The Link

NEWS FROM Information and Telecommunication Technology Center

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FCC Chairman Visits Center for Research Briefing

Michael Powell stopped by ITTC for a morning briefing on the Center's research activities on February 20. Professor **Gary Minden** outlined ITTC research involving the radio frequency (RF) spectrum and advanced radio technologies for the Federal Communications Commission (FCC) Chairman.

Along with past successes, Minden also discussed his three-year National Science Foundation (NSF) project, the National Radio Networking Research Testbed (NRNRT). ITTC researchers are seeking new ways to use the spectrum more efficiently and evaluate new wireless technologies.

"Your team's work focuses on some of the most critical issues to the development of the next generation of spectrum-based services, and I commend the outstanding research you are doing to help make these services become a reality," Powell wrote in a follow-up thank-you letter to **Victor Frost**, ITTC director.

Powell was in Kansas to give the keynote address and participate in the Kansas Rural Stakeholder Summit, a forum on broadband technologies. Powell, as chairman of the FCC, oversees everything from licenses for television and radio stations to regulation of the Internet and the telecommunications industry.

"Chairman Powell's visit was especially important because it emphasized that even rural, relatively sparsely populated states are full partners in the communications systems that have so enriched contemporary society," says KU Chancellor Robert Hemenway. "Whether you live in Kansas or California, telecommunications technology is equally important to your future."

FCC Chairman Michael Powell (left) talks with James Roberts, interim vice provost for research, and Victor Frost (right), ITTC director. Powell visited ITTC on February 20.

State Representative **Tom Sloan** (R-Lawrence) was the primary sponsor of the event and invited Powell to the summit.

"Strengthening ties between ITTC, the FCC, Kansas political leaders, and broadband providers is essential to convey the scope of ITTC's research and expand researchers' impact," Sloan said. "Chairman Powell's visit provided ITTC with a key educational opportunity to demonstrate its value as a partner with the FCC and other stakeholders."

Powell said during the Summit that rural areas of the country would benefit from new technologies that allow the Internet to be accessed via land-based radio, satellites, and existing electric lines.

Minden's NRNRT project could help provide the answer to that "last-mile problem," the inability to easily provide rural homes and businesses with high-speed Internet access. Copper wire, which has traditionally provided voice and data service, cannot deliver the necessary data rates. The question, worth billions of dollars, is how to provide bandwidth service to rural America. ■

Powell listens to a description of current ITTC research involving the RF spectrum. A circular array, a specialized antenna developed at ITTC, sits in front of him.

Director's News

In my last column, I wrote about the additional facilities we created with ITTC's space. The extra room in Nichols Hall also allowed us to establish the Computer Systems Design Laboratory (CSDL) and the Bioinformatics and Computational Life-Sciences Laboratory (BCLSL).

Director Victor Frost

CSDL researchers are improving the design of computing systems, ranging from small, embedded elements to large, distributed computing environments. CSDL research addresses all aspects of a system's life cycle and develops and implements platforms for real-time and embedded computing. **Perry Alexander**, associate professor of EECS, will serve as lab director.

CSDL will help create faster, stronger, and more efficient electronics in everything from wireless telephones and personal digital assistants to car engines and climate-control systems.

BCLSL is working on knowledge discovery and the mining and analysis of data from large-scale biological research projects. Information technology is needed to process, analyze, and present huge amounts of biological data in meaningful and efficient ways.

Life-sciences research carried out by BCLSL will contribute to improvements in people's health, longevity, and productivity. Cancer detection and treatment and research on aging are just some of the possible beneficiaries of this research.

To expand our work in bioinformatics, the University has hired **Terry Clark** as an EECS assistant professor. He will continue his research with gene identification and sequencing. Clark, who is currently a research scientist with the Department of Computer Science at the University of Chicago, will join EECS/ITTC this summer. His background in computer science, chemistry, and biology makes him a valuable asset to the Center, and we look forward to Terry's arrival.

Along with the development of new labs, we have altered some of the Center's existing labs. We combined the networking and wireless labs into the Networking and Wireless Systems Laboratory (NWSL). **Gary Minden** will direct the lab, advancing knowledge of radio systems and other technologies. The lab will also improve Internet-based systems.

