

THE UNIVERSITY OF KANSAS

**Information and Telecommunication
Technology Center
(ITTC)**

Annual Report

Fiscal Year 2005

"Affinity for Excellence"

The ITTC Vision:

To be a global leader in, and catalyst for, the unification of computing, communication, and sensor technologies while being a strategic partner for their commercialization.

The ITTC Mission:

- To create the fundamental knowledge and technologies required to realize the convergence of computing, communications, and sensors for the expansion of our economy and the improvement of the quality of life.
- To educate the next generation of technology leaders who will drive this convergence.
- To transfer to industry the knowledge and technology that will enable this convergence.

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The ITTC Motto:

*Our Focus...
is Your Future!*

Director's Welcome

Thank you for your interest in ITTC. Fiscal Year 2005 was marked by strong growth and development for the Center as ITTC affirmed its **affinity for excellence**, the theme of this year's Annual Report. We significantly expanded our core base, building upon a stable and substantial foundation. Our breadth of research activity and the development of innovative technologies serve as the underpinnings for a bright future for ITTC.



The addition of seven faculty investigators fills the Center with enthusiasm and energy. In fact, we have added 10 new investigators in the last three years. From radar systems to wireless communications, including three researchers in bioinformatics, we have secured top-notch additions to our distinguished list of investigators. Their research will serve as a catalyst for even greater advancements in our thrust areas.

Studying the relationships and interactions in biological systems is an incredibly compute- and data-intensive challenge. Our new bioinformatics computer cluster, with its increased storage and faster processing facilities, is turning data into useful knowledge of biological systems. A greater understanding of these systems could lead to improved medical diagnoses, treatments, pharmaceuticals, and a host of other benefits.

We continue building relationships with Kansas companies and transferring technology to the private sector. ITTC, the Lenexa-based Rush Tracking Systems, and the RFID Journal formed the RFID Alliance Lab this fall. The Lab has published two objective benchmarking reports on RFID technologies, examining how RFID tags perform when placed in numerous realistic scenarios. For more information, please go online to www.rfidalliancelab.org/index.html.

The following pages highlight our accomplishments in FY2005. Please take a look at the exciting R&D activities occurring within ITTC.

A handwritten signature in black ink, appearing to read "Victor S. Frost". The signature is fluid and cursive.

Dr. Victor S. Frost
Dan F. Servey Distinguished Professor,
Electrical Engineering and Computer Science
Director of ITTC

ITTC's Affinity for Excellence

ITTTC helped attract six tenure-track faculty researchers from top-tier universities, research organizations, and companies during Fiscal Year 2005; these investigators see ITTC and its history of excellence as a launching point for their careers. With the addition of these six new teaching faculty along with one more research assistant professor, the Center has obtained eleven new faculty members in the last four years. This group of new researchers includes doctoral graduates from Purdue University, Penn State, Carnegie Mellon University, and McGill University. Other newcomers established research programs within the U.S. Naval Research Laboratory (NRL) and the University of Chicago before joining ITTC. The Center's executive staff also sought out faculty with industry credentials. New ITTC investigators have previously conducted innovative research at Motorola, BBN Technologies, and Science Applications International Corporation (SAIC). To learn more about this illustrious group, please see the "New Investigators" section, starting on page 30.

Among the eleven, Ron Sass, an ITTC research assistant professor, has earned an IBM Faculty Award since his arrival in the fall of 2004. The \$20,000 IBM award funds his work on the enhanced performance of embedded systems, which are found in everything from cars to medical equipment to vending machines. Another relative newcomer, **Terry Clark**, co-authored a book, *Parallel Scientific Computing*, which was published by Princeton University Press in the summer of 2005. Clark, whose last position was with the University of Chicago, is establishing a research program in computational methods and data management systems for biomolecular applications at ITTC. Clark was instrumental in the development of ITTC's new bioinformatics computer cluster, which was brought online in the summer of 2005. The cluster enables researchers to fragment computations and perform them in parallel, significantly enabling compute- and data-intensive bioinformatics research at KU, such as

the analysis of genomes that contain billions of nucleotides. The cluster, which is one of the largest at KU, demonstrates the Center's commitment to pioneering research.

