

## Center Receives \$1.8 Million Federal Grant

Losing a cell phone call or being unable to retrieve data from a wireless device can be a frustrating experience, especially in a world that relies more and more on wireless technology for personal communication and conducting business.



Minden

The explosion of wireless communication devices has created intense competition among radio and television broadcasts and satellite communications systems for space on the radio frequency (RF) spectrum—a medium that allows radio signals and other information to travel from one point to another. Cell phones and personal computers, along with newer technology, are consuming the limited spectrum rapidly.

Finding more available space on the spectrum, using that space more efficiently, and evaluating new wireless technologies are the goals of ITTC researchers who recently won a \$1.8 million National Science

Foundation grant.

The grant will fund the National Radio Networking Research Testbed project, which **Gary Minden** will lead.

“The RF spectrum is a limited resource, and it is not being used efficiently,” said Minden, professor of EECS. “The spectrum has ‘empty pockets’ within it that may provide radio designers with additional resources. But before this can happen, we must find out how the spectrum is currently being used.”

A better understanding of the spectrum will allow radio designers to build new types of radios and develop new services, Minden said. If these services can use spectrum more efficiently and avoid interfering with other radios and other services, many more people and businesses can take advantage of local wireless networks.

“These radios, with a higher data capacity, will allow people to exchange greater amounts of information between computers and other communal resources,” Minden added. ■

## RSL Student Earns Two Prestigious Honors

**Vijaya Chandran Ramasami** recently earned a NASA Earth Systems Science (ESS) Fellowship for his graduate education and research. He is the 16th student affiliated with ITTC’s Radar Systems and Remote Sensing Laboratory (RSL) to receive this fellowship.

“I feel honored to have received this award, and it means a lot to me,” Ramasami said. “I received phenomenal support and guidance from Dr. Gogineni, Dr. Kanagaratnam, and Dr. Braaten that helped me win this award.”

His doctoral research will focus on the development of algorithms to estimate the snow accumulation rate of polar ice sheets. By comparing data taken over several years, scientists can estimate the amount of snow deposition by watching the internal reflecting

layers move downward as more snow is accumulated each year. In other words, if a volcanic layer could be seen 130 m down in the ice four years ago and appears at 133.2 m down this year, then 3.2 m of snow has fallen in the last four years, or an average of 0.8 m per year. The snow accumulation rate is important in predicting the effect of global climate change on polar ice sheets.

Ramasami also earned third place in the International Union of Radio Science student paper contest in June. He presented data collected from field experiments conducted last May. The paper explained an innovative approach to measuring the thickness of sea ice. Sea ice thickness plays an important role in the Arctic and Antarctic climate. ■

As the New Year approaches, I would like to take a moment and thank you for your continued support of ITTC. Our productive and successful year would not have been possible without our sponsors and collaborators.

We are also thankful for the additional 7,125 square feet of space the Center received in Nichols Hall. With this space, we have created a number of facilities to aid ITTC faculty in their research.

Associate Professors **Swapan Chakrabarti** and **John Gauch** can now work in their respective graphics/visualization and video rooms.

ITTC's Polar Radar for Ice Sheet Measurements (PRISM) project, under the direction of **Prasad Gogineni**, Deane E. Ackers distinguished professor of EECS, has added a snow radar characterization and test facility. The Center now also serves as an independent testing facility for Bluetooth devices.

The Center recently opened space for the Cerner Software Engineering Facility, featuring hands-on tools, software applications, and computers. For more information, please see "Cerner Provides Funding, Support for New Facility," page 3.

Space was also allotted for the National Radio Networking Research Testbed, a project funded by the National Science Foundation. The project, led by Professor **Gary Minden**, is featured on page 1 of the newsletter.

Although the number of students working at ITTC has consistently risen, the space allocated for them has not. Unfortunately, this meant many of our 140 students worked in crowded conditions. This new space within Nichols Hall has allowed faculty, staff, and students to be allocated suitable research space.

