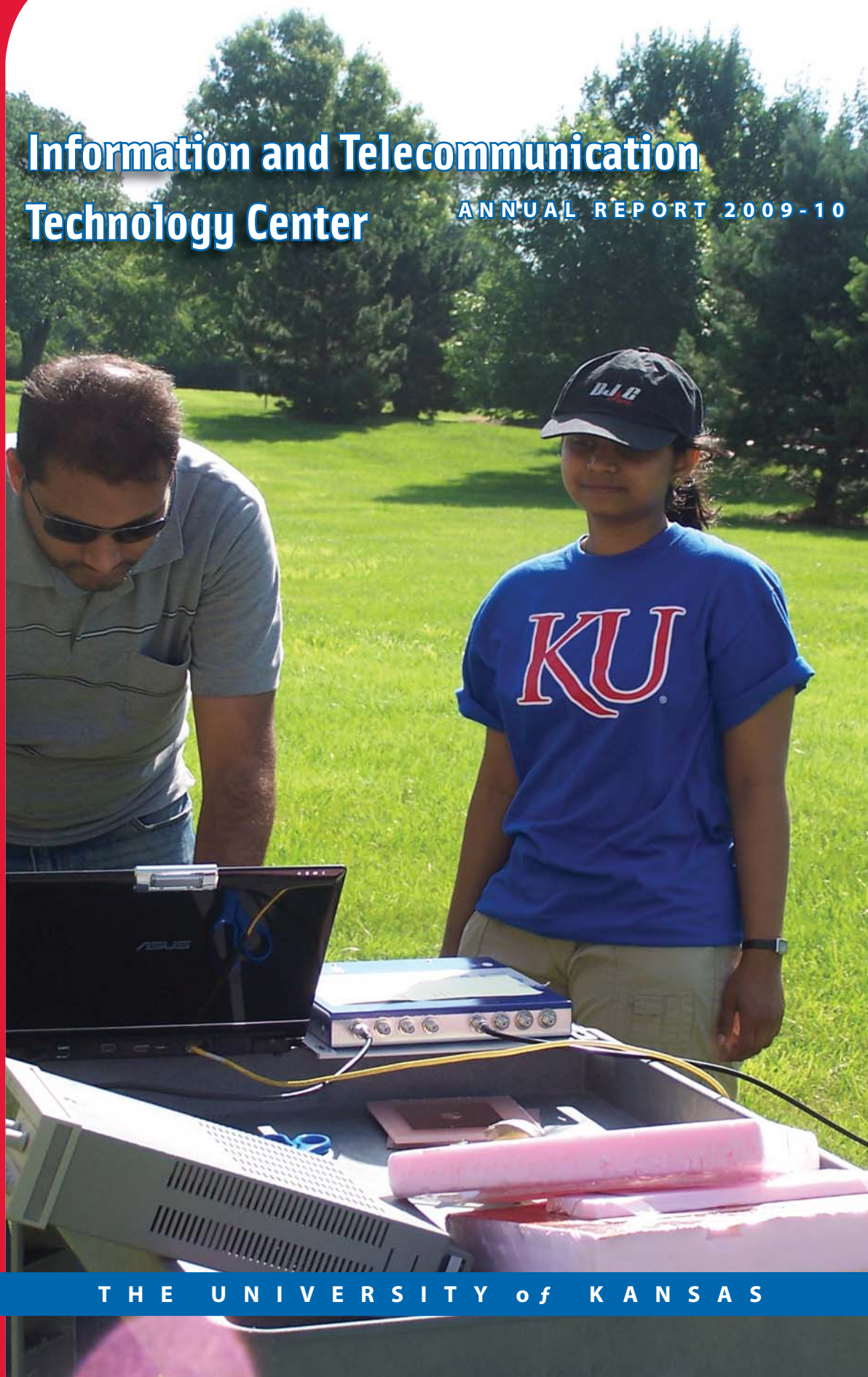
Information and Telecommunication Technology Center

ANNUAL REPORT 2009-10



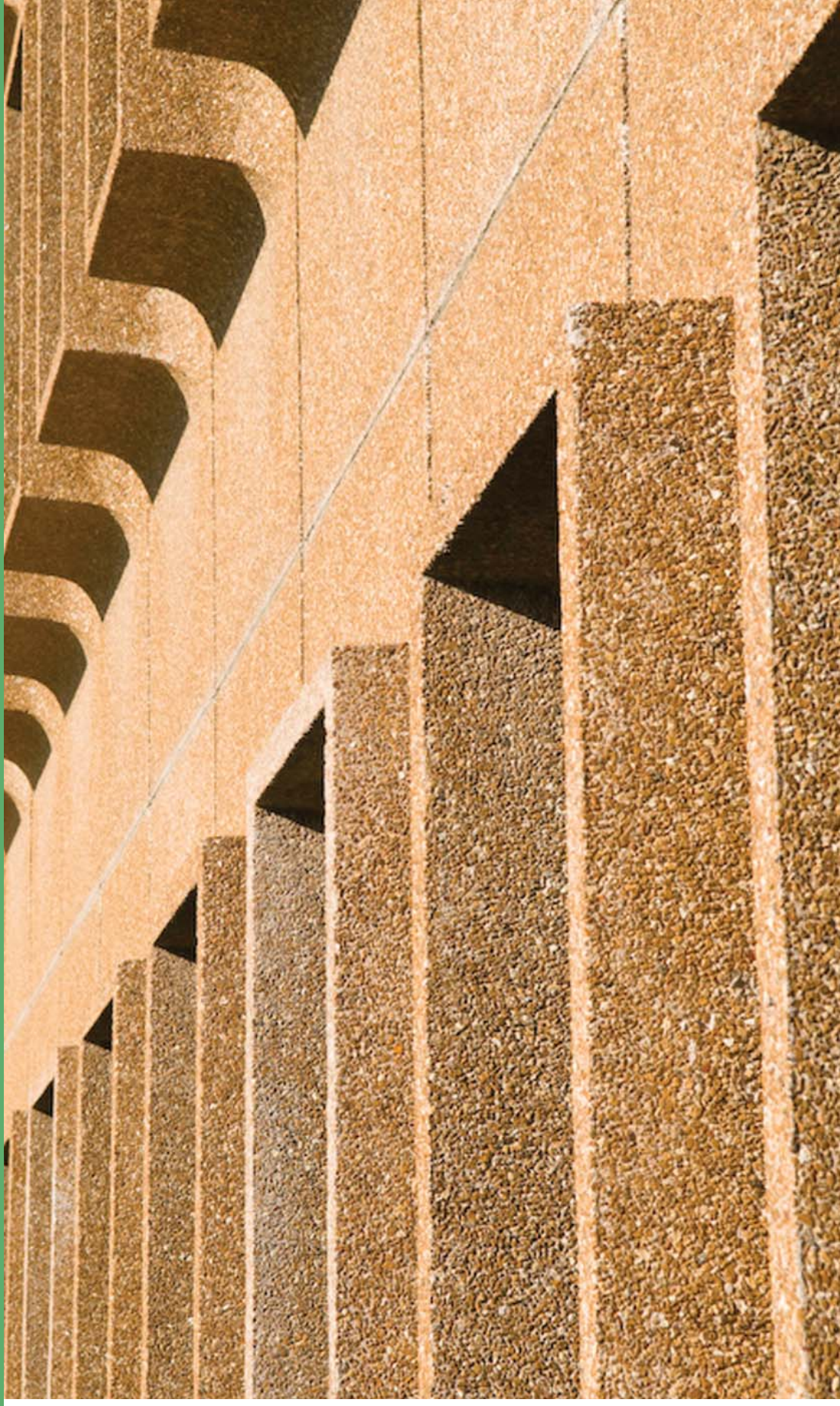
THE UNIVERSITY of KANSAS

"As a Midwest native and small business owner, I understand the importance of creating and keeping high-tech jobs in the state. ITTC is working hand-in-hand with members of the Kansas Technology Enterprise Corporation (KTEC) network and others to make the commercialization process easier and more efficient. We want our technologies out of the laboratories and into the hands of Kansas entrepreneurs."

–ITTC Director Perry Alexander

KANSAS TECHNOLOGY ENTERPRISE CORPORATION ktec

ITTC is a KTEC Center of Excellence, funded in part by the Kansas Technology Enterprise Corporation.