Susan Gauch, associate professor of EECS, now leads the Intelligent Systems Laboratory (ISL), previously the Intelligent Systems and Information Management Laboratory directed by **Costas Tsatsoulis**, who has become chair of the EECS department. ISL continues to develop artificial intelligence, intelligent agents, information retrieval, data mining, and robotics.

The Lightwave Communication Systems Laboratory is now the Photonics Technology Laboratory (PTL), headed by **Ron Hui**, associate professor of EECS. The name change reflects the broader R&D focus, as photonics is an area of study that includes but is not limited to lightwave communication.

While expanding our research and development, we are also making strides in transferring ITTC-developed knowledge and technology to industry. An ITTC spin-off company, BioComp Systems, Inc., is developing a marketable True 3D (T3D) system. T3D's creator, **Swapan Chakrabarti**, associate professor of EECS, recently received a U.S. patent for the system, which should be on the market next year. T3D allows images to display depth, height, and width and could transform everything from medical imaging to video games. Read more about T3D on page 4.

Hui also received a U.S. patent for an optical spectrum analyzer (OSA) he developed. Hui's OSA is smaller and less expensive than current analyzers. An OSA can help researchers better understand fiber-optic systems, which increase the efficiency of systems. This will provide users extra bandwidth for high-speed video and audio and other multimedia online services.

For more information on OSA, see page 3. ■

Hinman Juggles Various Duties

Robin Hinman recently accepted a newly created position at ITTC, which aims to bring greater efficiency to the entire proposal and research administration process. She serves as the primary administrative liaison between KU/KUCR and ITTC principal investigators on all administrative issues related to research. Robin is responsible for staff and student payroll, accounts payable, purchasing, and tracking of research supplies and equipment. She provides support and oversight for sponsored research conducted in the Center. ■

Robin Hinman

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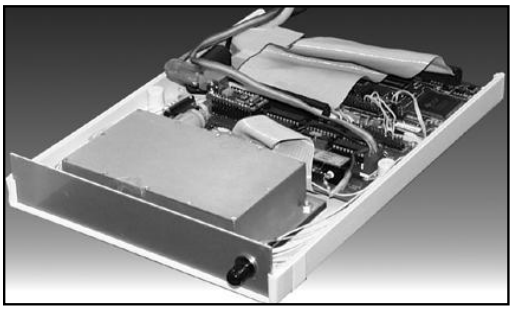
Hui Develops, Patents Optical Spectrum Analyzer

Ron Hui, director of ITTC's Photonics Technology Laboratory, has refined technology that could aid in the improvement of optical bandwidth development. To satisfy the demand for enhanced online services, such as high-quality, high-speed video and audio transmissions, more and more bandwidth is required.

Hui recently received a U.S. patent for his design of an optical spectral analyzer (OSA). An OSA monitors the quality of signals traveling over fiber-optic cables, which helps measure information distortion. Hui's design provides up to 100 times greater resolution than current smaller analyzers. These OSAs provide only low-resolution images, which do not supply the precise signal information needed.

ITTC's OSA will provide a more detailed picture of signals on the fiber. This will help researchers better understand fiber-optic systems and increase the efficiency of systems. The additional bandwidth will cost a fraction of what it would cost to install and maintain new or extra fiber-optic facilities.

Hui built a small, field-deployable OSA with resolution which equals those of larger laboratory analyzers. Smaller OSAs have not been widely used because of their poor resolution, Hui says. Larger, higher-resolution analyzers are used in the laboratory. The cumbersome devices come with a $100,000 price tag. Hui combined these two analyzers, developing a high-resolution analyzer in a compact form that will cost less than $10,000.



Ron Hui developed this optical spectral analyzer, which helps monitor the performance of optical networks. Hui recently received a U.S. patent for the analyzer. He is now working on a marketable prototype.

Fiber-optic cables transmit digitized messages that travel as light signals. Lasers switch on and off to send each signal. A single laser can transmit billions of bits of information per second on fiber-optic cable—far more quickly than the information can be sent on traditional copper wires. But light traveling long distances on fiber-optics can begin to fade because of impurities in the cables.

Fiber-optic cables laid along highways are serviced by regularly spaced amplifiers that reenergize fading signals. While high-resolution analyzers could help evaluate these signals, the current economics and logistics do not make this feasible. Hui is offering a possible cost-effective solution that would allow telecommunication companies to better observe information traveling on their cables. This audit could be completed optically without changing information from optical to electrical and back to optical, as is the status quo. By keeping the information in the same format, the all-optical system would reduce the cost of the communication system.

