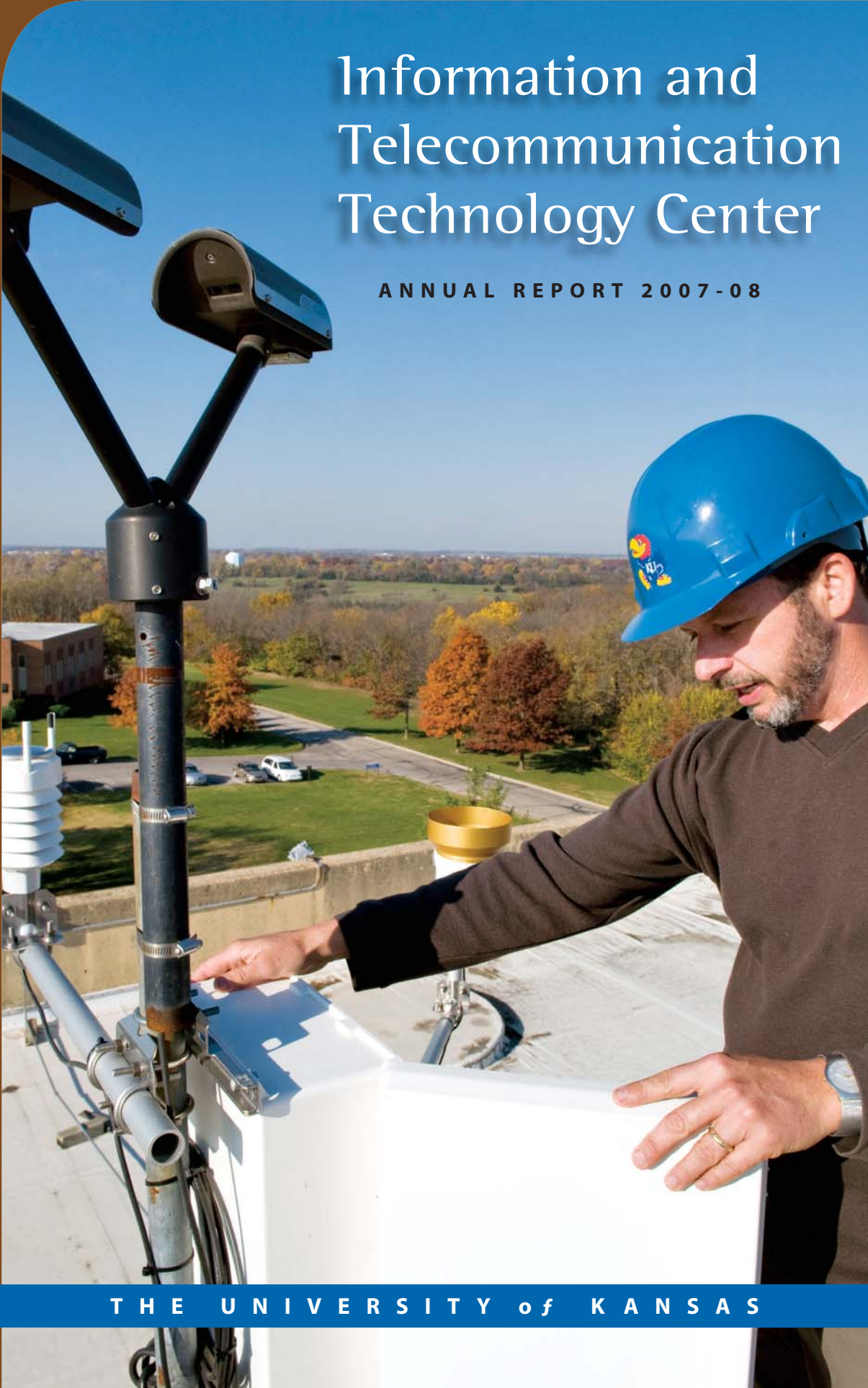


# Information and Telecommunication Technology Center

ANNUAL REPORT 2007-08





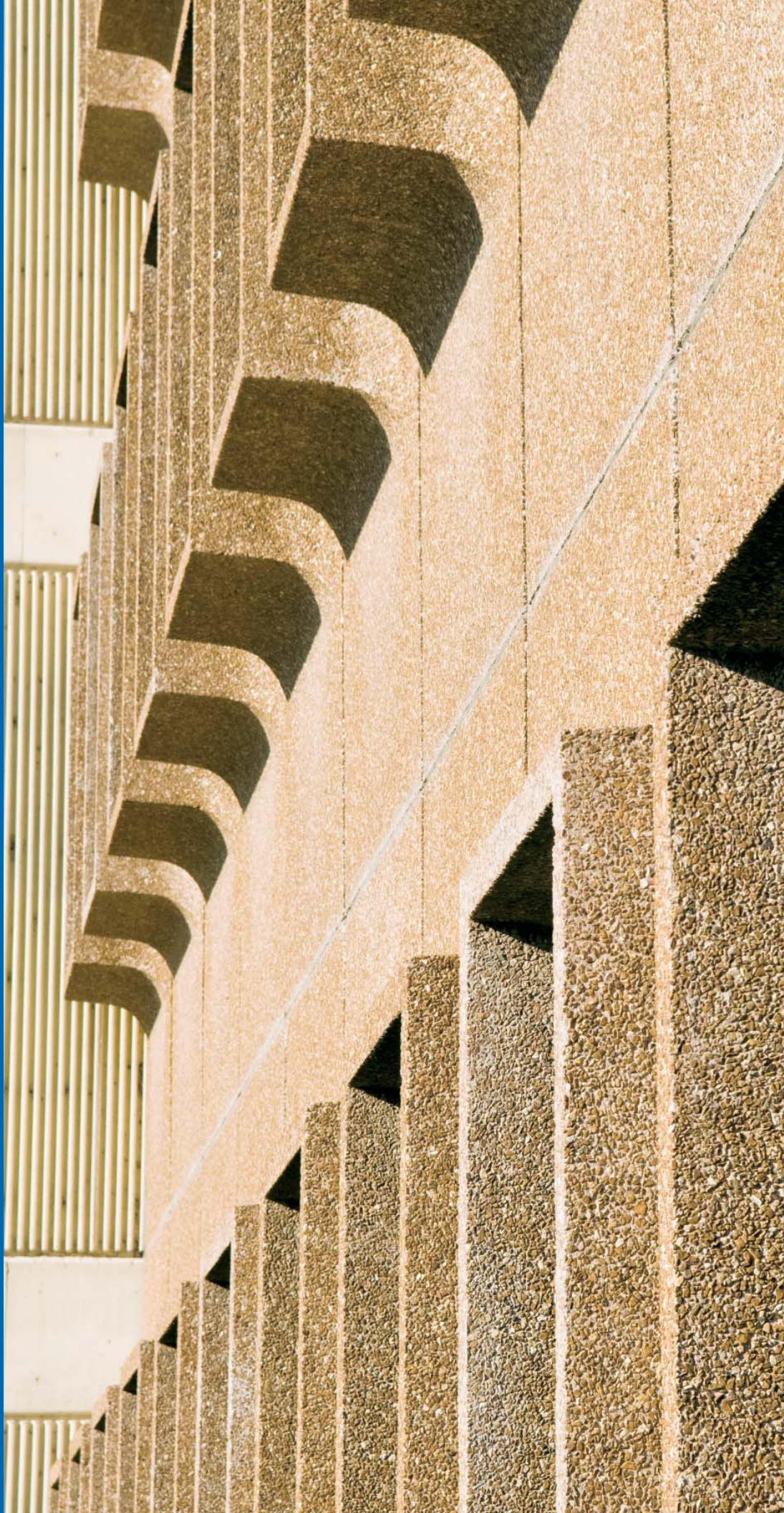
“The growth of the information technology sector is important to diversifying the Kansas economy. Such companies are dependent upon innovation, and ITTC is an important component of the state’s innovation network for both existing and emerging information technology companies.”