The additional room has allowed us to pursue important new research opportunities, including bioinformatics. The EECS Department has hired its



Director Victor Frost

first bioinformatics professor, **Xue-Wen Chen**, and ITTC has provided research space to support his bioinformatics research. You can read about Chen's research in microarray data analysis on page 3.

The lengthy reorganization process was successful chiefly because of the planning and hard work of **Paula Conlin**, facilities coordinator. She developed a timeline for when each move would occur, ensuring that no one was left without an office. She also worked with Facilities and Operations to make sure each room was cleaned and painted. We also asked our System Administrators, led by **Michael Hulet** and **Brett Becker**, to pull double duty. They not only had their regular duties, which keep them quite busy, but also provided an invaluable service during the move.

Paula and the system administrators also organized ITTC's part in the first-ever Campus Cleanup. The Provost's office initiated the event, which led to old furniture and equipment being hauled out of Nichols Hall. Paula said she never thought she would see such a cleanup. It would not have happened without her leadership and the hard work of the system administrators. Thank you for all you have done. We really appreciate it!

In addition to helping with the moves, the system administrators expanded the main ITTC file server to meet our growing needs, especially with data from various radar field experiments. The server, responsible for the central storage and management of data files, now has almost 1.7 terabytes of storage space.

Overall, these new resources have enabled ITTC to expand its research activities and have helped our faculty, staff, and students increase their productivity.

Once again, thank you for your support. We hope you have a wonderful holiday season, and we look forward to another exciting year for ITTC. ■

## RSL's Donnis Graham Retires

**Donnis Graham** retired in November from ITTC's Radar Systems and Remote Sensing Laboratory (RSL). She has been with RSL since 1987. During these years, she has managed general office tasks, coordinated lab purchasing and payroll, planned travel, organized international conferences and edited the conference proceedings, edited all published articles and technical reports generated by the lab, and interfaced with many students. She also assisted faculty with editing an international professional newsletter for three years and a conference-related special issue of a geophysics journal.

Donnis says she will miss daily contact with the excellent engineering and scientific work accomplished at RSL and especially will miss the professors and students in the lab and her friends and co-workers at ITTC and KUCR. She greatly values the opportunities she has had to get to know such a variety of talented and friendly people from around the world. ■



Graham

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# Cerner Provides Funding, Support for New Facility

ITTC and the Cerner Corporation have teamed up to create a software engineering facility.

The Kansas City-based company provided funding for the Cerner Software Engineering Facility. It features software applications and tools, and computers, giving students hands-on experience through the entire software development life cycle. The funding has allowed the creation of a software engineering tools course offered by the Department of Electrical Engineering and Computer Science.

**John Hansen**, a director of engineering at Cerner, helped develop the course with **Arvin Agah**, associate professor of EECS. Hansen said students are doing more than writing code in this course. They are learning about requirements, specifications, design, implementation, integration, and deployment of software products. This “big picture” is often missing from computer science courses, as is the opportunity to work with these tools in school.

“Through this course and accompanying hands-on exercises, the students are exposed to the complete software development life cycle,” Hansen said. And according to Hansen, “This is why Cerner is so excited to be a part of this collaboration between industry and academia.”



Associate Professor Arvin Agah answers a student's question before final presentations in his Software Engineering Tools class. This is the first class in the new Cerner Software Engineering Facility.

In addition, Cerner, a leading supplier of healthcare information technology, has provided guest speakers during the fall semester. The more than 30 students who enrolled in the course have heard industry professionals speak on topics from software engineering concepts to tools for software engineering.

ITTC researchers are working toward initiating a research project with Cerner. ■

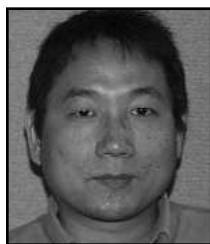
# KU Engineering Hires Its First Bioinformatics Professor

**Xue-wen Chen** has joined the University of Kansas as an assistant professor in EECS with an emphasis in bioinformatics. Bioinformatics is a field of science in which biology, computer science, and information technology are combined into a single discipline.