Groups within the University and from a national level

have recognized ITTC's affinity for excellence. Researchers from KU's Molecular Graphics and Modeling Laboratory and its Bioinformatics Core Facility have joined ITTC. They are helping the Center develop a new focus area in bioinformatics, which was formally announced last fiscal year. **Joe Evans**, Deane E. Ackers distinguished professor of electrical engineering and computer science, rejoined ITTC and also became the director of research information technology at the KU Center for Research. He returned after his two-year appointment with the National Science Foundation where he was the program director of networking in the Computer and Network Systems Division of the Directorate of Computing and Information Science and Engineering. He is the fourth ITTC-affiliated faculty member to serve as a federal program manager.

With innovative faculty and first-rate resources,

ITTC attracts a superior group of student researchers. **Jeffrey Young**, a National Science Foundation (NSF) Fellow, chose KU and ITTC for his graduate work in computer science when he had the opportunity to attend any accredited university within the United States or internationally. Self Fellows **Heather Amthauer** and **Chris Taylor** conduct their Ph.D. research at the Center along with Sprint Fellow **Sohel Khan**.

ITTC will continue uniting visionary researchers with cutting-edge facilities to increase the Center's excellence and produce the next generation of information technologies.

Fiscal Year 2005 Overview

ITTC continues to make progress toward fulfilling its mission of research, education, and technology transfer. During FY2005, ITTC secured more than \$6.6 million in awards for sponsored research. Throughout the past fiscal year, the Center has submitted 87 research proposals totaling more than \$25 million in research efforts.

ITTC continues to support a number of local companies in their technology development efforts, including ELearning Creations; Sprint; Cadstone, LLC; Veatros, LLC; and Rush Tracking Systems.

FY2005 Accomplishments

Realigned ITTC Thrust Areas

To position ITTC for future opportunities means to continually evolve ITTC's research activities, which are reflected in the Center's structure. A laboratory/thrust-area structure is used to organize, focus, and coordinate the strengths of the Center. ITTC was initially composed of four laboratories: Intelligent Systems and Information Management, Lightwave Communication Systems, Networking and Distributed Systems, and Wireless Communications and Digital Signal Processing. Over time these thrust areas have evolved. Specifically, the Radar Systems and Remote Sensing Laboratory and e-Learning Design Laboratory were added first, and later the Bioinformatics and Computational Life-Sciences Laboratory and Computer Systems Design Laboratory were created. The Networking and Distributed Systems and the Wireless Communications and Digital Signal Processing Laboratories were eventually consolidated into the Networking and Wireless Systems Laboratory. This new structure positions the Center for continued growth.

Employed New Bioscience Computer Infrastructure

ITTC's role in bioinformatics continues to expand. Bioinformatics is a research area complementary to the Center's traditional expertise in computing, communications, and signal processing. Bioinformatics is a very broadly defined term, including everything from the design of special-purpose supercomputers for proteomics, using biological materials in computing, and data mining in very large data bases, to computational biology. The common theme is the combination of biology with computational methods, computer science, and mathematical/statistical analysis.

The bioinformatics activities in ITTC are nearing "critical mass." Research in bioinformatics is being conducted by established KU professors as well as the three new tenure-track EECS bioinformatics faculty, one research assistant professor (in collaboration with the Molecular Graphics and Modeling Laboratory and Kansas IDeA Network of Biomedical Research Excellence: K-INBRE), one postdoctoral associate, and two full-time support staff. Further, ITTC is now involved with bioinformatics activities around KU: e.g., with Higuchi Biosciences Center, we are associated with storage and processing of microarray data; with the Structural Biology Center, the storage of mass spectrometry data and collaborative communications; and with KU Medical Center, cluster processing and collaborative communications.

The ITTC bioinformatics computing and storage infrastructure now includes a 384-processor cluster computer with 27 TB of on-line storage and a state-of-the-art data back-up system. This facility is now being used to support life-science activities of several ITTC as well as non-ITTC researchers. Specifically, Professor **Roberto De Guzman**, of KU's Division

Key ITTC Performance Indicators (not including KTEC & MAMTC* funds)

Key Indicators	FY2001 Actual	FY2002 Actual	FY2003 Actual	FY2004 Actual	FY2005 Actual
R/D&C Industry Funds Leveraged	\$ 660,584	\$ 685,656	\$132,834	\$ 576,334	\$316,709
R/D&C Federal Funds Leveraged	\$ 3,706,281	\$ 5,101,914	\$ 6,708,851	\$ 6,365,848	\$6,195,274
Total R/D&C Funds Leveraged	\$ 4,366,865	\$ 5,787,570	\$ 6,841,685	\$ 6,942,182	\$6,511,983
New Technologies Commercialized in KS	3	4	7	1	0
Licenses Awarded	5	5	3	1	1
License Fees/Royalties	\$ 139,757	\$ 172,215	\$ 67,212	\$ 81,370	\$38,351
New Companies Formed in KS	0	2	0	0	0