— Tracy Taylor,  
president and CEO,  
Kansas Technology Enterprise  
Corporation (KTEC)



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

ITTC is a division of the  
University of Kansas,  
which is an entity of the State of Kansas  
separately managed and distinct from the  
Kansas Technology Enterprise Corporation.





# A Conversation .....

## with Joseph Evans, ITTC Director

**S**ince joining KU in 1989, Joseph Evans has emerged as a national authority on wireless and high-speed communications networks. Interweaving innovative research with education and technology entrepreneurship uniquely prepared him to serve as ITTC director.

We recently sat down with Evans to discuss the future of ITTC.

▼ *The tenure of Victor Frost came to a close this summer, and he's returned to teaching and research. Frost was ITTC Director for over 10 years and championed many research breakthroughs. Can you tell us about your plans for the future of ITTC?*

**Evans:** Did you know ITTC technologies are helping protect national security and military personnel, enable the next generation of wireless technologies, and uncover the causes of cancer? The breadth of our research amazes me!

ITTC personifies Midwestern humility, and we sometimes fail to advertise this exciting work. Because of the increasingly competitive research scene, ITTC must increase its visibility in order to become even more successful. We are working to promote our capabilities and achievements. Growing name recognition will help us build a network of new potential supporters and collaborators.

▼ *The Center has more than 40 faculty members, and this fall you welcomed four new assistant professors. The diversity of ITTC faculty, in terms of age and research, must bring some unique synergies to the Center. You must be looking forward to seeing what these new faculty will accomplish.*

**Evans:** Absolutely! Andy Gill's industry experience and expertise in the Haskell programming language make him a tremendous asset to the Computer Systems Design Lab. Brian Potetz and Bo Luo



will invigorate an evolving Intelligent Systems Lab. Güneş Erçal-Özkaya specializes in a long-standing area of ITTC expertise—intelligent and resilient communications. Each of these talented researchers will create new knowledge and drive innovation. We look to foster these budding research programs and sustain the momentum of established ITTC researchers.

▼ *ITTC students contribute so much to the research the Center undertakes. Can you talk about their role?*

**Evans:** ITTC student researchers help develop and research cutting-edge technologies, applying what they are learning in the classroom. They coauthor papers and attend conferences throughout the nation and world to share the ideas developed at ITTC. We are training the future technology innovators and leaders of tomorrow.

▼ *ITTC has an important technology commercialization mission. How do you see technology transfer fitting into the ITTC mission?*

**Evans:** We see technology maturation and commercialization as a natural outgrowth of our research. Our technologies can provide the foundation upon which Kansans build a more diversified, robust economy.



## ITTC — Building the Future Now

“This world-class research center is a renewable Kansas resource. Given the necessary care and resources, ITTC can help grow a more robust, diverse economy. Talented ITTC researchers are developing technologies that can be spun out into Kansas companies. These start-ups attract high-tech innovators and give ITTC alumni more opportunities to stay in the state after graduation.”

— Marc Epard, ITTC Industry Advisory Board Member, Horizon Analog, Lawrence, Kansas

**I** TTC is one of eight multidisciplinary research centers at the University of Kansas, with approximately 170 faculty, staff, and students. Its collaborative, interdisciplinary environment, combined with state-of-the-art laboratories, facilitates superior research and development. Business, communication, education, finance, and medicine are among the fields that employ ITTC technologies.

Our researchers have helped shape national policy as federal program managers for DARPA, NASA, and NSF, but they play an even bigger role in the development of tomorrow’s technology leaders. ITTC students gain hands-on experience as they conduct fundamental research and help develop strategic solutions. The outstanding faculty researchers at ITTC attract talented students who often earn prestigious awards. Currently, we have Self and Department of Defense fellows along with Fulbright, and National Merit scholars.

As the KTEC Center of Excellence for information technologies, ITTC assists Kansas companies with their technology needs. Our Technology Commercialization Office focuses on maturation and transfer of ITTC-developed technologies. We strive to partner with entrepreneurs and companies that can help build a more diverse, robust Kansas economy.

We carefully cultivate each component of our mission—research, education, and technology commercialization. The resulting synergy produces an exceptional Center.

## Turkish-Born Researcher Studies “Selfish” Behavior

**E** ECS Assistant Professor Güneş Erçal-Özkaya (pronunciation is Gue-nesh Er-chal – Oez-ka-ya, all vowels are short) began attending the University of Southern California (USC) on a full scholarship after her junior year of high school. She moved to the opposite end of Los Angeles for graduate school, attending the University of California Los Angeles (UCLA).

Güneş returns to the Midwest with a Ph.D. in computer science and expertise in game theory and graph theory. She models and predicts “selfish” behavior and then engineers cooperative, intelligent, and resilient communications. Her interdisciplinary research compliments the KU Agile Radio and spectrum access and efficiency research at ITTC.

Newlyweds Güneş and Emrah Özkaya grew tired of the Southern California traffic and frenetic lifestyle. They were attracted to KU because of its strong math, engineering, and business programs. Her research spans these fields, and Emrah is pursuing a Ph.D. in business after working as an



industrial engineer. Lawrence’s proximity to Güneş’ parents (who live in Rolla, Missouri) in addition to its “hippie” twist and cultural activities sold them on KU. Güneş and Emrah particularly feel welcomed by the town’s Turkish community. They have hosted and attended Turkish potlucks as well as get-togethers for playing traditional music. Born in Istanbul, Güneş lived in both Turkey and the United States as a child.

*EECS Assistant Professor Güneş Erçal-Özkaya is developing cooperative intelligent systems. The ITTC investigator is shown here in front of the Bioinformatics computer cluster.*

## Kenya Native Receives University of Kansas Scholar Award

**W**hile the spring semester ends in May, it begins in the dead of winter. A season Angela Oguna had not experienced growing up in subtropical Kenya until she arrived at KU in January 2008. The formidable cold did not dampen Angela’s spirits or



success in the classroom. In October, she was selected as a 2008–2009 University of Kansas Scholar by the Honors Program.

The highly competitive scholarship program honors talented sophomores and fosters their development via seminars, events, special advising, and faculty mentors.

Scholars attend a required three-credit-hour interdisciplinary seminar. Angela’s will interweave history, art, architecture, planning, culture, population, and challenges in “KC: The Biography of a City.” Scholars are eligible to receive a \$250 scholarship for up to five semesters while at KU.

EECS Professor Gary Minden serves as Angela’s mentor. Angela took a digital design course from Minden who was impressed by her work. He offered Angela a student research position to help develop software and conduct sensor testing for ITTC’s “Transportation Security Sensor-Net” (TSSN) project. Currently, she is developing a checklist for an upcoming field test and maintains the internal project website.

**“Angela is a dedicated and intelligent student. We are fortunate to have her at ITTC.”**

— Gary Minden, EECS professor and director of the Communications and Networking Systems Laboratory



# Talking with Keith Braman

## ITTC Director of Technology Commercialization

**I**n July 2007, Keith Braman was named the director of Technology Commercialization after seven years as assistant director. We asked Braman about the technology commercialization process and opportunities for successful tech transfer.