The ITTC-developed analyzer can also provide greater flexibility in laboratory research. Hui says the OSA can be used in everything from life-sciences research to optical sensors. ■

Haskell Student Joins ITTC's Bioinformatics Research

ITTC is continuing to build bridges between Haskell Indian Nations University and the University of Kansas. **Xue-wen Chen**, associate professor of EECS, has hired Haskell student **Jared Fire** to help him conduct bioinformatics research this spring.

Jared Fire

Fire, from the Cheyenne Arapaho tribe, is part of Haskell's 500 Nations Bridge Program. In part, the Bridge program helps American Indian students who are seeking an undergraduate degree in biomedical sciences, where the aim is to understand the origins of diseases and provide better treatments for them.

Haskell does not offer degrees such as chemistry, biology, or computer science—Fire's desired major. To provide a transition for students seeking degrees in these areas, Haskell sends students to KU to take mandatory classes and gain laboratory experience. The students can then transfer to KU to complete their degrees.

Fire attended a bioinformatics course at Haskell taught by KU professors in the fall of 2002. His success in the bioinformatics course led to his acceptance in the Bridge program and the opportunity to work with Chen.

"I never dreamed I would have the chance to be in such an exciting field of technology," Fire said. "Dr. Chen has been extremely helpful and very attentive."

Fire is conducting microarray research at ITTC. A microarray, commonly known as a gene chip, contains hundreds of thousands of cells on a piece of glass or plastic. Not much larger than postage stamps, the chips permit researchers to conduct numerous genetic tests simultaneously on one sample. Scientists can observe the interactions of different cells and the system as a whole. ■

Software Allows Greater Security in Online Chat Rooms

ITTC researchers hope to help curb inappropriate and deceptive usage on the Internet with software they developed. ChatTrack provides a permanent record of chat room exchanges that can then be reviewed. The software's profile and retrieval mechanisms provide a new safety and security tool for parents, the government, and businesses.

ChatTrack developer **Susan Gauch** and ITTC are now looking to transfer this technology to the marketplace, licensing ChatTrack to private industry.

The technology is not intended to be a "Big Brother" device but aims to protect young people and national security. Chat room providers already archive most information, but they lack sophisticated tools to filter out innocuous messages from those needing investigation, says Gauch.

Within the ChatTrack program, ChatRetrieve flags questionable topics, such as sex, violence, drugs, and/or gangs, for parental review. For example, "Alice" may be in a chat room with 10 different people. During that time, only she and "Charlie" discuss topics that may be inappropriate. While Alice's other nine conversations will not be tagged, the one with Charlie will be.

Chat rooms aimed at children may be subject to increased monitoring compared to those for adults, Gauch says.

For enhanced security and safety, the software also tracks when people join and depart chats. Administrators then know who overheard particular items being discussed.

Chat service providers (such as Yahoo) can use ChatTrack to spot dangerous users, prompting the termination of their accounts. Service providers may directly block offenders, or parents may automatically block instant messenger conversations that discuss inappropriate topics.

The technology also addresses safety and homeland security issues in Internet chat rooms. Through ChatProfile, rooms and participants are monitored for topics of interest, such as bomb making. The government can then gather those chats through the ChatRetrieval program, says ChatTrack Chat Administrator and graduate student **Jason Bengel**.

Bengel, along with graduate students **Eera Mittur**, **Rajan Vijayaraghavan**, and **Solomon Nagelli**, helped develop the software, which can also benefit the corporate world.

Companies need records of chat rooms and/or instant messaging to meet legal requirements. Electronic meetings that take place over several days or weeks also need to be tracked. With the hazards of the Internet and the increasing recognition of the legal need to track communication in corporations, retrieval of chat history is now of great interest.

Gauch says it will be important for companies to be up front about the monitoring they do. Participants within chat rooms must be aware of, and agree to, these monitoring activities.

For more information, log on to http://www.ittc.ku.edu/chattrack/. ■

True 3-D Earns U.S. Patent, Moves Closer to Market

Doctors analyze X-rays, MRIs, and other images for critical information, but the two-dimensional (2-D) representations provide an incomplete picture. The images lose a crucial element, the sense of depth, when they are transformed from three dimensions to formats that define only height and width.