*On the cover: ITTC graduate research assistants **Naaser Ahmed Mohammed** and **Lakshmi Anusha Kosuru** test radio frequency identification (RFID) technology being developed for Lawrence Livermore National Laboratory. Smaller pictures from the top: ITTC graduate research assistant **Megan Peck** is the recipient of a NSF Graduate Fellowship. Self Fellow **Paul Anglin** discusses his radar systems research at the ITTC Industry Advisory Board Meeting. ITTC investigator **Jun "Luke" Huan** leads a $4.6 million renovation and expansion of ITTC's Bioinformatics Computing Facility. RF Electronics Engineer **Daniel DePardo** conducts RFID testing with Mohammed and Kosuru.*

News From

Perry Alexander, ITTC Director

I have always said my proudest professional achievement is my students. It is amazing to teach young people and watch them grow in knowledge and ability. At ITTC, our students apply what they are learning in the classroom to research. They gain practical experience by conducting experiments, analyzing data, and performing other necessary, but sometimes tedious, research. Critical to the success of ITTC, students are often our unsung heroes. We are recognizing students and their efforts throughout this year's Annual Report.

A trio of students— **Daniel Fokum**, **Angela Oguna**, **and Megan Peck**— received national recognition for their work. Daniel was invited to Google's inaugural Graduate Researchers in Academia of Diverse backgrounds (GRAD) Computer Science Forum. Angela is the first KU student to win a prestigious Google Anita Borg Memorial Scholarship. Megan received a National Science Foundation fellowship through its Graduate STEM in K-12 Education (GK-12) program. We are incredibly proud of them!

Not to be outdone, ITTC faculty researchers earned top honors. ITTC investigator **Tyrone Duncan**, professor of mathematics, was named a fellow of the International Federation of Automatic Control this summer. His citation noted his "exceptional contributions to stochastic, optimal adaptive control, filtering theory, and stochastic systems." ITTC investigator **Prasad Kulkarni** received one of the highest National Science Foundation honors given to junior faculty members. The Faculty Early Career Development (CAREER) award will support Prasad's ongoing efforts to build more secure and better performing software systems. He is the third ITTC researcher to receive a CAREER Award since 2007, showcasing the strength of our junior researchers. We also introduce new ITTC researcher **Xin Fu**. Xin spent the last year as a Computing Innovation Fellow, which recognizes the top young researchers in computing.

We see technology maturation and commercialization as natural outgrowths of our innovative research. After identifying technologies with market potential, we are able to give them time to develop with funding from the Kansas Technology Enterprise Corporation (KTEC). This maturation process allows us to prepare roll-out ready technologies. It is not enough to create transformative technologies; we need to get them into the hands of Kansas businesses and entrepreneurs. By streamlining the licensing of innovations, ITTC can foster economic growth and create jobs in IT. Additionally, we offer applied research, technical consulting, product development, and other services to assist Kansans with IT challenges and opportunities.

While conducting fundamental research and developing strategic solutions for industry, we are training the technology leaders of tomorrow. ■

International Foundation Partners with ITTC

There is no way (yet) to wirelessly network multiple aircraft traveling at Mach speeds over vast areas, but ITTC researchers are developing technologies to address this challenging situation.

Investigators in ITTC's Communications and Networking Systems Lab (CNSL) are pioneering advances in telemetering—measuring at a distance. In recognition of their efforts, the International Foundation for Telemetering (IFT) has donated $60,000 to KU and named it a partner university. IFT promotes the professional and technical interests of the telemetering community by sponsoring conferences, educational activities, and technical publications.

ITTC and the Department of Electrical Engineering and Computer Science will use the initial donation to award four IFT Fellowships to graduate students, purchase equipment for labs and senior design projects, and support students traveling to conferences to present their research. As one of only six partner universities of IFT, KU can present additional gift requests and proposals at the annual meeting of the IFT Board of Directors, which KU will host next year.

ITTC investigator Erik Perrins (left) and graduate research assistant Ehsan Hosseini are developing a deep-space communication system for NASA that will transmit large amounts of data while adhering to severe size, weight, and power constraints.

"We are extremely honored to form this partnership with the IFT," said CNSL investigator **Erik Perrins** who detailed KU's telemetry-related programs at the IFT board meeting in May. "We have been involved with the IFT and the larger telemetry community for the past five years and we look forward to having a synergistic relationship with them for many years to come. We are excited to host the IFT board next spring and let the board members see our engineering programs up close."

Professor Perrins and fellow CNSL researchers **Andy Gill** and **James P.G. Sterbenz** are developing wireless networking systems for highly dynamic aircraft. Their collaborative telemetry research will give the U.S. Air Force the ability to conduct multiple tests simultaneously, instead of staggered over time. ■

ITTC and the Department of Electrical Engineering and Computer Science will use the initial International Foundation for Telemetering (IFT) donation to award four IFT Fellowships to graduate students, purchase equipment for labs and senior design projects, and support students traveling to conferences to present their research.

Alexander Is Named ITTC Director

Perry Alexander, professor of electrical engineering and computer science, has been named director of ITTC. He has served as ITTC interim director since October, 2009.

"ITTC is an important research and commercialization program at KU," said **Steve Warren**, Vice Provost for Research and Graduate Studies. "Perry is an excellent choice to direct this center. His work with the National Security Agency and the Department of Homeland Security to obtain designation for KU as a National Center for Academic Excellence in Information Assurance Education is just one example of his research skills and leadership abilities."

> "ITTC is an important research and commercialization program at KU. Perry is an excellent choice to direct this center."
>
> – Steve Warren, Vice Provost for Research and Graduate Studies

During Professor Alexander's tenure as interim director, ITTC's Bioinformatics Computing Facility was awarded a $4.6 million grant from the National Institutes of Health. This will provide a 20-fold boost in computing power, and will enable additional KU researchers and Kansas businesses to use the high performance computing facility. The International Foundation for Telemetering also donated $60,000 to KU and selected it as a partner university. As one of only six partner universities, KU can seek additional funding to advance the science of telemetry—measuring at a distance - that is used in health care, space exploration and other applications.

"As a Midwest native and small business owner, I understand the importance of creating and keeping high-tech jobs in the state," said Professor Alexander. "ITTC is working hand-in-hand with members of the Kansas Technology Enterprise Corporation (KTEC) network and others to make the commercialization process easier and more efficient. We want our technologies out of the laboratories and into the hands of Kansas entrepreneurs." ■

Mason Honored as KU Employee of the Month

ITTC Network Specialist **Wesley Mason** received the March KU Employee of the Month Award. Interim Provost and Executive Vice Chancellor **Danny Anderson** presented Mason with the surprise award at Nichols Hall.

ITTC investigators say Mason is the go-to guy when they are in need of innovative solutions to computer or networking problems. Researchers are always impressed at how fast Mason solves their problems, according to **Michael Hulet**, ITTC Senior Network System Administrator. Hulet adds that Mason has saved ITTC tens of thousands of dollars by implementing free open source software over commercial products. Mason's latest project was Zimbra, an open source server software that incorporates e-mail, calendar information, file storage, web management, and other applications. Hulet says a comparable commercial product would have been cost prohibitive for ITTC. ■

ITTC Network Specialist Wesley Mason (right) receives the KU Employee of the Month Award from Interim Provost and Executive Vice Chancellor Danny Anderson at Nichols Hall in February.

EDGE Innovation Network Director Visits ITTC

In February, **Pete Palmer,** Director of the EDGE® Innovation Network, visited ITTC to learn about research that could help soldiers in the field be more mobile and better informed. The EDGE® Innovation Network is a collaborative initiative that enables industry and academia, with government input, to work together to deliver new technologies and innovative capabilities to soldiers and first responders. ITTC was invited to join EDGE® in February, 2009.

According to **Keith Yehle**, Director of Federal Relations at KU, "Having Pete briefed by KU ITTC faculty was crucial to connecting the dots for him. As Pete visits with EDGE Network members who alert him to problems related to communications, software, and networks, he can informally point them to KU as a resource."

ITTC researchers are developing technology to help soldiers be more mobile and better informed. In August, the EDGE Innovation Network asked ITTC to become a member of its network. The EDGE brings together industry and academia to more quickly solve challenges faced by soldiers and first responders.