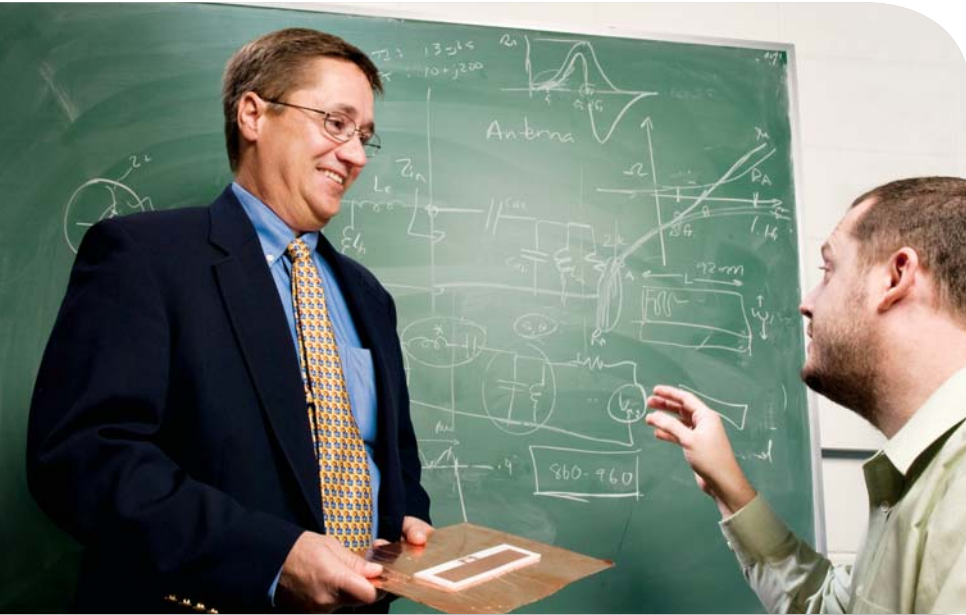
▼ *Some people do not know what technology commercialization or technology transfer is. How would you define it?*

Our focus at ITTC is on technology maturation. By that I mean, we apply ITTC resources to preliminary research results that look commercially promising. We do this with the objective of furthering the development of a particular idea or invention to a commercially viable point when a technology transfer event can be explored. We follow up the maturation process through technology transfer, which is the sharing of knowledge and technologies among industries, universities, governments, and other institutions. This ensures that scientific and technological developments are accessible to a wider range of users who can then exploit the technology into new products, processes, applications, materials or services.

Bridging the gap from the university to the commercial world can be difficult, but ITTC is experienced in managing the journey for our researches. Whether it's identifying a proper fit between a technology and an organization's needs, or negotiating the inherent differences between the research lab's focus and the commercial sector's interests, ITTC specializes in driving the process forward for successful technology maturation and transfer.

▼ *Would you tell us about a technology being developed at ITTC now that has good potential for commercialization?*

One of our researchers is developing an algorithm that can disambiguate two harmonic signals measured from a signal microphone. (See article at right.) We see a substantial opportunity in the video gaming market for this technology. Properly implemented in music education or a karaoke-style game, two singers would be able to perform a duet with each having an individual display of their performance using a signal microphone.



*ITTC Director of Technology Commercialization Keith Braman (left), holds a radio frequency identification (RFID) tag. He is talking to the tag's creator, ITTC Research Assistant Professor Daniel Deavours. Deavours' tags are designed to work exceptionally well in contrary environments.*

“ITTC is a great example of the exciting possibilities that exist at the intersection of research and enterprise. Researchers develop innovative technologies that are given opportunities to mature at the Center. This incubation makes ITTC technologies ripe for commercialization opportunities.”

— Victor Hwang, managing director,  
T2 Venture Capitol, Mountain View, California



## KU Researchers Collaborate on More Accurate Brain Mapping

New brain imaging scans, known as magnetoencephalographs (MEGs), are enabling a better understanding of healthy brain function and changes caused by age and illness. Accurate image processing and subsequent brain activity mapping could significantly aid in the understanding and treatment of Alzheimer's disease and other neurological disorders. ITTC, in partnership with the Hogland Brain Imaging Center (HBIC) at KU Medical Center, has developed a method with unprecedented accuracy to process MEG scans. Early results from the Source AFFine Image Reconstruction (SAFFIRE) have enabled the precise localization of primary and secondary auditory responses, a previously unsolved problem.

*Above: The magnetoencephalograph provides researchers with imaging of brain function in order to map brain activity.*



## Technology Sings a Duet

ITTC researcher Dave Petr is marrying technology to vocal training, through the *Duet-on-Pitch* project. Currently, choral directors are only able to train one student at a time through traditional vocal display software programs. The *Duet-on-Pitch* technology separates duet performers' voices so they can see where they need to correct their pitch. This technology is currently being marketed to music education software developers.

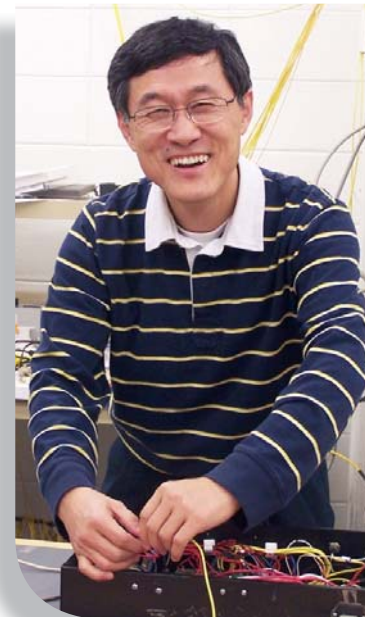
“Such collaborative research would not be possible without the resources and facilities of ITTC.”

— Shannon Blunt, Radar and Remote Sensing Lab, ITTC

## ITTC, Sprint Partnership Becomes Tradition

A phenomenon called polarization mode dispersion (PMD) can corrupt data traveling through high-speed fiber-optic cables. ITTC investigator Ron Hui, with funding from Sprint, has developed a tool to detect PMD in fiber-optic networks. Field technicians quickly identify and fix PMD in a transmission line, preventing service disruption.

In addition to funding scores of projects, Sprint has provided KU/ITTC with access to its network for the last 15 years. The ability to conduct research on professionally installed, real fiber subject to environmental forces is an incredibly valuable asset. It has aided ITTC researchers in their development of communications technologies.



# Bioinformatics and Computational Life-Sciences Lab

**K**nowledge 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

Bioinformatics integrates computers, software tools, and databases to examine and store biological information. It turns data being generated in molecular biology, genetics, and other life-sciences into useful knowledge.

tools and methods focus on modeling, analysis, and data management. The interdisciplinary research efforts involve investigators from computer science, electrical engineering, mathematics, life-sciences, and medicine.

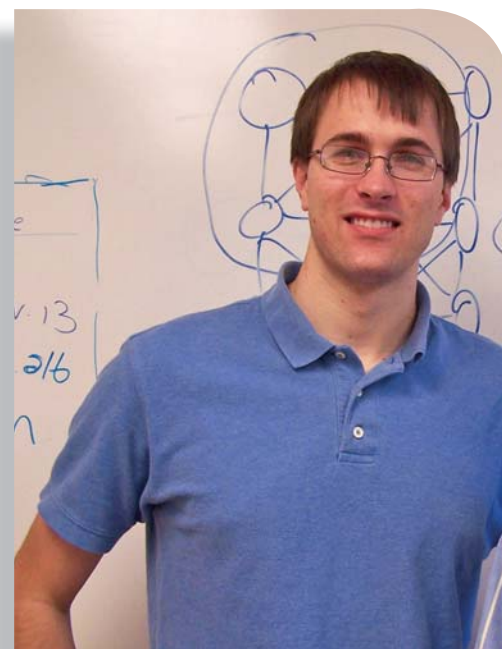
## One SMART Fellow

**F**or as long as he can remember, artificial intelligence (AI) has fascinated Mike Wasikowski. He sees limitless possibilities for machines endowed with knowledge, reason, and other abilities. Seeing similar potential in Wasikowski, the Department of Defense has awarded him a prestigious Science Mathematics And Research for Transformation (SMART) fellowship. The award provides a \$25,000 stipend, full tuition and fees, and other benefits.