Swapan Chakrabarti, associate professor of EECS, received a U.S. patent for technology that provides the missing puzzle piece. His True 3-D (T3D) system allows everything from medical images to video games to display depth, height, and width; and viewers will not have to wear any special type of glasses or headgear to see the 3-D images.

The actual X-ray or scanning will not change, but the results will be presented in a dramatically different way. ITTC researchers are developing both software and hardware that will give objects a sense of depth. Along with providing the ability to see objects from different viewpoints, this depth will help in the early detection of tumors. T3D visualization can also provide doctors with better information about fractures or other trauma injuries. The clearer the picture a doctor has of an injury or disease, the better equipped she or he will be with treatment options.

Chakrabarti explains that T3D will also benefit scientists studying phenomena such as tornadoes. Scientists can study the different visual information presented from each direction. They can view a scene from different directions simultaneously, helping them to better understand the physical processes involved. This will lead to more accurate predictions, which will save lives.

The extra dimension could revolutionize the video game industry, says Chakrabarti. In such games as auto racing, 3-D information is continually being developed at a higher accuracy, but the results are still presented on a 2-D screen. But with T3D, cars and obstacles will appear to jump off the screen.

The T3D system being developed will cost $15,000–$20,000 to buy, unlike other 3-D systems costing nearly $100,000. Chakrabarti and his team are using mostly off-the-shelf components, which greatly cuts cost. This will allow many people and companies to take advantage of T3D technology.

An ITTC spin-off company, BioComp Systems, Inc., is developing a marketable T3D product. A system should be on the market by 2005. ■

Students Build GeoWall for School of Engineering Expo

-Donning cheap 3D glasses, viewers witnessed images, such as the Earth and a tape measure, jump off the screen. Some participants even walked toward the projection screen with outstretched arms, trying to touch the objects.

Victor Petty and **Frederick Weidling** built the 3-D viewing environment, known as GeoWall, at ITTC for the School of Engineering Expo in February. The computer engineering majors spent 80 hours developing different lens configurations and alignment, setting up hardware, and creating content for the presentation.

GeoWall consists of a viewing screen, a computer, and two projectors. While the concepts behind it are not new, the price tag is. Before GeoWall, the specialized equipment would have cost between $150,000 and $1.5 million. Advances in technology are enabling GeoWall designers to use off-the-shelf parts, which allow a GeoWall to be built for under $15,000.

The lower costs will allow more high school and university classrooms access to GeoWalls. The technology can help students in a variety of sciences, including geology and meteorology.

Students in geological courses can see the different layers that make up the earth. They can clearly view why the geologic features in a certain area formed. Students can also observe in 3D how the earth changes over time.

In meteorology, a variety of factors, including temperature, dew point, and winds, all influence weather. While weather is a 3D system, traditional 2D models have been used to illustrate forces and movement in the ever-changing atmosphere. Three-D viewing will give students a better representation of how storms, tornados, and general weather patterns develop.

Petty estimates between 200 and 300 participants saw their presentation, not including repeat viewers. Petty and Weidling completed the project for the Expo, an outreach event aimed at students in first through 12th grades.

The 10-minute show included pictures of Hawaiian beaches and the surface of Mars. The presentation also included an animated look at downtown Lawrence, created through aerial and satellite imagery. Geography graduate student **Matt Dunbar** accurately detailed Massachusetts Street down to the position of the trees along the sidewalk.

EECS Professor **Gary Minden** oversaw the project's completion, and **Leon Searl**, ITTC information specialist, built specialized lens mounts that are crucial to the GeoWall. ■

Visiting Scholars Conduct Communications Research

ITTC received two visitors from Europe this spring, a Portuguese professor and a Spanish Ph.D. student.

Sam Shanmugan, Southwestern Bell distinguished professor of electrical engineering and computer science, is hosting both visiting scholars.

Silvio Abrantes, a professor of electrical engineering from Oporto University in Portugal, is visiting ITTC for the third time. He is spending part of his sabbatical at ITTC, which provides him with a quiet environment and good working conditions, he said. "ITTC people are friendly, and the campus is very agreeable," says Abrantes.

Silvio Abrantes

Abrantes' research involves Turbo Codes, which, like other families of error-correcting codes, attempt to correct errors in communication. For example, when communication takes place between devices on Earth and those in deep space, a lot of unwanted noise may be in the message. Turbo Code prevents this corruption, which could otherwise destroy the communication.