Photo Credit: Spc. Dustin Gautney, 2nd AAB, 3rd ID Public Affairs

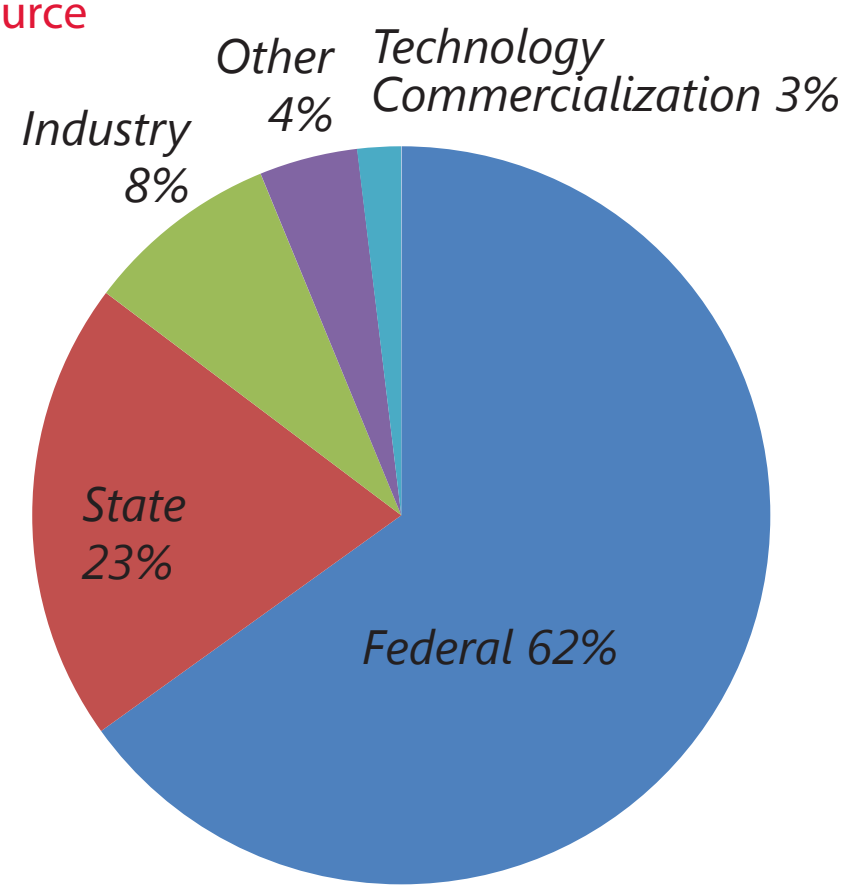
ITTC investigator **Shannon Blunt** discussed a covert communication method that would "piggyback" on existing signals, masking them from eavesdroppers. Preliminary test results show the ITTC system operates at data rates 1,000 times faster than current radar-embedded communication systems while offering at least the same level of security. ITTC investigator **Erik Perrins** highlighted research on communication systems that would transmit large amounts of data while adhering to severe size, weight, and power (SWaP) constraints. **Gary Minden**, Director of ITTC's Communications and Networking Systems Lab, spoke about his pioneering research in the efficient use of the radio frequency spectrum with the KU Agile Radio. The shrinking allotment of RF spectrum for the Department of Defense requires the military to use wireless technologies more effectively and efficiently.

Sponsored by General Dynamics C4 Systems, the EDGE® Innovation Network bridges the gaps that occur between research and development done in EDGE-member laboratories and the production of military and government systems. EDGE members fill these gaps by rapidly developing prototypes of new capabilities or improved systems for customer evaluation and ultimately, insertion into the military. ■

ITTC By the Numbers

Total Expenditures from External Sources	$4.3M
Total Revenue from External Sources	$4.2M
Active ITTC-Affiliate Tenure Track Faculty	37
Faculty in Leadership Positions	7
Research Papers Published	160
Active Sponsored Research Projects	66
Patents Issued	3
Technical Support Staff	7
Students Employed	91
Ph.D. Students	43
MS Students	50
Undergraduate Students	20
Post-Docs	1

ITTC Research, Development, & Commercialization Expenditures by Income Source



ITTC Researchers Develop Tools to Monitor Network Efficiency

More and more people are watching movies and television shows, listening to music, looking at pictures, or accessing other large files over the Internet. The popularity of high bandwidth applications, such as YouTube and iTunes, has made maximizing the efficiency of existing fiber-optic cable a top priority for telecommunication companies. ITTC researchers have developed tools to continuously monitor the performance of network fiber optic cable.

The ability of fiber optics to transmit large amounts of information over long distances has enabled the Internet revolution, but these strands of glass are delicate. Slight irregularities in fiber can cause random fluctuations in how light, or information, travels through the cable. This phenomenon, known as polarization mode dispersion (PMD), can degrade the data transmission performance of a fiber. By characterizing the PMD within the fiber network, operators will be able to compensate for it and improve network performance.

ITTC investigator **Ron Hui** and ITTC Electronics Engineer **Daniel DePardo** have constructed a test set designed to monitor PMD characteristics over fiber-optic networks. The PMD Test Set provides diagnostics and maintenance data, without interfering with the operational capability of the fiber. Since PMD characteristics are known to vary over time, the ITTC PMD Test Set has been designed to capture long-term measurement results.

Sprint Nextel has purchased two PMD test sets. A Brazilian telecommunications company also sought out the ITTC technology to limit its network costs while meeting growing demand for digital media and data services. ■

ITTC Investigator Ron Hui develops a prototype PMD test set in ITTC's Communications and Networking Systems Lab. The inset picture shows the final version of the test set, which provides performance data over fiber-optic cable.

"It is not enough to create transformative technologies; we need to get them into the hands of Kansas businesses and entrepreneurs. By streamlining the licensing of innovations, ITTC can foster economic growth and create jobs in IT. Additionally, we offer applied research, technical consulting, product development, and other services to assist Kansans with IT challenges and opportunities."

–ITTC Director Perry Alexander

U.S. Patents Granted

ITTC Research Engineer Danico Lee was awarded a patent for her "Automated Data Entry System" based on the SmartXAutoFill technology. SmartXAutofill reduces the time and effort needed for data entry, offering an alternative to costly, error prone manual data entry. SmartXAutofill makes suggestions to fields based on matches between values in past documents and the current one.

The SmartXAutoFill technology was developed through a ITTC Technology Development Grant awarded to Lee and co-researcher Costas Tsatsoulis. Tsatsoulis, former Chair of KU's Department of Electrical Engineering and Computer Science and current Dean of Engineering at the University of North Texas, is a co-inventor on the patent, along with former ITTC student Steve Perry.

ITTC investigator Shannon Blunt and Ph.D. student Tom Higgins received a U.S. patent in October. The patent, "Computationally Efficient Adaptive Radar Pulse Compression," is an algorithm to separate items of interest (namely detectable targets) from noise and interference within radar transmissions. For example in land mine detection by ground-penetrating radar, the ground can mask a mine. By adapting the filter to the received signal, sidelobes resulting from large targets can be suppressed.

This is the 11th patent for Professor Blunt and the first for Higgins, who is finishing his dissertation while working as a scientist at the Naval Research Laboratory in Washington, D.C. ■

Student Researchers Critical to ITTC Success

From developing prototypes to performing experiments and analyzing results, ITTC student researchers conduct labor-intensive parts of research. Most often students are paid from external research grants obtained by ITTC faculty researchers. The life cycle of grants can make the continuous funding of students difficult. Understanding the important role of students to advancing ITTC research and development, ITTC's Office of Technology Commercialization provides short-term funding for students to ensure the continuity of research.

ITTC graduate research assistant Naaser Mohammed performs testing on an ITTC-developed Radio Frequency Identification (RFID) tag. Mohammed is among 14 ITTC students supported through KTEC funds.

In FY 2010, ITTC supported 14 students with funding from the Kansas Technology Enterprise Corporation (KTEC). Students are able to apply what they are learning in the classroom by helping research and develop cutting-edge technology at ITTC. Their experience prepares them for future success and will help them further develop the high-tech industry in Kansas. ■

In support of our KTEC mission, ITTC researchers conduct innovative research that will lead to new companies while providing technical assistance to strengthen existing Kansas companies.

ITTC Supports Technology Maturation

ITTC's Office of Technology Commercialization, directed by **Keith Braman**, supports the development and commercialization of internal projects with market potential. Internal commercialization funding is made possible with support from the Kansas Technology Enterprise Corporation. A committee of ITTC Industry Advisory Board members and senior ITTC staff evaluate each project for its technical innovation and market appeal. Below are two projects receiving ITTC commercialization funds.

bioCAD: Bioinformatics Based Cancer Analysis and Diagnosis
While early detection of cancer is critical to successful treatment, only a small number of clinically approved biomarkers are available for population screening and early diagnosis. New exploratory software analyzes biological data for biomarker identification and cancer diagnostics. Eventually, it will allow for novel diagnostic and predictive tools to identify biomarkers.

