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Sensing a Shift: Computer Systems Engineering

Fostering cooperation between dynamic departments at the University of Georgia tied directly to employment and socio-economic progress for the state, new degree programs promise unprecedented avenues to balancing academic strengths with land-grant responsibilities. When approved, the Computer Systems Engineering degrees to be offered by the Faculty of Engineering will represent the latest innovative new programs at UGA.

Traditionally, computer science departments in US colleges and universities are either housed in an engineering school or, as is the case with UGA computer science, part of a college of Arts and Sciences. The difference usually connotes whether instruction is geared more toward designing software or the principles of engineering behind the design of actual hardware. For undergraduate and graduate students, the variation in emphasis often marks the kinds of collaborations the faculty participate in and in turn, the extent to which students can see computer science reach into other disciplines. "Computers in a broad sense have become so pervasive," says UGA computer science department head K.J. Kochut. "From genomics to English, where there are programs looking at works by Shakespeare from a graph theoretic point of view, computing applications continue to evolve alongside the curriculum."

Computer science applications have indeed become integral across the academic spectrum, and CS faculty pursue research in concert with the biological sciences, genomics, bioinformatics, physics, plant sciences, the CCRC and E.I.T.S. as well as engineering. "We try to provide useful tools that other researchers can employ in their work," says Associate Professor of Computer Science Eileen Kraemer, "and to make problems easier to solve." Often this research entails developing new computational methods and techniques to create software systems, perform number crunching and statistical analysis. Other, multi-faceted research involves developing and selecting algorithms for specific problem-solving as well as looking for more novel applications of

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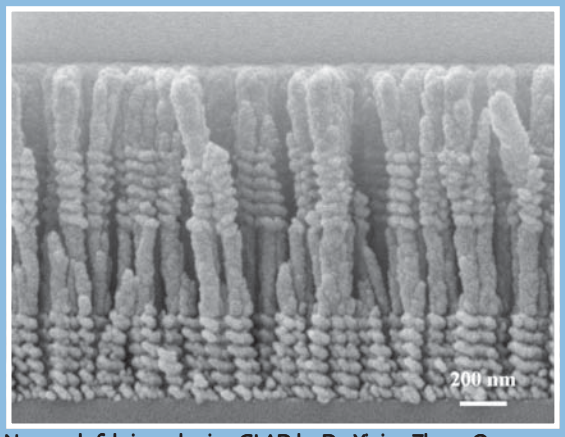
NSF Awards $1Million Grant to Faculty of Engineering Researchers



Nanorods fabricated using GLAD by Dr. Yiping Zhao. One nanometer is about 1/50,000 the diameter of a human hair.

The National Science Foundation has awarded $1million to a team of Faculty of Engineering researchers to study and develop 3-D nanoscale structures to address problems in biosensing. The project seeks to integrate biotechnology and nanotechnology for advancing fundamental knowledge in this nascent frontier, and for deriving useful applications of this knowledge to benefit the public good. Combining the elements of collaborative research and innovative problem solving, the grant epitomizes the stated goals of the Faculty of Engineering to anticipate and take advantage of new avenues in external funding.

The team is made up of Yiping Zhao of UGA Physics, and William Kisaalita and Guigen Zhang, both of Biological & Agricultural Engineering. Their collaboration points up the importance of new, interdisciplinary initiatives at UGA like the Faculty of Engineering and Nanoscale Science and Engineering Center (NanoSEC). The grant award itself is the first byproduct of the decision by the Faculty of Engineering to invest in new laboratory facilities, primarily the Nano-Micro fabrication lab in Driftmier.

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computing that might exhibit themselves in areas like visualization.

In this light, a natural extension of this type of problem-solving is one of the factors empowering the overall concept of comprehensive engineering at UGA. As the program has been conceived, Computer Systems Engineering involves looking at computer software and hardware as an integrated system; further, this integrated system is embedded to perform functions under complex situations, able to adapt to even unexpected circumstances. As the work of many members in the Faculty of Engineering demonstrates, engineering problems take many shapes and sizes, and by their nature demand fluency across disciplines and traditional ranges of expertise. An in-depth understanding of computer hardware and software and the ability to synthesize them and create designs optimizing both is imperative to an array of specific applications that, more and more, overlap traditional disciplines.