The ITTC graduate research assistant is exploring AI techniques that integrate knowledge “learned” from their experiences and observations. Thus, machine learning methods improve in efficiency and effectiveness as they analyze massive data sets. Wasikowski gives the example of satellite imagery on a proposed target. ITTC software could dissect the data and determine whether it was a civilian truck or an enemy tank.

“Mike is a hardworking and brilliant student,” said Xue-wen Chen, director of BCLSL. “I was impressed by his motivation and sincerity toward work. He is dedicated and has great potential in research.”

As part of the program, fellowship recipients must fulfill a one-year employment obligation



with a Department of Defense agency for each year they receive the fellowship. Wasikowski will work for TRAC-Monterey, a research center at the Naval Postgraduate School in Monterey, California.

“This scholarship is very competitive — so it speaks volumes about our program, our research, and our students,” Chen said.



## NSF Award Supports High-Power Computing Capabilities for Research and Education

The National Science Foundation awarded ITTC researchers \$300,000 to upgrade the largest KU open access scientific computing system. This grant was a joint effort with the University's College of Liberal Arts and Sciences, the Natural History Museum, the School of Engineering, and the Instructional Lab/Molecular Structures Group.

A substantial upgrade will enable ITTC's Bioinformatics computing cluster to support more life-sciences research at KU. Thanks to an NSF/KTEC-funded grant, the cluster will receive an additional 384 cores, taking the total to 768 cores. The powerful, integrated research platform drastically reduces the amount of time it takes to perform data-intensive research such as analysis of a genome or examining misfolded proteins.

Such computational resources will provide scientists at KU a competitive edge available to numerous universities, such as the San Diego



Supercomputer Center at UCSD, that have advanced local high-performance computing centers readily available.

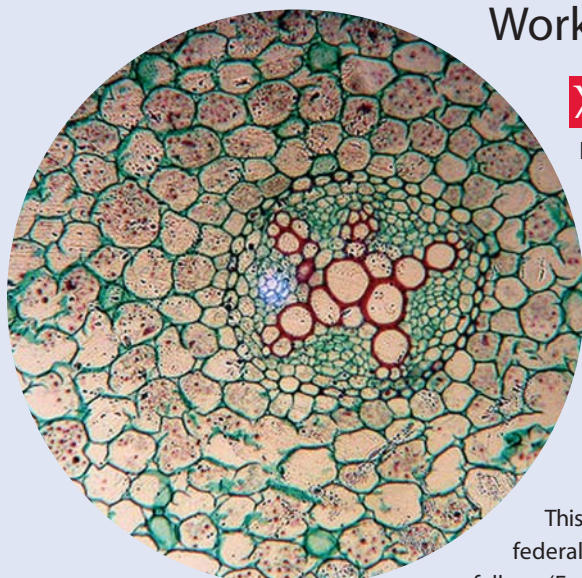
In addition to supporting local research, such facilities can attract faculty and pave the way for interactions with industrial partners.

The system will support educational users from the KU School of Engineering, the Department of Chemistry, and KU's Project Discovery for Girls, among others.

For scientists, the system will house numerous projects providing services to the research community, such as protein function prediction and species niche modeling. All these applications will be enhanced by access to this high-speed computing resource.

*Michael Hulet, ITTC senior network system administrator, and Wes Mason, ITTC network specialist, perform system maintenance on ITTC's Bioinformatics computing cluster.*

## Working on the Big Picture



Xue-wen Chen is developing software to find needles in a haystack. His machine learning methods are extracting patterns and recognizing biological networks within massive data sets. His research is helping provide an unprecedented "big picture" view of complex biological systems. Scientists are beginning to replace the one gene per experiment with a systems-level understanding.

Since arriving at KU in 2003, Chen has helped ITTC attract more than \$2.7 million in research awards. This includes the multiyear CAREER Award he received from the National Science Foundation last year. One of NSF's most prestigious honors, the CAREER Award recognizes Chen's exemplary research and teaching.

This year, one of Chen's students, Mike Wasikowski, was the recipient of an esteemed federal research award. The Department of Defense named Wasikowski a SMART fellow. (For more information, see adjoining page.)

# Computer Systems Design Lab

**T**he Computer Systems Design Laboratory (CSDL) focuses on the development and implementation of complex, high-assurance, embedded computer systems, such as radios, controllers, and sensors. CSDL research results in techniques for developing predictable, robust systems critical to the nation's economy, security, and quality of life. CSDL researchers provide advanced languages and techniques for compilation and synthesis, profiling and verification, and high-assurance, real-time performance.

To protect national security, health, and economic interests, it is critical that complex engineered systems are predictable before fielding and have assured behaviors even in adverse situations.

## Successful Entrepreneur Joins ITTC

**A** warm smile and a Scottish accent are the first things you notice about Andy Gill. Born and raised in the United Kingdom, Andy received his Ph.D. from the University of Glasgow in 1996. The day after he handed in his dissertation, Andy boarded a plane for California. He has lived in the United States ever since, working with industry giants Microsoft and Hewlett Packard among others. He spent the last eight years with Galois, a company he cofounded. Galois specializes in the development of secure, safe software for government and industry.

The responsibilities of helping manage a growing company left Andy little time for his true passion, research. Andy returned to academia to continue building bridges between engineering practices and theoretical possibilities. ITTC's Computer Systems Design Laboratory (CSDL) was exploring the same ideas Andy wanted to pursue. He felt the established lab was the best fit for him.



*Andy's biggest smile came when asked about his family. The proud father pulled out his phone to show a picture of Kayleigh and Liam. At 3 and 2, the Gill children test the stamina of their father and mother, Beth. Andy says they are getting settled into their new home and town. There have been numerous park outings as well as a trip to the Maple Leaf Festival in Baldwin City.*



## Native Kansans Flourish through KTEC-Sponsored Programs



**J**ennifer Streb is a Kansas success story. Graduating in the spring of 2009 with her Ph.D. in computer science, Jenni represents the State's most important resource—its talented, highly educated younger citizens. Kansas has implemented an aggressive economic development plan to keep such future technology leaders. It is working. The increasing number of technology companies allows Jenni and her fiancé, Adam Lohofener, to remain in their home state. Lohofener, a former ITTC research assistant, joined Garmin after graduating in 2006 with his Master's in electrical engineering.

Born and raised in Olathe, Jenni chose the University of Kansas for its academic excellence and tradition. Scholarships for the Olathe North standout combined with in-state tuition made KU an affordable choice. In

**G**arrin Kimmell bought his first house last year. It is just one, albeit the biggest one, of the Garnett native's growing responsibilities. Through resources provided by the Kansas Technology Enterprise Corporation (KTEC), the Center will fund Garrin's postdoctoral position for the next two years. He will continue working on the Rosetta specification language, which allows individual pieces of computers and other complex electronics to interact with one another. Rosetta founder and CSDL director Perry Alexander has spun Rosetta out to form Cadstone, which KTEC has generously supported.