Improving Java Virtual Machine Startup Performance
Billions of devices run Java Virtual Machines (JVM) that provide portable and secure execution of Java programs. The JVM must first launch and then optimize code as it runs, which leads to slower startup times. To counteract this, the JVM compiles only the important, or hot, components. Hot components are determined by profiling past program behavior. If past behavior does not model future execution, the predictions will be incorrect. ITTC researchers are devising a new profiling strategy that will use program constructs called "loops" to predict future hot sections more quickly at startup. ■

BCLSL

Bioinformatics and Computational Life-Sciences Lab

Knowledge of the human genome is revolutionizing medical and biological research. It will provide a new understanding of inherited diseases and how to treat them, along with improvements to overall health and aging. Bioinformatics will drive these breakthroughs by making sense of the data deluge. Novel BCLSL tools and methods focus on modeling, analysis, and data management. ■

Ph.D. student Alexander Senf has developed an algorithm to uncover genes involved in biological pathways. These complex networks can provide clues about genetic changes that occur during illness and expose the root of diseases.

Bioinformatics detects valuable data contained within enormous volumes of biological information. With this knowledge, researchers can then develop custom medications to prevent and treat diseases.

Ph.D. Student Publishes Work in Prestigious Journal

Developing intelligent computational tools to analyze the massive biological data being generated is critical to understanding the underlying mechanisms of human health and disease and transforming treatment and prevention.

Ph.D. student **Alexander Senf** has developed an algorithm to uncover genes involved in biological pathways. Actions by genes, proteins, and other molecules make up biological pathways, and multiple pathways often interact to complete designated tasks. These complex networks can provide clues about genetic changes that occur during illness and expose the root of diseases. Using machine learning, Senf can connect genes to biological pathways through similar behavior and identify undetermined genes by their behavior.

Senf's work has been published in the field's leading journal, *Bioinformatics*. "Identification of genes involved in the same pathways using a Hidden Markov Model-based approach" appeared in the November issue. ■

Bioinformatics Facility Receives $4.6 Million NIH Grant

ITTC investigator Jun "Luke" Huan stands in front of the Bioinformatics Computing Facility. Huan spearheaded the $4.6 million proposal to expand the facility.

ITTC's Bioinformatics Computing Facility will receive a 20-fold boost in computing power thanks to a $4.6 million grant from the National Institutes of Health. In addition, the new "green" design will utilize the heat generated from the computing hardware to supplement the building's heating infrastructure.

"This is a superb example of a win-win," said KU Chancellor **Bernadette Gray-Little**. "Investigators on the cutting edge of biological research will have much more robust computing at their command and see that their research is energy efficient and sustainable—a priority for our campus."

ITTC researchers will renovate more than 3,500 square feet of computing space and 2,400 square feet of support space. A sophisticated computer-rack cooling system will shuttle heat from computing equipment into the Nichols Hall boiler room, resulting in an expected 15 percent reduction in natural gas use.

"The existing BCF is running at capacity and cannot be expanded further," said ITTC Director **Perry Alexander**. "It supports more than 50 research projects and 10 core service laboratories. Researchers from across KU participated in this proposal. It was a university-wide effort to increase high-performance computing capacity for an exceptionally diverse collection of researchers, ranging from life sciences to engineering, while focusing on sustainability and energy efficiency."

Examples of research projects conducted at ITTC's bioinformatics cluster include prediction of the misfolding of proteins that contributes to Alzheimer's, Parkinson's and other neurodegenerative diseases; sequencing of genomes; and data mining of emergent chemical genomics databases. ■

"This is a superb example of a win-win. Investigators on the cutting edge of biological research will have much more robust computing at their command and see that their research is energy efficient and sustainable—a priority for our campus."

—KU Chancellor Bernadette Gray-Little

CSDL

Computer Systems Design Lab

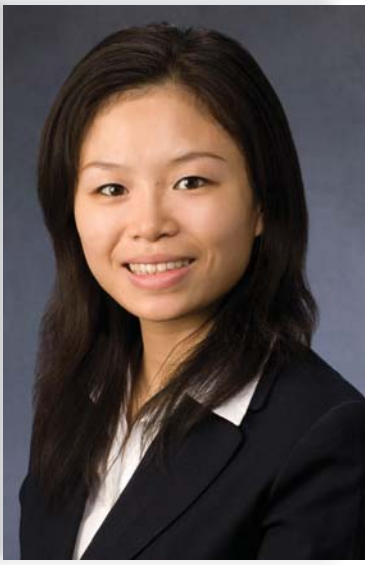
The Computer Systems Design Laboratory (CSDL) focuses on the development and implementation of complex, high-assurance embedded computer systems, such as radios and sensors. CSDL researchers develop predictable, robust systems critical to the nation's economy, security, and quality of life. CSDL research provides advanced languages and techniques for compilation and synthesis, profiling and verification, and high-assurance, real-time performance. ■

Interdisciplinary research among ITTC's computer systems design, information assurance, and networking systems researchers produces more secure and better developed computer systems.

Computing Innovation Fellow Joins ITTC

ITTC researcher **Xin Fu** is exploring solutions to the increasing hardware failure rate in microprocessors due to scaled processing technology. She has developed software to analyze and improve microprocessor reliability in the presence of soft errors, which destroy data but do not permanently damage hardware. She also proposed several methodologies to mitigate the aging effects in microprocessors by ensuring an optimal trade-off among reliability, performance, and power.

Before coming to ITTC, Professor Fu was part of the inaugural 60-member class of Computing Innovation Fellows. Established in 2009, the CI Fellowship sponsors the top emerging researchers in computing in postdoctoral positions. Professor Fu worked as a postdoc at the University of Illinois at Urbana-Champaign, helping test the SoftWare Anomaly Treatment (SWAT), a paradigm to ensure hardware reliability across all segments of the computing market. ■



Xin Fu will join ITTC's Computer Systems Design Lab in August. The Computing Innovation Fellow specializes in developing solutions to the increasing hardware failure rate in microprocessors due to scaled processing technology.

Photo Courtesy of University Relations

Peck Receives NSF Fellowship

In March, ITTC graduate research assistant **Megan Peck** was awarded a $30,000 National Science Foundation fellowship through its Graduate STEM in K-12 Education (GK-12) program. GK-12 supports partnerships between future scientists and science, technology, engineering, and mathematics (STEM) teachers. The Fellowship aims to improve Fellows' teaching and communication skills, advance STEM education in middle schools, and provide role models for younger students.

Peck, a Ph.D. student in computer science, will bring innovative, cutting-edge ideas from computer science and math into area middle school classrooms. In collaboration with partner teachers, she will develop interactive demonstrations and other projects aimed at igniting student interest in scientific study and careers.

Steven Case, Director of the KU Center for Science Education, says Peck will help close the gap between what scientists know and what the public understands about science. Science teaches students to observe, test, and collect evidence before making conclusions. People can use science to become better critical thinkers and problem solvers. Science must be taught in a way that allows students to integrate this thought process into their daily lives.

"Megan is an ideal candidate for helping us build this bridge between scientists and the public," said Professor Case, who is coordinator of KU GK-12. "A graduate of Lansing (KS) High School, Megan is someone whom students will identify with. She is smart and articulate and understands that we must find new ways to capture and challenge students' natural curiosity about the world around them."

Additionally, the fellowship supports Peck's research in the CSDL. Different vocabulary and engineering processes hamper communication among functionality, power, and other subsystems within complex electronics. Rosetta software allows designers to better understand how these components interact, enabling faster and more accurate production. Peck's research focuses on mathematical applications to better define components' interactions within Rosetta software. ■

ITTC Ph.D. student Megan Peck received a $30,000 National Science Foundation fellowship through its Graduate STEM in K-12 Education (GK-12) program. GK-12 supports partnerships between future scientists and science, technology, engineering, and mathematics (STEM) teachers.

"Megan is an ideal candidate for helping us build this bridge between scientists and the public. A graduate of Lansing High School, Megan is someone whom students will identify with. She is smart and articulate and understands that we must find new ways to capture and challenge students' natural curiosity about the world around them."