*Mid-America Manufacturing Technology Center: KTEC funding for MAMTC is awarded through ITTC (\$87,354 for FY2005).

of Biological Sciences, solved for the 3D structure of a protein from *Burkholderia pseudomallei*. Dr. **Jianwen Fang** is using the infrastructure for simulation of molecular dynamics in support of research headed by Dr. **Ron Borchardt**, of Pharmaceutical Chemistry. Dr. **Yang Zhang** from KU's Bioinformatics Center is using the infrastructure to develop new computer algorithms to predict and deduce three-dimensional protein structures from amino acid sequences, and **Krzysztof Kuczera** from Chemistry is beginning to use the facility for molecular dynamics simulations. In addition to ITTC investigators conducting their own bioinformatics research, the Center is becoming a campus-wide resource for both bioinformatics computing and applications support.

Formed Partnership to Provide Technical Resources and Expertise for the Transfer of Software and IT for KU

ITTC and KU's Office of Technology Transfer and Intellectual Property (OTTIP) have joined forces to enhance their technology transfer and commercialization services for the Lawrence Campus. This collaborative relationship will provide additional technical resources and expertise for the transfer of software and information technologies for the entire Lawrence campus.

For the past several years ITTC's Office of Applied Technology has provided a large part of the technology maturation and commercialization effort for the technologies coming out of the Center. ITTC's efforts in technology transfer have yielded more than \$1 million in commercialization revenues returned to the University. In addition, the Center has been a catalyst for the formation of a number of start-up ventures.

But software and information technologies are developed through KU research projects across the entire campus—many in units outside the purview of ITTC. We have recognized the ongoing convergence of IT throughout the sciences and believe that together with **Jim Baxendale's** office

(OTTIP) we have an opportunity to leverage ITTC's expertise and resources by directly assisting the IT commercialization efforts throughout the University. The new ITTC/OTTIP relationship also advances the Kansas Technology Enterprise Corporation (KTEC) mission by expanding ITTC involvement in IT technologies that are not otherwise associated with the Center. Under the new agreement, ITTC will assist with technology evaluation, IP protection, marketing and licensing of KU software, and information technologies developed across the University of Kansas campus.

Support of NSF's New Polar Science and Technology Center

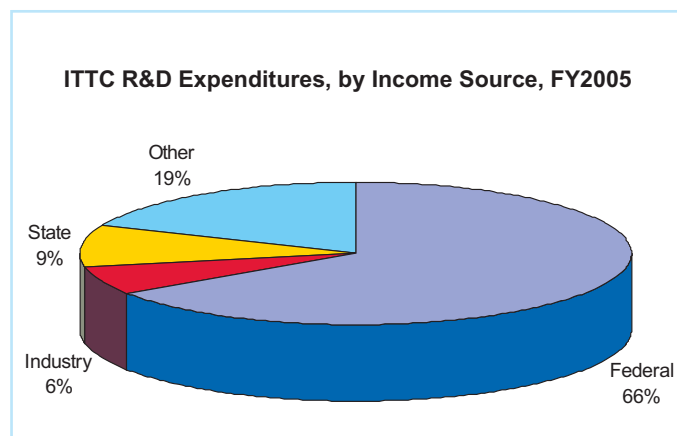
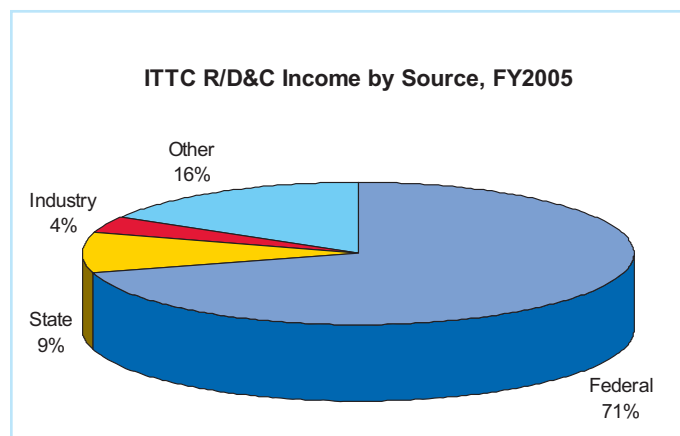
The Center for Remote Sensing of Ice Sheets (CRISIS) is a new independent KU research center that grew out of the Radar Systems and Remote Sensing Laboratory (RSL) and ITTC's National Science Foundation large Information Technology Research grant for Polar Radar for Ice Sheet Measurements (PRISM). It was established as a NSF Science and Technology Center. This effort is expected to provide invaluable information to glaciologists studying polar ice melt and global warming.