Before moving into his postdoctoral position, Garrin had worked at ITTC as a Master's and Ph.D. student. Garrin says ITTC has given him incredible opportunities. Among the highlights, he notes his international travel to present research and collaborate on the Rosetta project.

her final semester as an undergraduate, she joined ITTC. Jenni found a community that supported and challenged her. She began to gain confidence in her own abilities and enrolled in the Ph.D. program the next semester.

Jenni has spent more than four years developing safer, more reliable, and more secure embedded systems. These special purpose computers are critical to design tools and services for the ITTC system-level design language Rosetta. By allowing different subsystems within complex electronics to interact with one another, Rosetta software helps build faster, stronger, and more efficient electronics.

Her research has been funded, in part, by the Kansas Technology Enterprise Corporation (KTEC). For the last 20 years, KTEC has been developing a tech-based economy and support structure. It funds innovators and companies that are helping build a stronger, more diversified Kansas.

“KTEC support has allowed ITTC the ability to provide research and commercialization opportunities to exceptional students. KTEC's investment in ITTC helps insure a more robust Kansas economy and a continuing supply of highly-skilled graduates and future business leaders.”

— Keith Braman, director of Technology Commercialization

# Communications and Networking Systems Lab

**P**ioneering research on intelligent, agile communication systems has earned Communications and Networking Systems Laboratory (CNSL) international acclaim. Research includes developing the foundation for the future wireless Internet.

ITTC's Agility Technology enables passive UHF radio frequency identification (RFID) tags to perform reliably and efficiently in contrary environments. The technology has been licensed for commercialization.

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."

## Research Focuses on Resilience of the Internet

**T**he global Internet has become essential for all aspects of our daily lives, but was not designed with resilience as a fundamental property, needed for its current role as critical international infrastructure. This increasing dependence on the Internet also makes it an increasingly attractive target to attack by crackers (unethical hackers) and terrorists, who can increasingly exploit architectural design weaknesses and security vulnerabilities. The increasing diversity in technologies and applications exacerbate this problem, such as mobile personal communications, in the civilian, government, and military sectors.

ITTC investigator James P.G. Sterbenz and researchers from Lancaster University in the UK are developing new technologies and protocols to address existing vulnerabilities and future challenges. Their ResiliNets initiative includes projects that focus on the resilience and survivability of the future Internet. ResiliNets aim to maintain an acceptable service level in the face of challenges to normal operation, including attacks and



*ITTC investigator James P.G. Sterbenz and his students are working to include greater resilience and survivability in the future Internet. This will allow networks to continue providing acceptable service in the face of attacks.*

large-scale natural disasters. This involves a multilevel approach at all protocol layers and planes (data, control, and management).

ResiliNets first employs a two-phase strategy  $D^2R^2+DR$ . The first phase,  $D^2R^2$ , begins with defense, making the network as resistant as possible to challenges, but inevitably a network will be threatened and it must be able to detect this automatically. It will then remediate any damage to minimize the overall impact, and finally will recover as it repairs itself and transitions back to normal operation. The second longer-term phase, DR, consists of diagnosing any design flaws that permitted defenses to be penetrated, followed by a refinement of network behavior to increase its future resilience.





Dan DePardo, ITTC RF electronics engineer, checks an antenna on the roof of Nichols Hall.

## ITTC Research Focuses on Effect of Weather on Wireless Networks

**W**eb browser, MP3 player, GPS navigator, and video recorder are among the features rolled into today's cell phones. These multimedia devices are overwhelming traditional cell phone towers. New wireless technologies, millimeter wave (mmw) systems, will connect cell towers to the Internet and have the potential to reduce costs and improve high-speed wireless services. But weather events, particularly precipitation, can reduce signal strength and information-carrying capacity. Sprint-Nextel-funded research investigates exactly how weather impacts network performance.

ITTC Principal Investigator Victor Frost and his team are collecting weather data around Lawrence. The Sunflower Broadband network transports the measurements to the Center. KU Department of Geography researchers analyze data and other information to construct storm models. The collaborative research will lead to a better understanding of the link between atmospheric events and network performance. ITTC researchers will then develop techniques to direct traffic around impacted links.

*"If technology comes along that can better serve the public, then we should enable those technologies to flourish. We can do that by carefully understanding the science and the technology before making policy decisions."*

— Joseph Evans, ITTC director, on a study he coauthored that concluded 'white spaces' in the TV band spectrum could be used by digital devices with no disruption of service to the adjoining signals.

## ITTC Research Cited by FCC

**I**TTTC research was cited in comments submitted this spring to the "Federal Communications Commission's Proceedings on Unlicensed Operation in the TV Broadcast Bands." The FCC is considering opening unused frequencies in the television band of the radio frequency (RF) spectrum to unlicensed wireless devices. By giving secondary users access to TV band spectrum, regulators would ease congestion in urban areas and enable greater access to wireless broadband service in rural areas. This could solve the "last mile" problem.

ITTC investigators Dan DePardo and Joe Evans led experiments to determine critical operating parameters for unlicensed devices operating in TV bands. Secondary use will require the development of emission specifications for TV band devices

to prevent interference problems. Their study found that low-power unlicensed devices could transmit over unoccupied television channels without interfering with television viewing on other channels. Researchers suggested emission limits for secondary devices to protect Digital TV (DTV) receivers. Currently, licensees are granted exclusive rights to their spectrum, but proposed regulatory changes could allow wireless devices to access "white spaces," or empty pockets, within the TV band.

On November 5, 2008, the FCC ruled that white spaces could be used for unlicensed devices connecting to the Internet when the spectrum becomes available following the conversion to digital television in early 2009.

## e-Learning Design Lab

**T**he e-Learning Design Laboratory is jointly sponsored by the 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.



### Programmer Benefits from Instructional Design and Technology

**D**an Spurgin is excited about the fusion of technology and education taking place at the e-Learning Design Lab (eDL). Computer scientists and award-winning educators are developing web-based units and other innovations to enhance learning and improve student success. Dan, eDL's lead programmer, stresses the importance of a holistic approach in the creation of new interactive learning environments. eDL has created numerous online programs including those for special needs students, staff development, and standards-based instruction for K-12 education.

Dan is working on an online Master's degree in Instructional Design and Technology (IDT), a relatively new discipline specializing in the development and integration of technology into teaching and training. Dan will conduct an empirical study to assess online education for his thesis.

The eDL brings together research in instructional design, learner characteristics, and content. The latest eDL research benefits teachers and students in mathematics.

“Online learning provides valuable opportunities for teachers and students in southwestern Kansas. I think our students are more inclined to be engaged if there is a technology component. e-Learning allows us to have access to the same type of resources that cities with four-year universities have.”

— Jessica Bird, principal of Kenneth Henderson Middle School in Garden City





## Interactive, Online Database Allows Teachers to Collaborate in New Ways

**A** new interactive online database allows teachers to search, modify, and add lesson plans. Educators create personal accounts to store new or regrouped lessons. Saved lessons are added to the database, enabling its growth. The ensuing collaboration leads to stronger, more efficiently developed lessons. Teachers are able to spend more time with students.

The “Reusable Learning Object Creation and Management System” database spans grade levels and disciplines. Kindergarten teachers to college professors will use it in lesson preparation. While some classes, such as history and math, will require minimal restructuring, others will need constant revision to stay current.

## Kansas Teachers Add Tools to Math Curriculum

**K**ansas teachers can receive help aligning their lessons and student tutorials with standards in mathematics. The Blending Assessment with Instruction Program (BAIP), developed by John Poggio, Ed Meyen and Diana Greer, includes 1,781 instructional units embedded in 276 lessons for teachers and 416 online tutorials for students. All lessons include extensions for accommodating the instructional needs of students with exceptionalities.