–Steven Case, Director of the KU Center for Science Education

CNSL

Communications & Networking Systems Lab

Pioneering research on intelligent, agile communication systems has earned the Communications and Networking Systems Laboratory (CNSL) international acclaim. ITTC researchers are developing the foundation for the future wireless Internet. Shrewd use of the radio frequency spectrum will help bring high-speed Internet service to rural America and enable much bigger and faster "hot spots." ■

Researchers from CNSL and the RSL are finding ways for the U.S. military to more effectively use its shrinking allotment of radio frequency spectrum.

ITTC student researcher Angela Oguna is the first KU student to win a prestigious Google Anita Borg Memorial Scholarship. The $10,000 scholarships were awarded to 32 exceptional female students.

Oguna Wins Google Scholarship

ITTC student researcher **Angela Oguna** is the first University of Kansas student to win a prestigious Google Anita Borg Memorial Scholarship. The $10,000 scholarships were awarded to 32 exceptional female undergraduate and graduate students across the United States in computer science and related technical fields.

The Anita Borg Institute for Women and Technology and Google created the highly competitive scholarship to encourage women to pursue careers in computer science and technology and to become leaders and role models.

At ITTC, Oguna tests sensors that monitor cargo transported by rail cars. The theft detection system provides stakeholders with greater visibility, security, and accountability of their goods. ITTC researchers are working with KU's Transportation Research Institute and KC SmartPort, an economic development group, to develop efficient transportation corridors throughout Kansas City.

"Angela is a highly motivated student. She has taken the initiative on a number of projects and activities during the past few years," said **Gary Minden**, director of ITTC's Communication and Networking Systems Lab. "Her motivation and initiative are complemented with a solid engineering foundation." ■

National Lab Seeks ITTC Asset Tracking Technology

ITTC researchers have developed long-distance passive and battery-assisted radio frequency identification (RFID) systems for the Lawrence Livermore National Laboratory. RFID tags, which are microchips with antennas, "listen" for a reader's radio query and respond with their unique ID code. Passive tags, which are far less expensive, use the power from the initial radio signal by the reader to transmit a response.

ITTC Research Associate Professor **Daniel Deavours**' research group modified near-metal tag technology. Prior to the ITTC invention, trace amounts of a metal or liquid distorted communication between RFID tags and readers. The near-metal tag technology enables tracking of any object regardless of what it is made of or contains. ITTC researchers and staff designed and built a system for Lawrence Livermore that yielded a passive read distance of 52 meters and a battery-assisted passive system of a little more than 100 meters. A unique antenna design, developed by Professor Deavours, enables read ranges three times greater than comparable passive tags.

ITTC researchers will start a second project for Lawrence Livermore this fall. Professor Deavours and his team are tasked with adding more features to the long-distance near-metal technology. Stray radio waves, such as those from cell phone towers or Wi-Fi access points, can trigger the tag's RF detection circuits, draining the battery. Professor Deavours has devised a method where the antenna can be used as a filter to both improve the tag's response in the RFID frequency band and filter out signals from adjacent frequencies. ■

Daniel DePardo, RF Electronics Engineer, tests radio frequency identification tags developed for Lawrence Livermore National Laboratory. ITTC's near-metal tag technology enables tracking of any object regardless of what it is made of or contains.

Duncan Is Elected Fellow

For his exceptional contributions to stochastic, optimal and adaptive control, filtering theory, and stochastic systems, ITTC investigator **Tyrone Duncan** was elected a 2010 Fellow of the International Federation of Automatic Control (IFAC).

Professor Duncan has a long history of work on the control of stochastic systems. Recently, he has considered the control of stochastic systems whose noise processes are modeled by fractional Brownian motions. He has worked extensively in probability, particularly stochastic calculus. One facet of his work has been the application of stochastic methods to other areas of mathematics, particularly differential geometry.

The IFAC promotes the science and technology of control in the broadest sense in all systems, whether, for example, engineering, physical, biological, social, or economic. IFAC is also concerned with the impact of control technology on society. ■

ITTC investigator Tyrone Duncan was elected a 2010 Fellow of the International Federation of Automatic Control (IFAC).

Photo Courtesy of University Relations

eDL

e-Learning Design Lab

The e-Learning Design Laboratory is jointly sponsored by KU's Center for Research on Learning (CRL) and ITTC. The lab explores new uses of technology to enhance teaching and learning. Its focus encompasses the development of new designs, tools, and policies that contribute to the evolution of e-learning. ■

Established in 2001, eDL is a collaboration between ITTC and KU's Center for Research on Learning (CRL). eDL researchers have produced online instruction to give students—all students—access to high quality resources.

Student Makes Freeform More Accessible

Freeform, an interactive tool developed by e-Learning Design Lab (eDL) co-Director **James Miller**, is helping KU students learn important concepts in curve and surface design within Geometric Modeling (GM). The computer science graduate course focuses on the acquisition, manipulation, and analysis of three-dimensional objects for computer-aided design, computer vision and graphics, medical imaging, and other applications.

There are few publicly available applications that have similar capabilities to Freeform. Of those, none have the breadth of features that Freeform offers. Acknowledging its growing importance in academia, Professor Miller and **David Wolfe**, a senior in computer science, made the decision to overhaul the interactive application. Professor Miller developed and refined the Freeform application over the years as time and funding allowed. Freeform contains many enhancements not envisioned in the original framework.

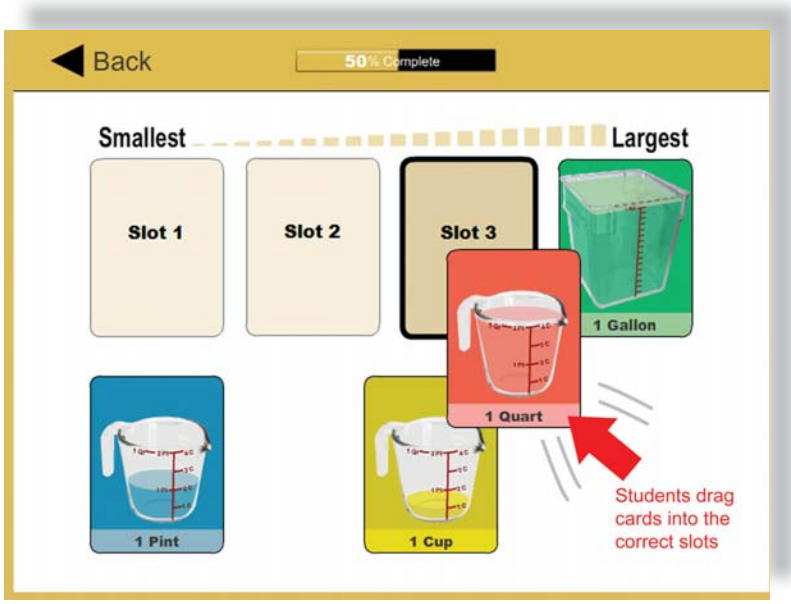
As part of his EECS Departmental Honors project, Wolfe moved Freeform from its original C++ code to Java. This allowed the application to be launched from any Web browser via Java Web Start. Originally developed for Linux and Macintosh operating systems, Freeform had not been available online. Moving it to Java and using Java Web Start technology addresses that issue.

eDL Co-Director James Miller (left) and David Wolfe, a senior in computer science, meet to discuss Wolfe's redesign of Freeform, an interactive tool that Miller developed to help his students learn curve and surface design concepts within Geometric Modeling.

"This is an important application that numerous students use," said Professor Miller. "We were lucky to have had David on the project. He did a wonderful job. Freeform will soon be much more accessible. My students and others will be able to use it online as they learn the fundamentals of geometric modeling." ■

Researchers Develop Graphics-Based Math Tutorial

This is what a student with dyslexia might see when reading instructions for a math assignment: con vret th ees meas ru emetns. While most children will not have such extreme reading disabilities, one in four elementary students reads slowly and feels he/she must work extra hard when reading. To better accommodate these students, researchers at the e-Learning Design Lab have created an animated online math tutorial. Numerous graphics and interactive techniques have reduced the amount of text by more than 80 percent, says eDL Assistant Research Professor **Diana Greer**. Professor Greer and **Anjali Kanitkar**, a graduate student in special education, met with experts in education and math to develop lessons and test out new graphics. For example, instead of written instructions to place a gallon, quart, pint, and cup in order from largest to smallest, fourth graders move the corresponding measuring cups into the right order.



To better help students with reading disabilities succeed in math, researchers developed an animated online math tutorial. Instead of a written lesson on measurement, students move corresponding cups from largest to smallest.

