, FL, died October 19, 2003
William F. Woodward, Jr., BSAE, of Titusville, FL, died January 10, 2003
1950 **David H. Estevez**, BSIE, of Tampa, FL, died May 1, 1982
Brown L. Whatley, Jr., of Jacksonville, FL, died September 15, 1994
1951 **Emmett L. Cochrane**, MSE, BSIE 1947, of Charlotte, NC, died August 19, 1991
1952 **Marvin S. Friedland**, BSEE, of Melbourne, FL, died August 4, 2003
1954 **Robert M. Baker**, BSIE, of Cumming, GA, died May 10, 2002
Emory J. Barrow, BSEE, of Tampa, FL, died January 14, 1997
1955 **Robert J. Bovard**, BCHE, of Panama City, FL, died March 1, 1986
James L. Bowen, BSEE, of Roanoke, VA, died September 23, 2003
Benjamine J. Garland, BSEAE, of San Leon, TX, died April 2, 1997
Stobo H. Wright, BSEE, of Lexington, MA, died March 15, 2002
1956 **Newton H. Bullard**, MSCHE, BSCHE 1936, of Grand Rapids, MI, died January 1, 1988
1957 **Roy E. Jones**, BCHE, of Atmore, AL, died January 1, 1987
1959 **Henry A. Blyth III**, BME, of Simpsonville, SC, died august 1, 2003
Andre S. Perez, BCE, of Jacksonville, FL, died June 7, 2002
1960 **Clarence W. Parham III**, BCHE, of Irving, TX, died September 3, 2003
Charles S. Phillips, BEE, of Atlanta, GA, died July 1, 2003
1961 **William C. Blasky**, BCHE, of Clermont, FL, died December 5, 2001
Richard C. Harden, PHD EE, MSE 1957, BEE 1956, of Eustis, FL, died January 4, 2001
Gordon W. Harvey, BME, of Houston, TX, died May 22, 2003
Charles R. Jones, BSEE, of Switzerland, FL, died November 11, 1986
1962 **John J. Boswell, Jr.**, BSCE, of Satellite Beach, FL, died April 8, 2000
Bruce S. Dobbs, BSEE, of Tampa, FL, died February 16, 1996
Salvatore A. Villani, BCHE, of Kokomo, IN, died April 22, 2002
1963 **Edward F. Bishop**, BSCE, of Montrose, CO, died February 15, 1999
Louis Lopez, MSE, BME 1961, of Houston, TX, died March 3, 1999
1965 **Norman Halem**, BEE, of Cocoa, FL, died March 23, 1991
James H. Walters, MSE, BSEE 1956, of Gainesville, FL, died April, 1980
Dale W. Washburn, ME, of Los Angeles, CA, died December 3, 1993
Ronald Zimmerman, MSE, BSIE 1964, of Tampa, FL, died January 1, 1976
1966 **Roger A. Capel**, BSCE, of Jacksonville, FL, died September 1, 1983
Stephen D. Moore, BSIE, of West Palm Beach, FL, died October 4, 2003
1967 **William H. Broadway**, BIE, of Winter Park, FL, died March 1, 1985
1968 **Friedrich W. Grothman**, BSEE, of Newport Beach, CA, died September 1, 1992
1969 **Juan C. Haayen, Sr.**, BSEE, of Miami, FL, died August 15, 1989
1970 **William L. Haynes**, BCHE, of Jacksonville, FL, died April, 1980
Robert K. Pence, BSIE, of Gainesville, FL, died December 1, 1976
1971 **Larry L. Foster**, BSEE, of Miami, FL, died April 1, 1980
1975 **Kaied F. Barot**, MSISE, of Wharton, NJ, died May, 1981
1977 **Hugh M. Adams**, MEEE, of Reston, VA, died February 6, 2003
Thomas C. Hall, BSENE, of Chicago, IL, died September 1, 1989
1979 **Danny S. Pao**, PHD EE, MEEE 1974, of Azusa, CA, died September 1, 1982
1982 **Jeffrey M. Walz**, MEEE, of Colorado Springs, CO, died December 18, 2002
1984 **Gary F. Groselle**, BSEE, of Hollywood, FL, died June 2, 2002
Eugene D. Powell, BSEE, of Zephyrhills, FL, died September 9, 2003
1985 **Lee J. Lacroix**, BSEAE, of Gainesville, FL, died October 4, 1988
1996 **Eric F. Wood**, BSAE, of Tucson, AZ, died August 2, 2003

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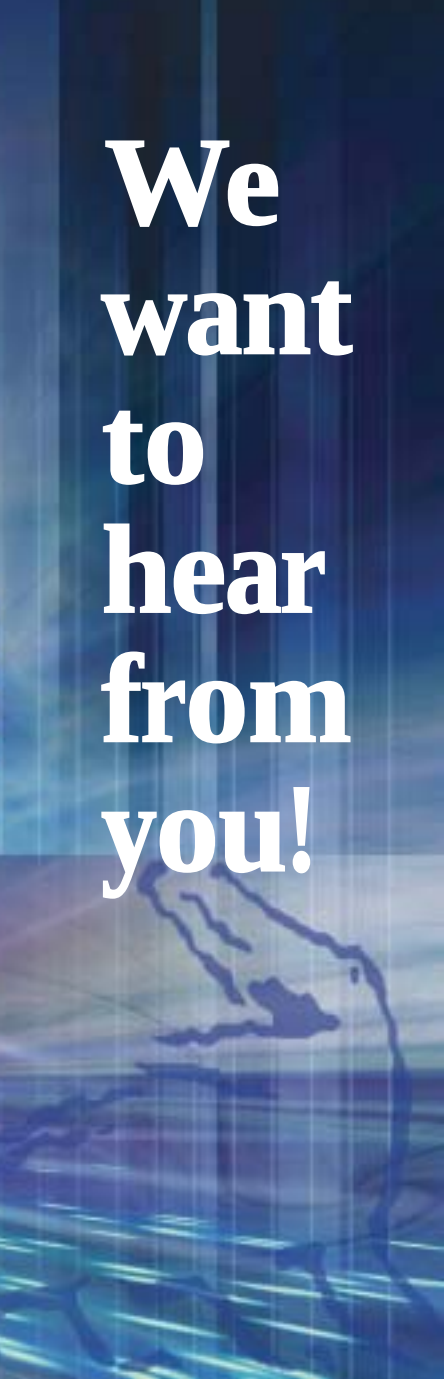

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