FY2005 Outreach Events

Active Networking Conference

The sixth annual International Working Conference on Active Networking (IWAN) gathered researchers from four different continents at ITTC on October 28 and 29, 2004. **Gary Minden**, director of ITTC's current Communications and Networking Systems Laboratory (NWSL), led the conference that focused on active networking systems, security, applications, and management.

While funding for basic networking research has decreased in the past few years, the conference participants are heavily involved in developing new programmable net-



works with self-organizing capabilities. The participants recognized the need to make networks easier to set up and operate and to adapt to current user needs. For example, networks should support users' moving from one location to another with little user input. Threats to network operation were also discussed, along with mechanisms to improve the robustness of common communications networks.

Bioinformatics and Telemedicine Hot Team

ITTC provided leadership in the "Hot Teams" stage of the Kansas Bioscience & Innovation Roadmap initiative, from January through April 2005. Industry, academic, and civic leaders met and worked together to develop strategic plans in six focus areas for the statewide initiative to boost the State's burgeoning biosciences industry. ITTC Executive Director **Tim Johnson** co-chaired the "Hot Team" that dealt with "Health-Related Information Technology—Bioinformatics and Telemedicine." **Nancy Hanson**, a program assistant at ITTC, served as "shepherd" for the Team. The Team produced seven strategic business plans, all of which were eventually either accepted as stand-alone plans or incorporated into joint plans with other teams for further development by the initiative's Steering Committee.

ITTC at the Capitol

ITTC participated in the second annual KU in the Capitol Day on March 16, 2005. Policy makers and other state officials had the opportunity to learn about more than 40 university programs. **Michelle Ward**, ITTC's public relations coordinator, interacted with legislators, state employees, KU staff, and students who stopped by during the day.

ITTC Technology Review and Industry Advisory Board (IAB) Meeting

More than 80 invited guests took part in ITTC's Spring 2005 Research Overview for Industry on April 7. The Center's researchers highlighted their work in wireless and networking, intelligent systems, computer systems design, and bioinformatics and life sciences during four sessions. (See presentations and posters online at <http://www.ittc.ku.edu/techreview2005/program2005.html>.)

The Overview included its traditional student poster session, which showcased 33 research projects via student-created posters displayed in the atrium of Nichols Hall. Almost every project in the Center was represented in either the Overview or the student poster session.

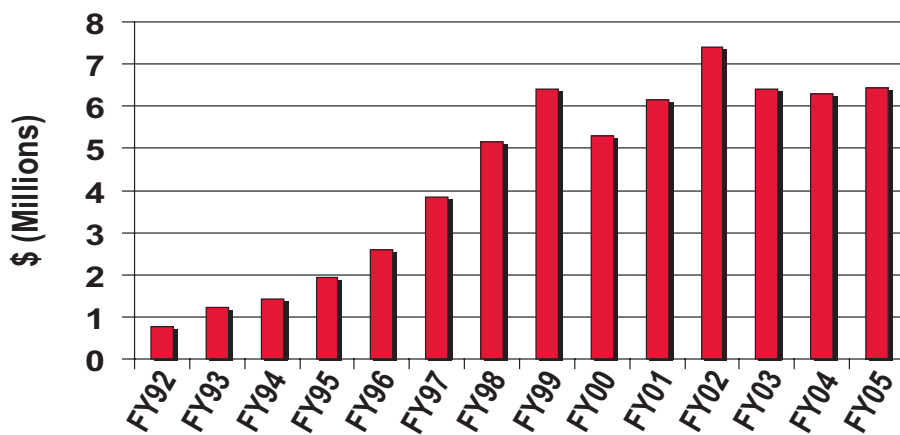
During the meeting, Executive Director **Tim Johnson** recognized **Brian Ruf** of Ruf Strategic Solutions who has served the Center for more than 10 years as an IAB member.