"At eDL, we have a strong focus on serving students with special needs," said Professor Greer. "The animated tutorial offers students a creative way to learn much needed math skills. eDL allows experts in education and technology to develop innovative tools to help all students learn."

In the fall of 2009, eDL researchers tested a prototype with experts in math, education, and multimedia applications. After testing is completed, animated tutorials will be added to the hundreds of online tutorials aligned with federal math and science standards. In addition to these lessons for K-12 students, the Blending Assessment with Instruction Program offers management and monitoring tools for teachers and resources for parents. More than 200 school districts in Kansas have participated in the program that was a collaborative effort between eDL co-Director **Ed Meyen**, **John Poggio**, former co-Director of KU's Center for Educational Testing and Evaluation, and eDL staff. ■

"At eDL, we have a strong focus on serving students with special needs. The animated tutorial offers students a creative way to learn much needed math skills. eDL allows experts in education and technology to develop innovative tools to help all students learn."

-Diana Greer, Assistant Research Professor in e-Learning Design Lab

IAL

Information Assurance Lab

The Information Assurance Laboratory focuses on developing, verifying, and fielding high-assurance information systems. Its purpose is to provide a University-wide focal point for those involved in information assurance research, education, and implementation. IAL research includes theoretical modeling, high-assurance system synthesis and verification, security modeling and analysis, and network and database security. ■

More than 2,800 publicly disclosed data breaches over the last five years have caused $139 billion in damages, according to the Digital Forensics Association.

Sustainability Is Priority in Life, Work

Cycling is Andrew Farmer's primary form of transportation. Autonomy, sustainability, and flexibility serve as core principles in the Ph. D. student's life and work with ITTC's Functional Programming Group.

On a campus woefully short of parking, **Andrew Farmer** always has prime spots waiting for him. While VIP parking is not the reason he cycles, it is a nice perk. The freedom and simplicity of biking attracted him as did the ability to burn calories instead of fossil fuel. It is not all rainbows and butterflies though as the state's ever-changing weather can present numerous challenges, highlighting the importance of adaptability. These themes of autonomy, sustainability, and flexibility serve as core principles in Farmer's work with ITTC's Functional Programming Group.

Led by ITTC investigator **Andy Gill**, the group is developing the programming language *Kansas Lava*. Lava allows programmers to build hardware using basic software constructs—kind of like Legos for programming. A more standardized structure embedded with security and information assurance practices protects systems while making updates and extensions easier. At ITTC, Farmer is writing testing tools for *Kansas Lava*.

When he returned to KU for his Ph.D. in 2009, Farmer wanted to develop technology to benefit programmers. The Spring Hill, Kansas, native is well on his way to this goal with *Kansas Lava*. ■

Kulkarni Receives Prestigious CAREER Award

ITTC investigator **Prasad Kulkarni** has received one of the most prestigious National Science Foundation honors given to junior faculty members. The multiyear Faculty Early Career Development (CAREER) award will support Professor Kulkarni's ongoing efforts to build more secure and better performing software systems.

"These highly selective grants are awarded to junior faculty members who are considered to be academic leaders of the future. Prasad is a dedicated researcher and highly deserving of this honor, and his work is critical to our national prominence in cyber security," said ITTC Director **Perry Alexander**. "Additionally, we are delighted to have three researchers in the last four years receive CAREER awards. Our younger faculty members are being recognized for their pioneering research and effective integration of scholarship and teaching."

At ITTC, Professor Kulkarni is developing a more secure and efficient framework for virtual machines (VMs), which ensure compatibility between applications and the devices running them. Cell phones, PDAs, and computers are among the billions of devices that have VM software running Internet programs and applications. To limit the cost and start-up time, current VMs apply only basic security checks. Devices are then left vulnerable to viruses and other malicious software that can corrupt and steal private data–from passwords to address books. Professor Kulkarni's new VM framework will slice out the security management and program monitoring tasks and perform them simultaneously with the main program. The framework will reduce the overhead of monitoring and security tasks and allow more secure and efficient execution of future programs.

ITTC Investigator Prasad Kulkarni and graduate research assistant Michael Jantz work on a new framework for virtual machines, which ensure compatibility between applications and the devices running them. This spring Kulkarni received a prestigious NSF CAREER Award.

"This new framework will allow developers to provide new and more expensive security checks while minimizing the performance penalty incurred at runtime," said Professor Kulkarni. "Our approach will employ program slicing to construct only the program state required for each security task. The proposed framework will naturally exploit the anticipated growth in the number of processing cores on a chip to run individual program slices concurrently with each other and with the main program thread." ■

"We are delighted to have three researchers in the last four years receive CAREER awards. Our younger faculty members are being recognized for their pioneering research and effective integration of scholarship and teaching."

–ITTC Director Perry Alexander

ISL

Intelligent Systems Lab

The Intelligent Systems Laboratory is creating smarter and more user-friendly environments and devices. Comprised of sensors, software, and computers embedded in machines and devices, intelligent systems emulate and enhance human reason and action. Intelligent systems allow machines to anticipate requirements and deal with complex, dynamic environments. ■

Intelligent systems add knowledge and reasoning to applications, databases,and environments,making them more sensitive to user behavior and changes.

Collaborative KU Research to Make Life-Saving Screenings More Accessible

Every year more than 250,000 women worldwide die from cervical cancer, one of the most treatable cancers in its early stages. Women in developing countries—where approximately 85 percent of new cases occur—often do not have access to Pap tests nor are they effectively screened. By enabling computer-assisted analysis of collected cells, University of Kansas researchers are aiming to make the life-saving screenings for abnormalities and precancerous lesions more affordable and efficient.

ITTC investigator Brian Potetz is developing computer vision techniques to help pathologists screen Pap smears thoroughly. Collaborative KU research is making screening for cervical cancer more affordable and efficient.

Photo Courtesy of University Relations

Traditional approaches to cervical cancer screening are not well-suited to digitization because cells are suspended in liquid, which means that only one cell is in focus at a time. KU Medical Center researchers are developing new ways to process Pap tests that allow liquid-based tissues to be sliced thinly and thus imaged more effectively.

Digitization of Pap preparations creates new opportunities for computer-assisted diagnosis. ITTC investigator **Brian Potetz** is developing computer vision techniques that help pathologists screen images thoroughly. Any abnormalities will be flagged for follow-up by health care professionals. Computer processing will alleviate visual fatigue and the subsequent rise in human error. Digital slides also make it easier to consult with pathologists remotely, and archiving digital images is substantially easier than glass slides. ■

ITTC Student Invited to Inaugural Google Forum

Daniel Fokum was among 75 students selected to participate in Google's inaugural Graduate Researchers in Academia of Diverse backgrounds (GRAD) Computer Science Forum in January. Designed to build and strengthen networks among emerging computer scientists, the event featured round table discussions along with technical talks from Google researchers and those within academia.

"Coming from a group that is typically underrepresented in computer science, I was inspired to see this diverse group of researchers," says Fokum, a Ph.D. student in computer science from Cameroon, West Africa. "I exchanged business cards with a number of participants and have already received a few e-mails. While an important networking event, the forum also highlighted the importance of diversity."

Google engineers selected Fokum for his academic excellence and leadership in computing. As part of his dissertation research, Fokum has helped develop ITTC's Transportation Security SensorNet (TSSN). TSSN integrates hardware, software, and sensors to enable real-time monitoring of goods en route. **Victor Frost**, Dan F. Servey Distinguished Professor of EECS, serves as the principal investigator on the project.

ITTC researchers teamed up with KC SmartPort, an economic development group and KU's Transportation Research Institute to develop an intelligent system to ensure secure, efficient transportation corridors. Its central location within the continent and nation and abundant transportation network has made Kansas City an ideal distribution center for global goods.

Daniel Fokum (standing) helps one of his students in the Introduction to Digital Logic Design lab. In addition to being a teaching assistant, Fokum is an ITTC researcher who helped develop the Transportation Security SensorNet. The Ph.D. student was selected to participate in Google's inaugural Graduate Researchers in Academia of Diverse backgrounds (GRAD) Computer Science Forum in January.

Fokum earned his M.S. in Computer Science with an emphasis in Networking at the University of Missouri-Kansas City in 2005 and B.A. in Computer Science from Park University in 2000. ■

ISL Director Arvin Agah will be on sabbatical during the 2010-11 academic year. Professor Agah will teach and conduct research on sensors and measurement technologies at the University of Canterbury in the United Kingdom.