"Computer Systems engineering is an area which will integrate many of our strengths in engineering and computer science: embedded systems, control, electronics, communication networks and software design," says engineering professor Takoi Hamrita. The nuance of a working knowledge not limited to any one of these disciplines represents a new mold specific to the modern engineering paradigm of an information age; flexible thinking that straddles a solid knowledge base. That is what comprehensive engineering at UGA is about, an expansive knowledge that triggers ingenuity. "Our students studying this in a liberal arts environment, where they're exposed to so many different potential application areas, can lead them to discover innovative solutions to problems we didn't even know existed," says Hamrita.

And from the standpoint of research, computer science is hand in glove with engineering. Some faculty are involved in the basic research of distributed systems, compilers, databases and programming languages; the new methods and techniques that arise from these endeavors are often used to create software systems. Others are interested in more novel applications of computing in general that exhibit themselves in other areas, such as genomics, which feed back into computer science research because of their specific problems. "In genomics, they'll have tons of data that will need analyzing from various angles," says Kochut, "and that's where computer science expertise finds a lot of opportunities." The development of these new methods and techniques are often the result of collaborations with engineering faculty involved in simulation, modeling, or optimization, which also feed directly back into CS research.

> ...expansive knowledge that triggers ingenuity.

Whether it is database applications from human-computer interfaces or using computer visualization and computer-aided design and manufacturing techniques to augment and improve medical procedures through ex vivo surgical planning, the applications and implications of CSE research at UGA are far reaching. In collaboration with computer science, engineering at UGA is advancing its capabilities to cast an even longer shadow over the new horizons in instruction and research. UGA is limited in fulfilling its mission without comprehensive engineering and computer systems engineering has unique characteristics to assuage this situation. Like the other degree proposals[1], CSE was selected to leverage UGA's existing strengths and provide quantifiable benefits to the state.

And yet, as experience in this process has illustrated, everything comes down to faculty enthusiasm and engagement. With the administration support and faculty commitment which has been demonstrated, these degrees will certainly be approved when they are presented to the Board of Regents. The compelling need in these areas is self-evident. In this, the Computer Systems Engineering curriculum is already self-fulfilling in that it has attracted some of the brightest computer scientists to engineering opportunities at UGA and throughout the state. Computer Science professor and Faculty of Engineering member Suchi Bhandarkar had this to say when the new program was mentioned earlier this year: "One of the things I'll be interested in developing as part of the degree is embedded vision systems, that is, vision systems embedded in the sensor itself. The applications are vast, like building smart cameras that not only take pictures but analyze them. I'll be able to take these vision algorithms and burn them into silicon, so they can be put on a chip, all integrated with a sensing mechanism." So if you're a UGA student or faculty and you're wondering where the cutting edge might be in Computer Systems Engineering, you could well be standing on it.

[1] In addition to BS and MS degrees in Computer Systems Engineering, The University of Georgia President has forwarded proposals for BS and MS degrees in both Environmental Engineering and Biochemical Engineering to the Board of Regents for approval.

New Collaborative Distance Education Facility Comes On Line

In this time of budget cuts and the scaling back of resources to respond to new budget realities, the mission of the University marches on. The obvious questions from faculty and staff revolve around how they will be able to continue to perform with less and serve the increasingly diverse needs of a growing student population. One seemingly minor development in this situation has taken place inside Driftmier Engineering Center which has potentially large implications for the future of doing more with less.

This Fall 2003, two Engineering professors from the UGA campus in Tifton are teaching classes in Athens without ever venturing onto Interstate 75. Faculty of Engineering professor Glen Rains is teaching sensors and transducers and Matt Smith leads a Water Quality class; both classes meet in room 219 of Driftmier. It's a new kind of experience for both teachers and students.

"Video conferencing and collaborative distance education are really the same; it's just having more capability for sharing and controlling resources," says Chi Thai, who has been working on developing this capability in Driftmier for the last two years. Engineering faculty located on UGA campuses in Griffin and Tifton have long been an integral part of the research and outreach programs in Athens. But now the infrastructure is in place to bring their expertise into the classroom for students in Athens.