The morning following the Overview, April 8, the Center held its annual Industry Advisory Board (IAB) meeting. The Board helps guide ITTC's research and development. Members of the Board participated in a lively discussion that produced suggestions for improvements in ITTC's marketing and strategic planning. (See IAB members on page 8.)

"What pleases me most about the IAB is the very symbiotic relationship it has with the Center. Industry and academia think differently—and both benefit from discussing their sometimes widely differing reactions to the same issue," says IAB member **Susan Norris** of Norport Technology Management Consulting. Our success is no doubt in part due to the individual and collective contributions of our IAB members.

The next section, "Technology Transfer," enumerates further notable achievements by the Center during FY2005.

ITTC R&D Core Expenditures



ITTC recognizes that innovation is of little value to society unless and until it can be utilized by society, and we approach innovation transfer as an essential part of our research mission. To enable society to realize the value of the Center's technologies, and specifically to improve the Kansas economy, ITTC strategically leverages its unique research and development infrastructure in a continuous effort to transfer the ideas that flow from our research. Throughout the last decade, ITTC has committed itself to the development and commercialization of technologies important to the economic development of Kansas.

Technology Transfer Activities

During the past fiscal year, ITTC's involvement in activities that support new technologies and their transfer included the following:

Formation of the RFID Alliance Lab in collaboration with Rush Tracking Systems (a Kansas technology company) and the RFID Journal (an International publisher for the RFID industry community). The RFID Alliance Lab functions as an independent evaluator of developing RFID technologies, providing the industry with an objective analysis of the technologies' performance. (See more about the RFID Alliance Lab on page 36.) This Lab involves ITTC in a field of growing importance, as RFID is a rapidly emerging technology with great market acceptance.

Participation in the Lawrence Technology

Showcase, featuring cutting-edge technologies and start-up businesses, November 3, 2004. ITTC highlighted two of our technologies that have evolved through our internal technology development efforts: The first was **Susan Gauch's** program Chat Track, which is an intelligent system to track online chat room conversations; the second, **Danico Lee and Costas Tsatsoulis' SmartXAutofill**, which is an XML-data-entry assistant that uses artificial intelligence to predict values entered. People from KU, local and state government, and the business community attended the Showcase. Goals for the event were to strengthen ties between the University and the community, raise awareness of the culture of innovation that exists in Lawrence, and highlight Lawrence as fertile ground for developing ideas at the forefront of science into sustainable economic growth and, ultimately, goods and services that benefit our lives.

Technology transfer throughout FY2005 included the support of two ITTC start-up companies. ITTC researchers were awarded two U.S. patents and filed four additional patent applications. Additionally, two technologies are being commercialized in Kansas. ITTC generated \$38,351 in technology transfer revenues during Fiscal Year 2005.

Internal Commercialization Projects

Each year, ITTC solicits proposals for technology development projects from within the University community and invests in a number of the most promising among them, targeting them for commercialization. The Center approves new internal technology development projects only after a positive review by staff and Industry Advisory Board (IAB) members. These projects must have commercial potential and must be in areas of ITTC's technical expertise. In the past, such projects have led to spin-off companies and licensed technologies and have enhanced the Center's knowledge base, which is then applied to support other commercialization opportunities and Kansas companies. A number of these projects have matured to a point of commercialization and are being shown to our industry partners. Through the year we have focused much of our effort into maturing a number of technologies that we expect to be ready to transfer to our commercial partners early in Calendar Year 2006.

Below is a partial list of ITTC's internal commercialization projects active during FY2005:

Intelligent AutoFill Form for XML: Software technology that uses statistical techniques to automate the entry of data in XML forms based on the contents of other forms in the same domain.

Opto-Magnetic Polymer: An enabling technology to realize integrated optical isolators in optical transmitters and high-sensitive, magneto-optic sensors.

HDTV: A wideband, planar receiving antenna that performs well under multi-path conditions.

Optical Domain Signal Analyzer: Technology that provides high-resolution and wide-bandwidth testing of optical signals.

Conceptual Search Engine: A search engine that retrieves documents based upon a combination of keywords and conceptual matching.

Temporal Search for the World-Wide Web: A system that queries a collection of Web pages relative to a specific time or time frame (i.e., tracks time-sensitive information).

ChatTrack: An instant-messaging archival technology. The technology will provide a real-time chat filter that enables safe chat procedures and an archive and classification system that allows for post-chat review.