RSL

Radar Systems & Remote Sensing Lab

RSL is widely respected for its radar remote sensing research, which includes the well-known radar modes of imaging, detection, and tracking. Researchers investigate signal processing and system-level approaches to solving radar problems. They explore potential new modalities of radar operation, the exploitation of radar scattering to facilitate low probability of intercept communications, and new radar waveform design techniques. ■

Ph.D. student Matthew Cook spent the summer as an intern at the Naval Research Laboratory (NRL) in Washington, D.C. He is the second RSL student to have a NRL internship. Ph.D. student Thomas Higgins interned at NRL in 2008.

Wi-Fi is Devouring Military Spectrum

The Department of Defense (DoD) has met a mighty foe, Wi-Fi wireless Internet access. With millions of devices, from cell phones and computers to Blu-ray players and e-book readers, having access to "hot spots," the radio frequency spectrum is being gobbled up. Diminishing access threatens the ability of the military to provide mission support and operational security. The loss of spectrum to Wi-Fi, particularly bands originally allocated for military radar applications, could ultimately threaten national security.

ITTC investigator **Shannon Blunt** is finding ways to more efficiently use the military's shrinking spectrum. He is pursuing interference cancellation approaches that will potentially allow the military to achieve greater re-use of its allocated frequency channels. By extension, this work may also enable partial sharing of spectrum by military and commercial communication entities. Additionally, radar emissions can interfere with other signals if not carefully controlled. In collaboration with ITTC researcher **Erik Perrins**, Professor Blunt is developing technology to ensure DoD radar signals minimize their "out-of-band" emissions by leveraging techniques used in aeronautical telemetry and that serve as the basis for the Bluetooth standard. The DoD wants to be good stewards of the spectrum, says Professor Blunt.

The interdisciplinary nature of ITTC is helping Professor Blunt develop innovative spectrum technologies. ITTC researchers **Gary Minden** and **Joseph Evans** have developed dynamic spectrum access technologies to find and use "white spaces," vacant frequencies between television channels. The ability of computers and other devices to access prime spectrum while not interfering with licensed devices has redefined spectrum management. ITTC technologies enable channel hopping between white spaces, giving right of way to licensed users.

This previous and on-going work has put ITTC in a good position to make a significant impact on spectrum usage and management within the U.S. and worldwide, says Professor Blunt. ■

Positive Experiences Keep Arnett at KU for Grad School

After visiting and being accepted to Stanford and the University of California, Berkeley, **Austin Arnett** chose to attend the University of Kansas. It is a decision he would make all over again. In fact, he is. Arnett, who graduated with honors in Electrical Engineering (EE) this May, will begin graduate school at KU this fall. He will focus on radar systems as he pursues a graduate degree in electrical engineering (EE).

"It has been a really good experience, which is why I am coming back," says the El Dorado native. "My professors have been a great resource."

An interest in math, science, and problem solving led him to EE. Radios and radar have become focus areas for Arnett.

At ITTC, Arnett is conducting research on radar-embedded communication for his EECS Departmental Honors project. American soldiers in hostile territory generally find it difficult to maintain communications with friendly forces, especially when they do not want to betray their location. Radio frequency (RF) emissions can be detected by devices "sniffing" the RF spectrum. ITTC investigator **Shannon Blunt** is developing technology that will enable soldiers' messages to "piggyback" on existing radar signals. Current covert communication of this type requires hundreds of radar pulses to convey just one communication symbol, resulting in very low data rates. In contrast, Professor Blunt's team embeds a communication symbol into each individual radar pulse. Preliminary results suggest the potential for operation at data rates 1,000 times faster than current radar-embedded communication systems while offering at least the same level of security.

Austin Arnett stands next to technology he helped develop for a reliable covert communication system for soldiers in hostile territory. ITTC investigator Shannon Blunt is leading research that will enable soldiers' messages to "piggyback" on existing radar signals. Arnett will begin graduate school at KU this fall.

"I am looking into the practical implementation of radar-embedded-communication (REC) theory. Up to now, there have only been computer simulations done to evaluate and test REC ideas," Arnett said. "I am using an actual radar system in ITTC's Radar and Remote Sensing Lab (RSL) to implement and explore challenges faced during implementation."

"I have been very impressed with Austin's willingness to go after an unconventional problem," Professor Blunt said. "He has also demonstrated the ability to work independently towards a solution. These are the hallmarks of a good researcher." ■

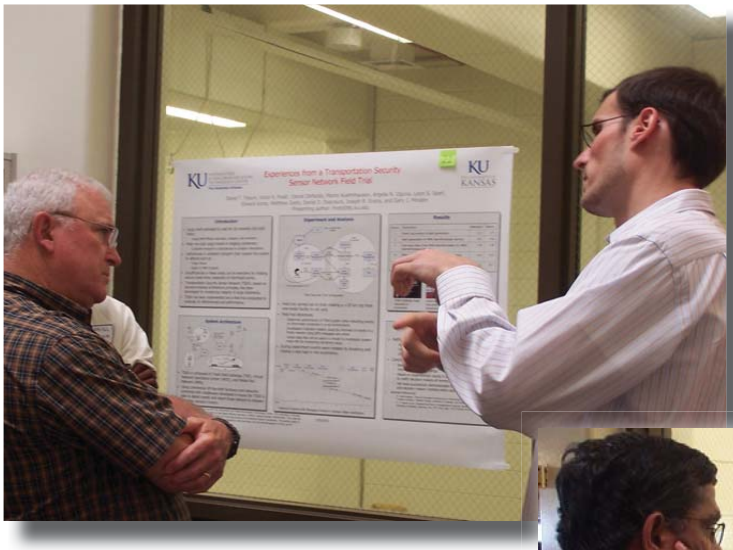
"It has been a really good experience, which is why I am coming back [to KU]. My professors have been a great resource."

-Austin Arnett, ITTC student researcher

Chancellor Headlines Advisory Board Meeting

The annual Industry Advisory Board meeting took place on June 10. ITTC Director **Perry Alexander** presented a State of the Center report to KU Chancellor **Bernadette Gray-Little**, IAB members, and other invited attendees. He spoke of the breadth of ITTC research and how many industries, specifically Kansas companies, benefit from ITTC R&D. Professor Alexander noted the changes in the leadership within the University and the opportunities this presented ITTC, such as the Chancellor's visit. Chancellor Gray-Little then spoke on the importance of research, education, and service (economic development) and answered questions about her initiatives.

The interdisciplinary nature of the Center enables researchers to tackle complex problems, from the causes of cancer to the future Internet, from multiple angles. ITTC researchers **James P.G. Sterbenz**, **Erik Perrins**, **Prasad Kulkarni**, and **Xue-Wen Chen** discussed their research. During his presentation, Director of ITTC's Technology Commercialization **Keith Braman** noted that ITTC had contributed to the development of 38 new technologies commercialized in Kansas over the last decade. IAB members took in the student poster session over lunch and finished the day with a lengthy brainstorming session of future research and development. ■



◀ *John Strand, an IAB member from Axis Solutions in Leavenworth (left), and Martin Kuehnhausen, Ph.D. student, discuss Kuehnhausen's research poster, "Experiences from a Transportation Security Sensor Network Field Trial." IAB members voted on the posters they found the most informative during the student poster competition. Kuehnhausen's poster tied for first place in the competition.*

ITTC graduate student Arvind Madhavan discusses the challenge between size and performance when designing radio frequency identification (RFID) systems with Raj Ananthanpillai, an IAB member from InfoZen in Rockville, MD. "Improving the Bandwidth of a High-Q UHF RFID Tag" was the title of Madhavan's poster for the IAB poster session held in the lobby of Nichols Hall.