Veronica Parrondo

Veronica Parrondo Garcia, a Ph.D. student from the University of Cantabria in Spain, is working on fourth-generation wireless systems. The difficulties posed by the wireless medium and the increasing demand for better and cheaper services create the continual need for research. Parrondo is conducting simulations on different transmission methods for these fourth-generation networks.

Parrondo needs only to complete her research project to graduate. Her advisor recommended the University of Kansas, which has a program complementary to Cantabria's. Cantabria has a strong wireless communication program, especially with hardware development, while KU does much at the system level, Shanmugan said.

The visiting scholar liked the idea of learning a new culture and improving her English. She is the latest telecommunication-engineering student to conduct research at ITTC. **Beatriz Quijano** came to ITTC in 2002 and **Raquel Martinez** and **Alvaro Alvarez** conducted research at the Center in 2001. ■

Achievements and Acclaim

OSU Student Prepares for PRISM Field Work

Indrajit Bhattacharya, an Ohio State University graduate student, spent part of his spring break at ITTC, working on the Polar Radar for Ice Sheet Measurements (PRISM) project.

Bhattacharya is measuring snow accumulation rates in the polar regions, using data from remote sensing satellites. ITTC researchers are also measuring the accumulation rate but are using different methods to calculate the snow accumulation. Bhattacharya and ITTC researchers will correlate one result with another, verifying the accuracy of each method. Bhattacharya will join KU researchers this summer for PRISM field experiments in Greenland. ■

Ukrainian Seeks Information on e-Commerce

Oleksandr Yefymenko, a Ukrainian businessman, visited ITTC in March. He asked **Tim Johnson**, ITTC executive director, and **Keith Braman**, ITTC associate director for applied technology, how small businesses could conduct sales on the Internet and about the hardware and software needed for e-commerce.

The two pointed Yefymenko to Web sites and services that could offer potential solutions.

Yefymenko was visiting the area as part of the Community Connections Project, a federally funded program that encourages public-private partnerships in Eurasia. During Yefymenko's week at the Enterprise Center of Johnson County (ECJC), he spent an afternoon at ITTC. ■

ITTC Advisory Board to Meet in May

On May 25, ITTC will host its annual Industry Advisory Board (IAB) meeting. Board members provide guidance for the Center's future, bringing knowledge and experience from a variety of companies, organizations, and U.S. government agencies.

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Analysis of PRISM Data Earns First Place at IEEE Event

Nazia Ahmed has won the local round of the student paper contest sponsored by IEEE (Institute of Electrical and Electronics Engineers).

Nazia Ahmed

Ahmed's paper, "Analysis of the Depth Sounder Radar Data Taken in Greenland," details her work in analyzing data gathered during field experiments in Greenland.

ITTC researchers traveled to Greenland last July as part of the Polar Radar for Ice Sheet Measurements (PRISM) project. PRISM researchers are developing radar and rovers to gather data on the polar ice sheets.

Using data from this trip, Ahmed, a senior in electrical engineering, determined the roughness parameters of bedrock, the solid rock underneath the ice sheets. Determining roughness parameters allows Ahmed to understand the bedrock or basal conditions below the glacier. She can then provide an estimate of how much friction there is between the bedrock and the glacier.

Ice streams are fast-moving glaciers. If the basal friction is reduced to a certain point, ice streams can slide across the bedrock faster. Understanding the roughness gives scientists a better idea of how fast ice streams will flow, since the roughness of the bedrock determines how much resistance the bedrock will give the glacier. Knowing the roughness also helps calculate how much ice is sliding across the bottom or just melting away.

The analyzed data will contribute to the understanding of ice dynamics and the global climate system.

Professors **Prasad Gogineni**, principal investigator of PRISM, **Chris Allen**, and **Pannirselvam Kanagaratnam** helped Ahmed prepare her paper. Ahmed's success follows that of a trio of KU undergraduates. **James Pingenot** won the local contest last year. **Travis Plummer** and **Bharath Parthasarathy** won the local and regional contests in the spring of 2002.

Ahmed is one of 24 students and 14 faculty and staff working on the PRISM project at ITTC. KU is leading the multi-institutional project, funded by the National Science Foundation (NSF) and NASA.

For more information on PRISM, please log on to http://www.ku-prism.org/. ■