“This signals our firm intent to organize and build upon our existing expertise, so that we can fully develop bioinformatics at KU,” says David Shulenburg, executive vice chancellor and provost. “Bioinformatics is an essential component of other life sciences research and is also a field with many career opportunities for students.”

Chen brings his work with microarray data analysis to ITTC. Microarrays, more commonly known as gene chips, are devices that contain hundreds of thousands of genes. The chips, which are not much larger than postage stamps, permit researchers to conduct numerous genetic tests simultaneously on one sample. Scientists can then observe the interactions of different cells and the system as a whole.

Chen and other researchers are developing algorithms that analyze genes' expressions or reactions under specific



Chen

conditions. Genes, in effect, have “on/off” switches. Scientists need to understand what activates these switches and how genes affect other molecules in the body.

For example, Chen is working on algorithms that will be used for cancer classification. He is developing software that can help in the early detection of this disease. In the case of breast cancer, cells in the breast tissue divide and grow without the usual controls on cell death and cell division. But Chen hopes doctors will eventually be able to diagnosis breast cancer before its virulent spread, by carefully monitoring the genes associated with this disease.

Another benefit of the microarray data analysis will be the individualized treatment of patients. While patient “A” and patient “B” may both have lung cancer, only patient A will benefit from a certain medicine. Patient B will need another type of drug to effectively treat his or her cancer. This is because the two lung cancers have different origins. If the gene source can be located, patients can receive the proper treatment immediately without having to try a series of drugs to find the ones that fight their specific cancers.

Cancer detection and treatment are just two of the numerous possible benefits from microarray data analysis. Other life science applications such as drug discovery and aging research will also gain from this work. ■

# North Greenland Receives Dependable Internet Access

In preparation for summer field tests in northern Greenland, ITTC researchers developed a remote communication system to provide dependable Internet access in the field. This link allowed researchers to send outreach data such as videos, pictures, status reports, and a daily journal, all of which are posted online at <http://www.kuprism.org/virtualprism/virtualprism.html>.

The prototype system permitted Internet access for the first time at the North Greenland Ice Core Project (NGRIP) field camp. Researchers at the camp could conveniently send drawings to order spare parts for their equipment. They were also able to send video, pictures, reports, and e-mail to their colleagues and other people.

The polar science community has listed the ability to communicate from remote field location as a high priority. ITTC researchers provided a solution by combining four Iridium satellite modems to make communication faster.

Most commercial satellite systems do not have true global coverage. The Iridium satellite system, with 66 low Earth-orbiting satellites, is the only system with true pole-to-pole coverage, but it was designed to provide primarily voice service. The system could not handle scientists' accessing the Internet or downloading software from the field in a timely way.

Under the guidance of **Victor Frost**, Dan F. Servey distinguished professor of EECS and ITTC director, KU graduate student **Abdul Jabbar Mohammad** developed this system for the Polar Radar for Ice Sheet Measurements (PRISM) project.

**Pat Smith**, manager of technology development at the National Science Foundation's Office of Polar Programs, said, "Dr. Frost's group has been the first public group to experiment and successfully field a working prototype [of a system for Internet access in northern latitudes]. I am eagerly watching their



Graduate students John Paden (front) and Abdul Jabbar Mohammad work online. The ITTC communication system allowed Internet access for the first time at the field camp.

progress as they are blazing a trail for what will become an important tool for general Arctic and Antarctic field research support."

This fall the technology was licensed for use in remote communications.

ITTC researchers are developing radar and rovers to measure ice thickness and determine bedrock conditions. These data from the ice sheets will help scientists analyze the status of the polar ice sheets and their possible future impact on sea-level rise.