Rosetta Technologies: An emerging systems-level design description language. The commercialization approach is the development of a Rosetta analysis environment, tools, and services. Two efforts are currently being explored: the first is the Analysis Support for Distributed Firewalls; the second, a Systems-Level Security Using Rosetta. (Read more about Rosetta and Cadstone, the company created to market the product, on page 39.)

Algorithm Development for Microarray Data

Analysis: A computational method for inferring putative transcription factor binding sites from gene expression data. This effort is targeted towards the development of a bioinformatics toolkit for microarray data analysis.

Patents Issued

ITTC continues to pursue patents on Center-developed technologies. The Center has earned its second U.S. Patent for its work with polarization-mode dispersion (PMD). At very high data rates PMD randomly corrupts signal quality on fiber-optic cable and cannot easily be distinguished from other kinds of problems, but ITTC researchers have developed a technique for detecting PMD-induced errors so that corrective action may be taken. **Chris Allen** along with Sprint's **Doug Richards** and **Doug Hague** were awarded the patent in August 2004.

Dan DePardo, an ITTC RF electronics engineer, invented a wideband planar antenna and was awarded a U.S. patent in November 2004. The antenna offers a relatively inexpensive method of increasing the frequency range or "bandwidth" capability over traditional patch antennas. The antenna can improve HDTV reception and computer wireless signals and be used in a variety of antenna design situations.

(For titles and numbers of patents issued in FY2005, please see page 47.)



Susan Gauch, director of ITTC's Intelligent Systems Laboratory (ISL), explains the instant-messaging archival software she created, called "ChatTrack," during the November 2004 Technology Showcase in Lawrence. ChatTrack provides chatroom security techniques applicable to family, business, and national defense matters.

Industry Advisory Board

Pictured here with ITTC executives are 17 of the 18 Board members who attended the spring 2005 IAB meeting at ITTC on April 8. The photo was taken by Wally Emerson.

Left half, left to center:
Kevin Carr,
Stan Pierson,
Phil Anderson,
Brian Ruf,
Gary Mastin,
Victor Frost.



Right half, left to right:
(top row) John Strand, Susan Norris, Keith Braman;
(next row down) Arcady Mushegian, Ben Vos;
(third row down) Wayne Morgan, Jim Roberts, Toby Rush, Marc Epard;
(front row) David Nicol, Tim Johnson, Gerard Canavan, John Hansen.

ITTC's Industry Advisory Board (IAB) helps guide the Center by advising on actions for future development. Members are drawn from businesses, large and small, and KU departments dealing in research and technologies related to ITTC's focuses. Members of the IAB during FY2005 were as follows:

Gary Alexander, Alexander Open Systems, Overland Park, Kan.
Phil Anderson, Ameriprise Financial, Lawrence, Kan.
James Baxendale, KU Center for Research, Inc., Lawrence, Kan.
Gerard J. Canavan, CCT, Englewood, Colo.
Kevin Carr, Kansas Technology Enterprise Corp., Topeka, Kan.
Steve Chaddick, Ciena Corp., Linthicum Heights, Md.
Jim Dahmen, Columbus Telephone Co., Inc., Columbus, Kan.
William P. Duncan, Kansas City Area Life Sciences Institute, Kansas City, Mo.
Marc Epard, Netopia, Inc., Lawrence, Kan.
Jeffrey G. Fuller, Honeywell FM&T/KCP, Kansas City, Mo.

Gunda Georg, Medicinal Chemistry, University of Kansas, Lawrence, Kan.
Bennett Griffin, Griffin Technologies, Lawrence, Kan.
John Hansen, Cerner Corporation, Kansas City, Mo.
James Isaacs, ITT Aerospace/Optical Div., Ft. Wayne, Ind.
Patrick Knorr*, Sunflower Broadband, Lawrence, Kan.
Bob LaGarde, LaGarde Inc., Olathe, Kan.
John Louis, Networking and Telecommunications Services, University of Kansas, Lawrence, Kan.
Tom Lyon, Lyon About, LLC, Palo Alto, Calif.
Gary Mastin, Lockheed Martin Integrated Systems and Solutions, Litchfield Park, Ariz.
Matt McClorey, Lawrence Regional Technology Center, Lawrence, Kan.
Mazen Mikha, Boeing Company, Wichita, Kan.
Wayne E. Morgan, Netchemia, Olathe, Kan.
Arcady Mushegian, Stowers Institute, Kansas City, Mo.
David Nicol, Overland Park, Kan.