BAIP provides individual student and classroom data to teachers to help them prepare for statewide assessments. The Kansas State Department of Education has made the online resources available statewide. To date, 239 school districts have registered.

The e-Learning Design Lab in collaboration with the Center for Educational Testing and Evaluation (CETE) developed BAIP.

“Education over the Internet is going to be so big it is going to make e-mail usage look like a rounding error in terms of the Internet capacity it is going to consume.”

— John Chambers, CEO Cisco Systems

# Intelligent Systems Lab

**T**he 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

ISL advances knowledge in artificial intelligence, intelligent agents, information retrieval, data mining, and robotics. ISL researchers are customizing IT services, creating smarter and user-friendlier environments and devices.

human reason and action. Intelligent systems allow machines to anticipate requirements and deal with complex, dynamic environments.



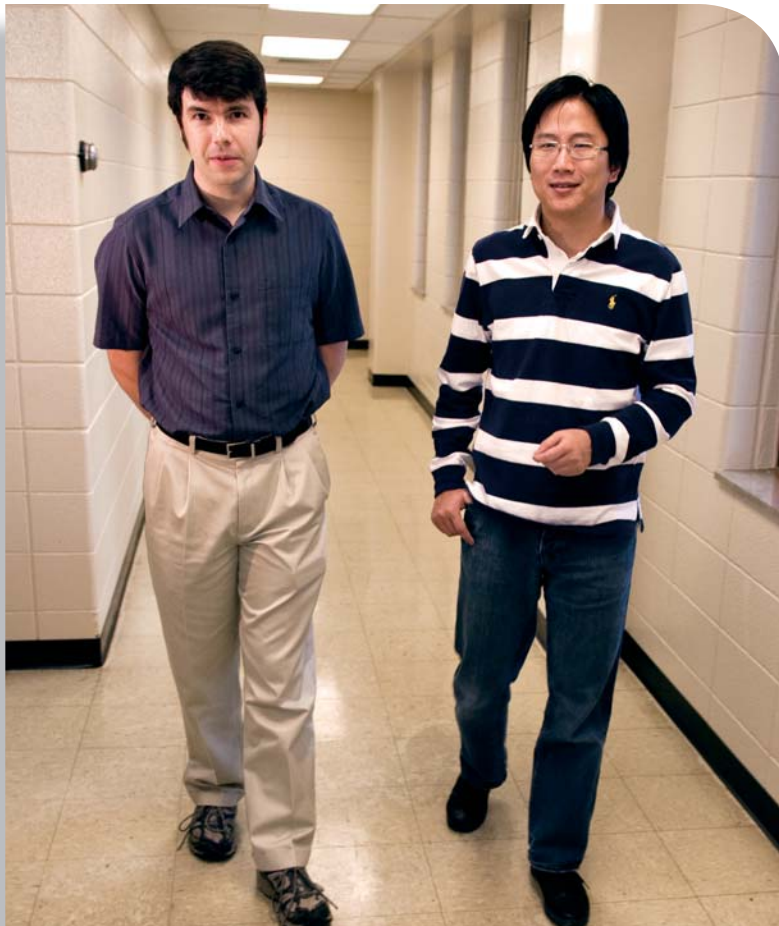
*ITTC postdoc Heather Amthauer works hard to maintain a balance between work and family. Her four-year-old daughter, Ava, is at the top of Heather's priority list.*

## Researcher Achieves Work-Life Balance

**A** researcher, mother, and wife, Heather Amthauer is an authority on prioritizing and negotiating. The Kansas native now develops these skills in Sensor Webs for a NASA-funded project. ITTC Sensor Webs incorporate intelligent and self-aware sensor agents. The collaborative agents must negotiate to pool and share resources for successful completion of sensing tasks. By combining the agents into coalitions, they will be able to better predict the effects of environmental change and natural disasters.

Heather attended Macalester College in Minnesota where she earned a B.A. in chemistry with a minor in biology. The opportunity to attend a leading research university that boasted an affordable cost of living led her back to Kansas. In 2003, she received a prestigious Self fellowship, which funded her doctoral studies in computer science at KU. She became an ITTC postdoctoral researcher this summer after successfully defending her dissertation. Heather hopes to find a teaching position at a university.





## New Faculty Has 3-D Vision

**F**or the first time, Brian Potetz is part of a university with a strong sports program. He is enjoying the fringe benefit. Potetz calls the two football games he attended in a packed, raucous Memorial Stadium this fall “pretty amazing.”

He is quick to point out that KU’s strong research focus and quality programs attracted him and his wife, Sarah Pressman, an assistant professor in psychology, to the University. The couple met at Carnegie Mellon University while pursuing their doctoral degrees.

Brian was excited to teach a graduate course in computer vision, his primary research interest. He examines the construction of 3-D pictures from single images. The medical and space industries have been among the early adopters of computer vision. Medical image processing assists surgeons, detects tumors and other abnormalities, and tracks the effectiveness of medical treatments. The Mars Exploration Mission reconstructs the planet’s surface with computer vision software.

The importance of Brian’s research can be seen by its funding agencies. In 2007, he received a National Institutes of Health (NIH) Computational Neuroscience Training grant. Prior to the NIH award, he had obtained a three-year National Science Foundation Graduate Research fellowship.

## Security Drives Luo

**E**veryone told Bo Luo that Kansas winters would be less harsh than those in the Northeast. He had endured the last five at Pennsylvania State University and was thrilled at the prospect of a milder winter. Bo finds it ironic that his first Kansas winter has produced some of the coldest days in recent memory.

Bo laughs as he says aside from the weather he is enjoying KU. He joins ITTC’s Intelligent Systems Lab (ISL) with expertise in one of the fastest growing fields, information security and privacy. Currently Bo is working on middleware that will check authorization for queries to medical databases. It will ensure that health care providers have access to specific records and provide them with relevant information. Additionally, Bo has applied for an NSF grant to study social networking sites, such as Facebook and MySpace, and delineate the flow, security, and privacy of information.

He is looking forward to the spring when his wife, Fengjun Li, will join him. She is in graduate school at Penn State, where the two met. She will conduct remote research on an anonymous Internet routing project.

“We are excited to have Bo and Brian join ISL. Their respective research shows great promise, and they are welcome additions to our evolving lab. The possibilities within intelligent systems are limitless, which makes research in this area exhilarating.”

— Arvin Agah, ISL director

# Radar Systems and Remote Sensing Lab

**R**SL is widely respected for its radar remote sensing research, which includes the well-known radar modes of imaging, detection, and tracking. This is the primary focus of the lab. Researchers investigate signal processing and system-level approaches to solving current radar problems. They explore potential new modalities of radar operation, such as simultaneous multimode operation, the exploitation of radar scattering to facilitate low probability of intercept communications, and new radar waveform design techniques.



Other RSL research has included the development of radar and radar subsystems that have been applied in other disciplines such as brain imaging with promising results.

## Self Fellow Married into Math

**W**hile most little boys dream of being a professional athlete or an action hero, Paul Anglin always wanted to be an inventor when he grew up. He now laughs as he talks about his fascination with blinking gadgets as a kid. Growing up, Paul excelled in math and science. He is still close to his high school math teacher, in part because she's his mother-in-law. Yep, Paul married his high school math teacher's daughter. His wife, Rian, is no slouch in science and math. She is conducting her pediatric residency at Children's Mercy, Kansas City, Missouri, which is what brought the couple to the Midwest.