Ten researchers from KU traveled to NGRIP in July. They collected data to help refine their radar, rover, and communication systems' design. The National Science Foundation/NASA-funded project will combine these individual systems into an integrated unit during the next year. ■

# RSL Researchers Test Radar in Southern Polar Region

**Pannirselvam Kanagaratnam**, research assistant professor, and graduate student **Brandon Heavey** spent a month and a half at sea in the southern polar region. The two conducted field experiments on two radars developed at ITTC.

The first radar, funded by NASA, measured the snow on top of the ice sheets. Scientists must understand the differences between the water accumulating as snow on the world's ice caps, like Antarctica, and the water entering the ocean as melt water or icebergs.

The second radar gathered data on sea-ice thickness, which plays an important role in the polar regions' climate. Sea ice insulates the warm ocean water from the cold polar air; this is vital for the survival of underwater aquatic life in the Arctic

region. The California Institute of Technology sponsored the development of this radar.

The Australian Antarctic Division leased the ship and invited researchers from Australia, Belgium, Germany, New Zealand, and the United States to conduct experiments during the voyage, which lasted from September 11 to October 30.

Now back at ITTC, Kanagaratnam and Heavey are beginning to analyze their data. They continue the innovative work of ITTC's Radar Systems and Remote Sensing Laboratory (RSL). RSL researchers have gained an international reputation for technology they have developed to support the missions of NASA, the U.S. Army, and the Office of Naval Research. ■

# ITTC Hosts National Earthquake Engineering Forum

The popular computer game “SimCity” allows users to create their own metropolises. A player builds his or her city's infrastructure from the ground up, developing roads, power plants, hospitals, airports, and other necessities. Far more sophisticated but still similar computational simulation and visualization technologies are having a tremendous impact on real-life earthquake engineering research.

Using simulation technology, researchers are striving to realistically model the response of man-made infrastructure to a violently shaking earth. With a greater ability to predict the effects of an earthquake, engineers can build structures than can better withstand these natural disasters.

This generational step in earthquake engineering research brought 40 experts to ITTC for a National Science Foundation-funded workshop. **Kim Roddis**, ITTC faculty researcher and KU professor of civil engineering, led the workshop, which addressed how to improve this technology and implement it in earthquake engineering research. Improvements in technology will help

erase geographic distances between researchers. Instead of separate groups each working on a certain problem, researchers will be able to work together using computational tools.

They will also be able to link computational simulations to physical tests already taking place. For example, researchers have developed a machine that can violently shake a part of a large bridge. They can observe the reaction of the part being shaken, but they cannot examine the effect this will have on the rest of the bridge. Computational simulations can tell researchers how each section of a structure will react and interact with others during an earthquake.

The forum was part of the George E. Brown, Jr., Network for Earthquake Engineering Simulation Research (NEES) project. NEES is a major NSF initiative with the goal of greatly increasing the nation's ability to predict the effect of earthquakes on the ground, on structures, and on the ocean. With this purpose in mind, earthquake engineering researchers are developing better computational simulations and visualizations. ■

# NSF Grants Continue Embedded Systems Research

ITTC researchers will continue their development of embedded systems thanks to two new National Science Foundation (NSF) grants. These advanced systems are able to control the operations of larger devices such as airplanes, automobiles, or manufacturing machinery on factory floors.

**Jerry James** and **David Andrews** are conducting research on “sensor webs” with their NSF Information Technology Research (ITR) grant.

Sensors with communication capabilities pass data among themselves to better detect and track objects. They could help detect and track terrorists, military movements, shipments of suspect materials, and other information critical to the nation's defense, said James, principal investigator (PI) on the project and assistant professor of EECS.

With their project, “Computation and Communication in Sensor Webs,” James and Andrews, co-investigator (Co-I), will investigate new architectures for sensor webs. These will require less power while producing better intelligence than current architectures.