Susan Norris, Norport Technology Management Consulting, Lenexa, Kan.
Stan Pierson, Aeroflex Test Solutions, Wichita, Kan.
James Roberts, KU Center for Research, Inc., Lawrence, Kan.
Brian Ruf, Ruf Strategic Solutions, Olathe, Kan.
Toby Rush, Rush Tracking Systems, Lenexa, Kan.
Michael F. Sobek, StoreFinancial, Overland Park, Kan.
Deborah R. Stokes, Nortel Networks, Richardson, Texas
John Strand, Oak Ridge National Laboratory, Oak Ridge Tenn./Leavenworth, Kan.
Kathy Suprenant, Molecular Biosciences, University of Kansas, Lawrence, Kan.
Ben Vos, Sprint, Overland Park, Kan.
Gerald J. White, BV Solutions Group, Overland Park, Kan.
George Wilson, KU Center for Research, Inc./ Chemistry/ Pharmaceutical Chemistry, University of Kansas, Lawrence, Kan.

* **Stephen Schneider** has replaced Mr. Knorr from Sunflower Broadband on ITTC's IAB.

Labs Overview

ITTC works to create fundamental knowledge and technologies that are enabling the convergence of computing, communications, and sensors. Visionary researchers from diverse areas give the Center its breadth of research activity. Currently more than 113 graduate and 23 undergraduate students are gaining hands-on experience under the direction of 55 ITTC-affiliated faculty and staff researchers. The Center is educating the next generation of technology leaders as it focuses not only on solutions to today's complex problems but also on the technological needs of tomorrow. ITTC research is categorized under the following six research laboratories:

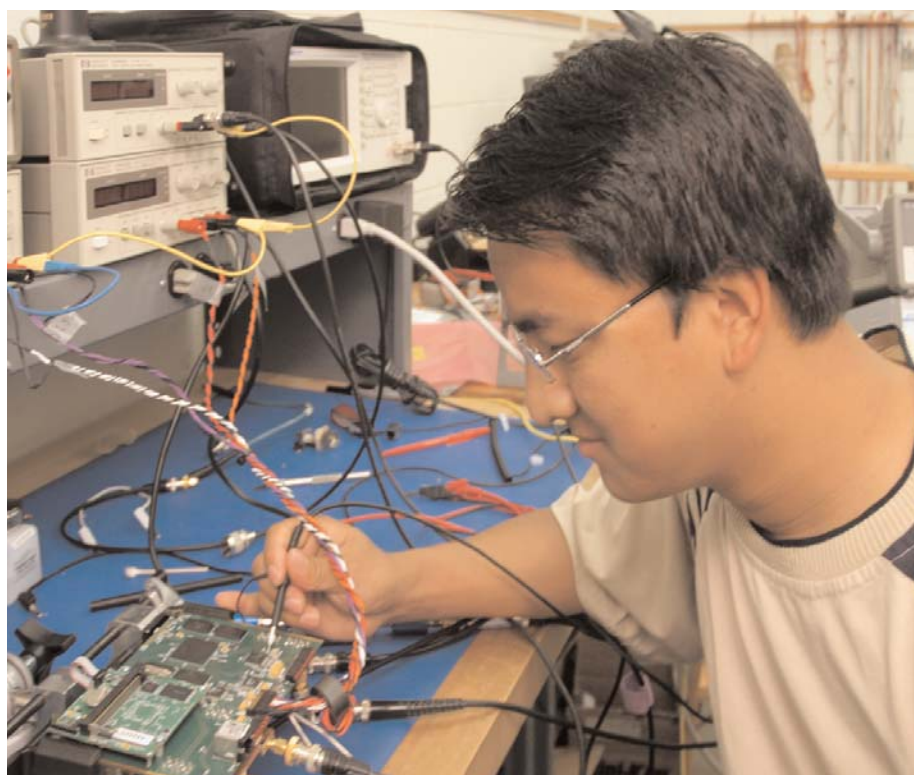
- Bioinformatics and Computational Life-Sciences Lab (BCLSL)
- Communications and Networking Systems Lab (CNSL)
- Computer Systems Design Lab (CSDL)
- e-Learning Design Lab (eDL)
- Intelligent Systems Lab (ISL)
- Radar Systems and Remote Sensing Lab (RSL)

The Center houses state-of-the-art facilities, including a high-speed networking lab with a fiber connection to a long-distance network. Researchers work in a digital radio laboratory that provides design and fabrication capabilities along with digital signal processing. The Center possesses an integrated, diverse networking environment and a leading-edge photonics research laboratory. Complementing the hardware facilities, the Center uses some of the best-in-class design, software-development, and bioinformatics tools.