Paul graduated summa cum laude from Auburn University in 2002 and worked in industry until this spring. He knew he wanted to return to school and started looking at universities in the Kansas City area. Paul came across ITTC Associate Director Jim Stiles' website. His work in mine detection and radar signal processing were both areas Paul had studied and wanted to pursue in his graduate work.

He views the Self Fellowship as a "huge opportunity." The four-year award, including a \$24,500 annual payment and full tuition and fees, helps recruit exceptional Ph.D. students to the University of Kansas.

With everything in place, Paul is attending class this fall and catching up on his reading. Sometimes the list feels like it has multiplied even as he crosses a book off it.





## Major Influences Future DoD Radar Designs

**A**s a Ph.D. student and U.S. Air Force Major, Geoff Akers understands the importance of multitasking. So much so, the idea has become a cornerstone of his research. Geoff is developing radar systems able to perform dual operations simultaneously. Current systems are limited to providing either image mapping, such as Google Earth, or moving target detection and tracking. A father of four young children, Geoff immediately recognized the inefficiency and added expense of multiple radar platforms performing independent missions. His system will perform imaging and moving target detection using one platform or multiple cooperating platforms. Geoff anticipates his research will influence future designs of Department of Defense radar.

Geoff chose ITTC/EECS because of its Radar Systems and Remote Sensing Laboratory (RSL), the broad range of courses, and the proximity of KU to his hometown of Eminence, Missouri. After his 2009 graduation, Akers will head the radar curriculum and research at the Air Force Institute of Technology (AFIT) at Wright -Patterson Air Force Base in Dayton, Ohio.

In 2006, Ph.D. student Jamie Jenshak was the first ITTC student to receive a newly created SMART Fellowship.

## Mr. Higgins Goes to Washington

**A**fter earning two degrees and spending seven years at KU, Ph.D. student Thomas Higgins is ready for a change of scenery. In January, he will begin working as a scientist at the Naval Research Laboratory (NRL) in Washington, D.C. Tom, who interned at NRL this summer, blushes slightly when he mentions his girlfriend still lives in D.C. A split appointment will allow Tom to work on NRL projects and complete his dissertation.

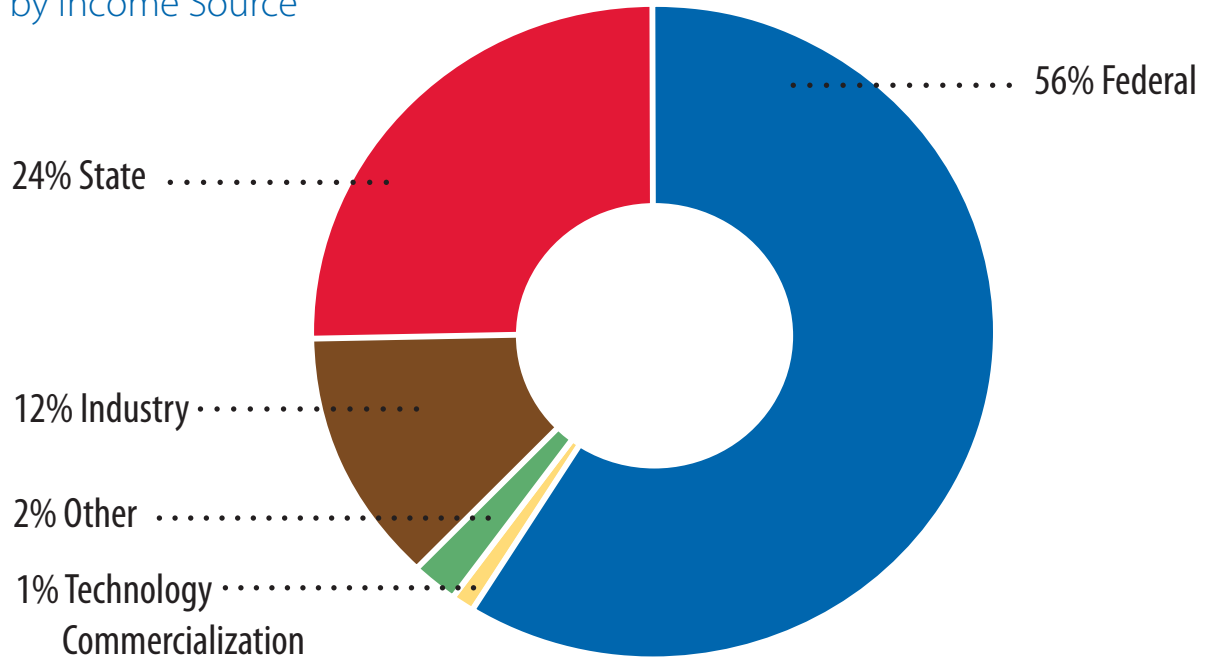
Tom's advisor, ITTC investigator Shannon Blunt, was with NRL before joining ITTC. While there, Shannon developed an algorithm to enable the separation of items of interest (namely detectable targets) from noise and interference. Tom spent the summer building upon his mentor's previous work. He completed and demonstrated a much faster program that has the potential to achieve real-time implementation. Tom will continue his research in the Radar Division when he returns to NRL.

A native Kansan, Tom was born in McPherson and grew up near Shawnee.



# ITTC by the Numbers

ITTC Research, Development & Commercialization Expenditures  
by Income Source



TOTAL EXPENDITURES FROM EXTERNAL INCOME .....\$3.7M  
 TOTAL REVENUE FROM EXTERNAL SOURCES .....\$4.1M



ACTIVE ITTC-AFFILIATE TENURE TRACK FACULTY .....	44
FACULTY IN LEADERSHIP POSITIONS.....	7
RESEARCH PAPERS PUBLISHED.....	125
ACTIVE SPONSORED RESEARCH PROJECTS .....	65
PATENTS FILED .....	5
PATENTS ISSUED.....	1
NEW INVENTIONS DISCLOSED.....	5
TECHNICAL SUPPORT STAFF .....	10
STUDENTS EMPLOYED.....	93
PHD STUDENTS.....	38
MS STUDENTS.....	43
UNDERGRADUATE STUDENTS .....	12
POST-DOCS.....	1



“In today’s world, business would do well to look toward the innovative research taking place in centers like ITTC. As a state and nation, we need to find new ways to use technology. ITTC helps us to understand what is possible and provides us with ideas on how to make possible, what is not. As we are challenged to create a new infrastructure and economy, it is good to be able to take advantage of this resource.”

— IAB Member Susan Norris, communications industry advisor,  
Norport Technology Management, Lenexa, Kansas



## The Industry Advisory Board

**Front row:** **Victor Hwang**, T2 Venture Capital, *Mountain View, CA*; **Joseph Evans**, ITTC, University of Kansas, *Lawrence, KS*; **Wayne Morgan**, Netchemia, *Lenexa, KS*; **Keith Braman**, ITTC, University of Kansas, *Lawrence, KS*; **COL Wayne A. Parks**, U.S. Army Combined Arms Center, *Ft. Leavenworth, KS*; **Chris Murrish**, Cerner Innovation, Cerner Corporation, *Kansas City, MO*; **Tom Crook**, Product & Technology Development, Sprint, *Overland Park, KS*; **David Nicol**, Solutionary, *Overland Park, KS*; **Mike Swink**, Ascend Intelligence LLC, *Arlington, VA*.