Andrews, EECS associate professor, will serve as the PI on a second newly funded NSF project, “Extending the Thread Execution Model for Hybrid CPU/FPGA Architectures.” Andrews, along with **Douglas Niehaus**, Co-I and associate professor of EECS, will develop system software for new hybrid chips that contain both a general-purpose central processing unit and field-programmable gate array (CPU/FPGA). These chips will make it easier for CPUs, which execute the instructions specified in a



Ph.D. student Razali Jidin (standing) and graduate student Mitch Trope examine a Virtex II development board. They are testing hardware/software co-design on it for David Andrews' newly funded NSF project.

computer program, and FPGAs, which are integrated circuits that can be programmed in the field, to interact under a single software model. These new hybrids are integral to the creation of commercial, easily obtainable hardware platforms for future real-time embedded control (RTEC) systems.

The ITTC project will result in faster times to market, reduction of overall costs, and the chips' accessibility to systems programmers. The software will allow programmers with no expertise in hardware development to specify custom components on the FPGA. ■

# Achievements and Acclaim

## Minden Leads DoD Task Force in Wideband Radio

EECS Professor **Gary Minden** chaired the Department of Defense (DoD) Science Board Task Force on Wideband Radio Frequency Systems that recently published its final report. An electronic copy is at [www.acq.osd.mil/dsb/wideband.pdf](http://www.acq.osd.mil/dsb/wideband.pdf).

The group was asked to review and advise the DoD on key aspects of DoD policy and technology issues associated with military applications of wideband radio frequency systems.

The task force began in June of 2002 and completed its service this September. ■

## Alexander Receives Kemper Teaching Fellowship

**Perry Alexander**, associate professor of EECS, received a W.T. Kemper Fellowship for Teaching Excellence in August. The award annually recognizes 20 outstanding teachers and advisers at KU. ■

## DoD Recognizes Becker for his Professionalism

ITTC Network Specialist **Brett Becker** received a letter of recognition and certificate of appreciation from the United States' Department of Defense (DoD). He was commended for his professionalism and help in completing the Communications Management and Control Activity's mission. The DoD group was in Lawrence in July for the dedication ceremony of the Dole Institute of Politics, which was attended by former President Jimmy Carter and other dignitaries. ■

## Searl Presents Bluetooth Work at Conferences

**Leon Searl**, ITTC information specialist, spoke on "Bluetooth Device Interoperability Testing" at the Energy Sciences Network Coordinating Committee (ESCC)/Internet2 Joint Techs Workshop this August in the Kansas Union. He also presented ITTC's work on Bluetooth at the September meeting of the Kansas City chapter of IEEE (Institute of Electrical and Electronics Engineers). ■

# Evans Accepts Appointment as NSF Program Manager

Professor **Joseph Evans** began a two-year term in August as a program director within the National Science Foundation's (NSF) Directorate of Computer and Information Sciences and Engineering.

Evans' program focuses on network systems that include new architectures, technologies, software, and protocols. This technology will be used in backbone, wireless, sensor, and overlay networks. Evans is directing research and educational activities in the networking testbeds program, including multiple organizations' research with wireless networks and security. His responsibilities also include a special projects program, which supports other large, interdisciplinary efforts.

NSF will benefit from Evans' ITTC research experience in the areas of ubiquitous computing environments, active networks, and network



Evans

## Pasik-Duncan Earns Accolades for Work

**Bozenna Pasik-Duncan**, professor of mathematics, has received the 14th Annual Louise Hay Award from the Association of Women in Mathematics (AWM).

The award cited Pasik-Duncan's broad and inspiring vision of mathematics as a discipline and profession.

She also earned an Outstanding Educator Award from the KU branch of the Mortar Board National Honor Society in November. ■



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performance enhancement. His previous work on networking projects includes the MAGIC gigabit networking testbed, the ACTS ATM Internet testbed, and the Rapidly Deployable Radio Network. He has also participated in outreach activities with the KU School of Education to produce K-12 educational resources.

Evans will also take leadership experience to NSF, having served as ITTC's Acting Director from October 1999 to August 2000 and director of ITTC's Networking and Distributed Systems Laboratory for several years.

Evans continues a tradition of ITTC/KU faculty serving federal research agencies to help set the nation's research agenda in computing, communications, and sensors. ■