The idea is that development of such a capability will lead the Faculty of Engineering to the larger opportunities this technology can offer. "The driving force behind this was the unique expertise of our faculty and the geographical distances that prevented us from engaging them as we should or as they wanted to be engaged," says Faculty of Engineering Director Dale Threadgill. "This capability allows us to focus our most valuable resources, which are faculty time and expertise."

Initially, Thai was working on two parallel projects: video conferencing and a collaborative educational facility. The video conferencing project was primarily aimed at facilitating whole departmental meetings for the three campuses simultaneously. The collaborative educational project came from a departmental thrust to merge lecture and practice during class time through closer interactions between teachers and students, as well as between students; the goal was (and still is) to get students more engaged in their learning. After going through two software iterations, the Net Support Manger suite was settled on to

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Dr. Glen Rains, on screen, addressing his ENGR 4230 class from Tifton.

The **Office of the Vice President for Research** and the **University of Georgia Research Foundation** announced the recipients of the Engineering Grants Program for 2003. Six interdisciplinary proposals were selected for funding; congratulations to the teams listed below for recognition of their engineering-related research with an interdisciplinary approach.

Yiping Zhao and William Kisaalita "Exploring the differences in cell behavior of neurogenerative diseases using three-dimensional nano-micro structures" $45,000

Suchendra Bhandarkar and William Tollner "Exploiting computer vision, computer visualization and computer-aided design and manufacturing techniques for ex-vivo surgical planning" $33,000

John Stickney and Uwe Happek "Fabrication of semiconductor thin films by electro-magnetic deposit" $45,000

Joy Doran Peterson and Mark Eiteman "Utilizing grasses in Georgia to produce biofuels and bioproducts through enzymatic hydrolysis" $34,000

The following are projects from the 2002 Engineering Grants program that were selected for a **second year** of funding:

Guigen Zhang, Steve L. Stice and Raj Rao "Endothelial differentiation of primate embryonic stem cells on modified micro-structure substrates" $25,000

W. M. Dennis and C. Momany "Identification of self-assembled arrays in living organisms using Harmonic Generation Microscopy" $10,000

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provide the interactive and collaborative classroom features that were necessary. "Then came the shortage in teaching personnel in Athens," says Thai, "and the obvious solution was to merge the two projects to provide a synchronous collaborative educational facility."

As the basic access and collaboration issues have been resolved, other software has been brought on line, allowing students to save live lecture notes into a personal file, in this case via Camtasia or Silicon Chalk softwares. And ultimately, despite putting professors through their paces to learn how to use these new tools, it is for the students' increased efficiency and accessibility to the material that the tools have been engineered. "They can create their own customized notes and recheck something they might not have understood the first time," says Thai.

"It actually seems pretty natural," says Glen Rains, who is teaching ENGR 4230 from Tifton this fall. "I can see all the students through the camera, they can see me, and using the Windows Journal software I write as I would normally write on the board, except they're looking at a big screen in front of the classroom."

For the Faculty of Engineering at large this opens up an endless stream of possibilities, from guest lectures to multi-campus instruction to novel ways of incorporating new facilities like the Student Learning Center. One of these possibilities will be undertaken in January 2004 by Dr. Thai, who will teach an applied machine vision class to students in Athens as well as students at Kagoshima University, a sister university to UGA in Japan.

$1 Million NSF Award, cont'd from page 1

"The research conducted by the Faculty of Engineering at UGA is important to the state of Georgia," said President Michael F. Adams. "In particular, this award from the NSF demonstrates that our approach to engineering is well-suited for developing new technologies and meeting future needs."

To achieve their objective, the team will expand on their newly developed nanofabrication technique – glancing angle deposition (GLAD) – to fabricate nanoscale 3-D pillars. This development will provide several unique features to suit the needs of biosensing applications. The increasing demand and interest in developing implantable glucose sensors for treating diabetes has led to notable progress in this area and the team plans to refine key issues of long-term calibration and other aging effects on the sensors.

"The fact that the Faculty of Engineering is making it possible for faculty around the campus to collaborate is beginning to yield dividends," says Dr. Kisaalita. "Each of us is bringing a different type of expertise which, taken together, make it possible to advance the in vivo blood glucose sensing technology. We could not do this individually."

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