**Back row:** **Kevin Carr**, Kansas Technology Enterprise Corporation, *Topeka, KS*; **George Wilson**, KU Center for Research, Inc., University of Kansas, *Lawrence, KS*; **David Hardin**, Rockwell Collins, Inc., *Cedar Rapids, IA*; **Gerald White**, EDS, *Overland Park, KS*; **Tim Johnson**, IDEA Center, *Manhattan, KS*; **Susan Norris**, Norport Technology Management Consulting, *Lenexa, KS*; **Brian Ruf**, Ruf Strategic Solutions, *Olathe, KS*; **Victor Frost**, ITTC, University of Kansas, *Lawrence, KS*; **Jeff Fuller**, Firing and Initiation Systems, Honeywell FM&T/KCP, *Kansas City, MO*; **James Baxendale**, KU Center for Technology Commercialization, University of Kansas, *Lawrence, KS*.

# ITTC Principal Investigators

## Arvin Agah

Professor, EECS, Associate Chair Graduate Studies, Intelligent Systems Lab director  
*Distributed and biomedical robotics; multi-agent systems; autonomous mobile robots*

## W. Perry Alexander

Alexander Professor, EECS, 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; 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  
*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 Assistant Professor, ITTC, Computer Systems Design Lab, Communications and Networking Systems 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; stochastic analysis and its applications; stochastic adaptive control of linear partial differential equations; applied mathematics seminar; differential equations; probability theory*

## Güneş Erçal-Özkaya

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, ITTC director, Communications and Networking Systems Lab, Information Assurance Lab  
*Networks; ubiquitous computing environments; adaptive systems*

## Jianwen Fang

Assistant Scientist, Bioinformatics and Computational Life-Sciences Lab, Applied Bioinformatics Lab director  
*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*

## Andy 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  
*Data mining; machine learning; rough set theory*

## 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, 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

Associate Scientist, Molecular Graphics and Modeling Lab director, Courtesy Assistant Professor, Medicinal Chemistry, Medicinal Chemistry Labs director, 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 codirector  
*Online instructional design, web tools; emerging instructional technologies*

## James Miller

Associate Professor, EECS, Computer Systems Design Lab, e-Learning Design Lab codirector  
*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*

## Richard Moore

Distinguished Professor Emeritus, EECS  
*Radar systems; scatterometry, radar observation of earth; radar oceanography; spaceborne radars; radar meteorology; radio wave propagation*

## Douglas Niehaus

Associate Professor, EECS, Computer Systems Design Lab, Intelligent Systems Lab  
*Real time, conventional distributed systems; operating systems; high performance networking*

## Bozena Pasik-Duncan

Professor, Mathematics, Courtesy Professor, EECS  
*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*

## Dave Petr

Professor, EECS, Communications and Networking Systems Lab, Associate Chair Undergraduate Studies  
*Performance analysis; traffic integration; congestion control; resource management; QoS*

## Brian Potetz

Assistant Professor, EECS, Intelligent Systems Lab  
*Computer vision; machine learning; computational neuroscience and natural scene statistics*

## Glenn Prescott

Professor, EECS chair, Radar Systems and Remote Sensing Lab, Communications and Networking Systems Lab  
*Digital signal applications and low probability of intercept communication*

## James Roberts

Professor, EECS, Communications and Networking Systems Lab  
*Wireless, spread-spectrum communications and information theory and coding*

## Hossein Saiedian

Professor, Associate Chair Edwards Campus, Computer Systems Design Lab, Information Assurance Lab, Intelligent Systems Lab  
*Software architecture; software processes, management; agile software development*

## Sam Shanmugan

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

## James Sterbenz

Associate Professor, EECS, Communications and Networking Systems Lab, Computer Systems Design Lab, Information Assurance Lab  
*Survivable, resilient, disruption tolerant networking; programmable, active networks*

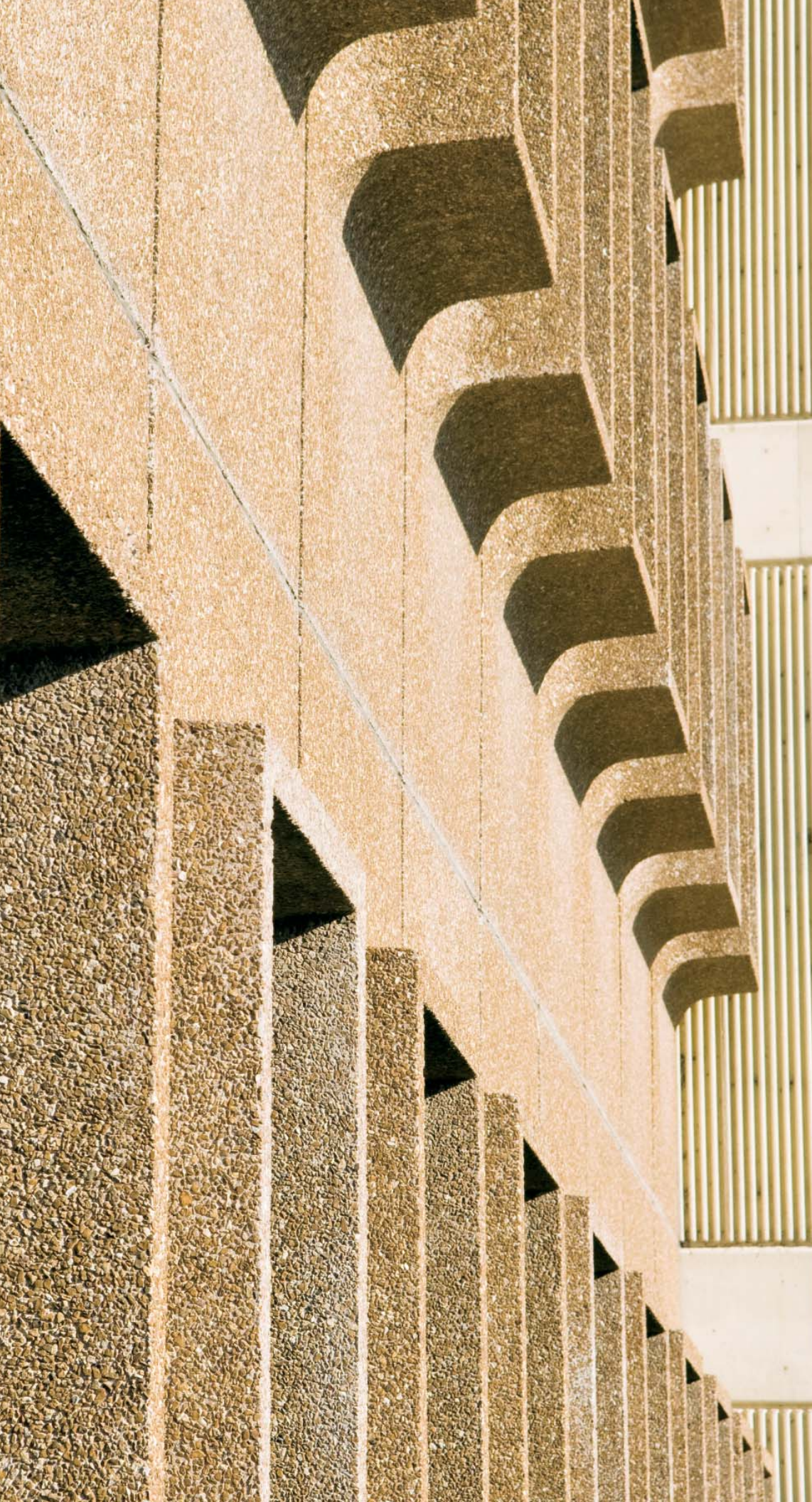
## James Stiles

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*

## Victor Wallace

Professor Emeritus, EECS, Communications and Networking Systems Lab  
*Interactive graphics; virtual reality and human interface design; distributed and real-time systems; computer network performance modeling; ATM traffic analysis models; operating systems theory; queuing theory*





## 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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## 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  
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