The ITTC Industry Advisory Board FY2010

Front row: **Ed Bishop**, PRO-telligent, LLC., *Columbia, MD*; **Gerard Canavan**, Road 9, *Greenwood Village, CO*; **David Nichol**, Nichol and Associates, *Overland Park, KS*; **Brian Ruf**, Ruf Strategic Solutions, *Olathe, KS*; **Ben Vos**, Sprint, *Overland Park, KS*; **Wayne E. Morgan**, Netchemia, *Lenexa, KS*; **Raj Ananthanpillai**, InfoZen, *Rockville, MD*; **Keith Gary**, KC Area Life Sciences Institute, *Overland Park, KS*

Second row: **Matt McClorey**, Lawrence Regional Technology Center, *Lawrence, KS*; **Eric Mokole**, U.S. Naval Research Laboratory, *Washington, D.C.*; **Gerald White**, Prio, Inc., *Overland Park, KS*; **David Hardin**, Rockwell Collins, *Cedar Rapids, IA*; **John Strand**, Axis Solutions, *Leavenworth, KS*; **Rob Herrington**, Horizon Analog, *Lawrence, KS*; **Chris Murrish**, Cerner Corporation, *Kansas City, MO*; **Chris Guiterrez**, KC Smartport, *Kansas City, MO*

Third row: **Marshall Greenspan**, Northrop Grumman, *Norwalk, CT*; **Stephen Schneider**, Sunflower Broadband, *Lawrence, KS*; **Jim Brandt**, RT Logic, *Colorado Springs, CO*

Not pictured: **Kevin Carr**, KTEC, *Topeka, KS*; **Andres Carvallo**, GridNet, *San Francisco, CA*; **Scott Coons**, Perceptive Software, *Shawnee, KS*; **Marc Epard**, Horizon Analog, *Lawrence, KS*; **John Fitzgerald**, Westar Energy, *Topeka, KS*; **Jeffrey Fuller**, Honeywell FM&T/KCP, *Kansas City, MO*; **Tom Holland**, KS Legislature, *Topeka, KS*; **Tim Johnson**, IDEA Center, *Manhattan, KS*; **Susan Norris**, Norport Technology Management, *Lenexa, KS*; COL **Wayne Parks**, Cubic, Inc., *Leavenworth, KS*; **Michael Sobek**, EVP Business Development, *Lenexa, KS*; **Michael Swink**, Ascent Intelligence, *Arlington, VA*; **Wade Wiebe**, KTEC, *Topeka, KS* ■

ITTC Principal Investigators

Arvin Agah
Professor, EECS; Intelligent Systems Lab Director
Distributed and biomedical robotics; multi-agent systems; autonomous mobile robots

W. Perry Alexander
Professor, EECS; ITTC Director, Computer Systems Design Lab Director, Information Assurance Lab Director
Systems-level design; formal specification and verification; IP reuse; specification and programming languages

Christopher Allen
Professor, EECS; Radar Systems and Remote Sensing Lab
Microwave remote sensing; radar system design and analysis

Ronald Aust
Associate Professor, Educational Leadership & Policy Studies; e-Learning Design Lab
Designing and developing multi-state educational networks and technologies to support collaborative learning

Shannon Blunt
Assistant Professor, EECS; Radar Systems and Remote Sensing Lab
Adaptive signal processing; interference cancellation; multistatic radar

Swapan Chakrabarti
Associate Professor, EECS; Bioinformatics and Computational Life-Sciences Lab, Intelligent Systems Lab
Neural networks and fuzzy systems in bioinformatics; signal processing; True 3-D display systems

Xue-wen Chen
Associate Professor, EECS; Bioinformatics and Computational Life-Sciences Lab Director, Intelligent Systems Lab
Bioinformatics; human-computer interaction; machine learning; statistical data analysis

Daniel Deavours
Research Associate Professor, ITTC; Computer Systems Design Lab, Communications and Networking Systems Lab, Information Assurance Lab
RFID privacy and security design and development; low-profile, planar, UHF RFID tag technology; performability modeling specification

Kenneth Demarest
Professor, EECS; Radar Systems and Remote Sensing Lab
Computational electromagnetic techniques; lightwave systems

Tyrone Duncan
Professor, Mathematics; Communications and Networking Systems Lab
Stochastics of mathematical finance; applied mathematics seminar; differential equations; probability theory

Güneş Erçal
Assistant Professor, EECS; Communications and Networking Systems Lab, Information Assurance Lab
Modeling and predicting "selfish" behavior systems; engineering cooperative; intelligent, and resilient communication systems

Joseph Evans
Deane E. Ackers Distinguished Professor, EECS; Communications and Networking Systems Lab, Information Assurance Lab
Networks; ubiquitous computing environments; adaptive systems

Jianwen Fang
Director Applied Bioinformatics Lab; Bioinformatics and Computational Life-Sciences Lab,
Genomics using statistical and machine learning approaches; structure prediction; function annotation/prediction; sequence and domain analysis of proteins; phylogenetic analysis

Victor Frost
Dan F. Servey Distinguished Professor, EECS; Communications and Networking Systems Lab
Internet QoS, traffic management; integrated broadband networks

Andrew Gill
Assistant Professor, EECS; Computer Systems Design Lab, Information Assurance Lab
Functional languages and technologies

Jerzy Grzymala-Busse
Professor, EECS; Intelligent Systems Lab, Bioinformatics and Computational Life-Sciences Lab
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Jun "Luke" Huan
Assistant Professor, EECS; Bioinformatics and Computational Life-Sciences Lab, Intelligent Systems Lab
Bioinformatics and data mining

Rongqing Hui
Professor, EECS; Communications and Networking Systems Lab, Bioinformatics and Computational Life-Sciences Lab
Optical communication systems; photonic devices; optical measurement and sensors

Prasad Kulkarni
Assistant Professor, EECS; Computer Systems Design Lab
Static and dynamic/adaptive compilers; embedded systems; machine learning; computer architecture

Bo Luo
Assistant Professor, EECS; Intelligent Systems Lab, Information Assurance Lab
Information security and privacy; XML and conventional database systems

Gerald Lushington
Director of Laboratories, Medicinal Chemistry; Bioinformatics and Computational Life-Sciences Lab
Computational simulation of the behavior of chemical systems; computational chemistry; biochemistry and materials science

Ed Meyen
Professor, Special Education; e-Learning Design Lab co-Director
Online instructional design; web tools; emerging instructional technologies

James Miller
Associate Professor, EECS; Computer Systems Design Lab, e-Learning Design Lab co-Director
Visualization, geometric and solid modeling for computer-aided design; computer graphics

Gary Minden
Professor, EECS; Communications and Networking Systems Lab Director, Information Assurance Lab, Computer Systems Design Lab
Digital systems; microprocessors; artificial intelligence

Douglas Niehaus
Associate Professor, EECS, Computer Systems Design Lab, Intelligent Systems Lab
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Bozenna Pasik-Duncan
Professor, Mathematics; Courtesy Professor, EECS; Communications and Networking Systems Lab
Stochastic adaptive control and Mathematics and Science education

Erik Perrins
Assistant Professor, EECS; Communications and Networking Systems Lab
Digital communication theory; advanced modulation techniques; channel coding; MIMO

David Petr
Associate Chair Undergraduate Studies, EECS; Communications and Networking Systems Lab
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Brian Potetz
Assistant Professor, EECS; Intelligent Systems Lab
Computer vision; machine learning; computational Neuroscience and natural scene statistics

Glenn Prescott
Chair, EECS; Radar Systems and Remote Sensing Lab, Communications and Networking Systems Lab
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Hossein Saiedian
Associate Chair Edwards Campus, EECS; Computer Systems Design Lab, Information Assurance Lab, Intelligent Systems Lab
Software architecture; software processes, management; agile software development

K. Sam Shanmugan
AT&T Distinguished Professor, EECS; Communications and Networking Systems Lab
Channel modeling; WCMA over satellite links; simulation of communication systems

James P.G. Sterbenz
Associate Professor, EECS; Communications and Networking Systems Lab, Computer Systems Design Lab, Information Assurance Lab
Survivable, resilient, disruption tolerant networking and programmable, active networks

James Stiles
Associate Professor, EECS; ITTC Associate Director, Radar Systems and Remote Sensing Lab Director
Radar remote sensing and propagation; scattering of electromagnetic waves in random media

ITTC Mission Statement

To advance knowledge and create innovative technologies in information systems, networking and communications, bioinformatics, and radar;

To educate and train students for technology leadership;

To transfer knowledge and innovative technologies to Kansas companies and national industries;

—by providing an excellent interdisciplinary research and development environment.

. . . . . .

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Back page: Ph.D. student Wesley Peck (baseball hat) has a lively discussion with Industry Advisory Board Members John Strand (next to Peck) and Brian Ruf about the systems level design language Rosetta. Peck and Ph.D. student Mark Snyder (behind Peck) are helping develop more predictable, robust, and secure computer systems.

The ITTC Vision

To be a global leader and strategic partner in the creation and commercialization of innovative technologies in telecommunications, information systems, bioinformatics, and radar.

KU INFORMATION & TELECOMMUNICATION TECHNOLOGY CENTER
The University of Kansas