Ph.D. student Rakesh Rajbanshi probes a field-programmable gate array (FPGA) board, checking for a signal. ITTC researchers use FPGAs in the design of specialized integrated circuits that can later be produced in large quantities for distribution to computer manufacturers. In the future, FPGAs might allow computer users to adapt microprocessors to meet their individual needs.

ITTC's new computing cluster, made up of 128 processors with 25 terabytes of storage, permits researchers to fragment computations and perform them in parallel. Such division of labor permits the analysis of genomes with billions of nucleotides, and other data-intensive computations. The multiple machines housed in one location on a high-speed network make the ITTC computing cluster a powerful, integrated platform for researchers.

The Center places great emphasis on realizing the commercial potential of the technologies and expertise developed in its laboratories. As a KTEC Center of Excellence, ITTC has transferred numerous technologies to companies, and it supports companies in their technology development efforts. For example, researchers in ITTC's Communications and Networking Systems Laboratory (CNSL) teamed with Rush Tracking Systems, a Lenexa, Kansas-based firm, to provide objective benchmarking reports on radio frequency identification (RFID) technology. The Center has spun out additional technologies to create start-up companies and continues its successful development of internally funded commercialization efforts. To date, 19 U.S. patents have been granted as a result of ITTC research.



Bioinformatics and Computational Life-Sciences Lab (BCLSL)

Interim Director: Victor Frost



The Bioinformatics and Computational Life-Sciences Laboratory (BCLSL) advances methods and tools geared to biological, biochemical, and medical applications. BCLSL investigators work with collaborators in the life sciences to identify, research, develop, and apply key computational approaches. These efforts directly involve the biological and medical domains in areas of modeling, analysis, and data management. In addition, concomitant research in traditional computational methods such as algorithm optimization, data- and compute-intensive methodologies, and statistical methods are pursued to meet the specialized needs of these problem domains. This interdisciplinary work in applied and basic research involves investigators from computer science, electrical engineering, mathematics, and life-science and medical disciplines.

Lab resources:

In addition to extensive software architecture including applications widely used in the public domain, the BCLSL provides:

Artificial intelligence development tools and languages
Massively parallel computer clusters, large-memory-capacity computer, terabyte storage systems, reconfigurable floating-point gate arrays
Databases and data-management systems for genomics data (GUS) and microarray data

Laboratory-data retrieval and management infrastructure
Parallel development tools including MPI, High Performance Fortran, and Pfortran compilers
Parallel molecular dynamics programs
Parallel BLAST Web server for sequence alignment

Communications and Networking Systems Lab (CNSL)

Lab Director: Gary Minden



The Communications and Networking Systems Laboratory (CNSL) advances knowledge of systems interconnected via radio and other technologies as well as increasing the performance and protection of Internet-based systems. CNSL also seeks to develop technologies to deliver reliable information to support end-user applications independent of the access technology.

Lab resources:

DSP rapid prototyping system
Logic analyzers
Network analyzers
Spectrum analyzers
Oscilloscopes and function generators
Prototype PC board fabrication tools and facility
RF signal generators
Variety of DSP platforms and evaluation tools
Extensive high-speed networking infrastructure: connected to high-speed, wide-area networks; fiber connection to the Sprint backbone network; cable connection to Sunflower Broadband's cable modem and TV network; Internet2; wide variety of routers, switches, and network interfaces
Extensive wireless LAN (Wi-Fi) networks

30 km of fiber installed for systems-level testing
Tunable laser sources and optical filters
Electro-optic modulators, WDM multiplexers, demultiplexers
High-speed photodetectors to 40Gb/s
Commercial WDM systems at OC192 and OC48 data rates
40Gb/s and 12Gb/s BERTs
RFID performance benchmarking facilities
Bluetooth evaluation facilities
High-speed workstations
Hardware and software design experience: developed network testing and measurement tools, network simulation and modeling tools, Web applications and servers, integrated wireless mobile systems with fixed networks; designed and implemented a software-defined radio

Computer Systems Design Lab (CSDL)

Lab Director: **W. Perry Alexander**



The Computer Systems Design Laboratory (CSDL) focuses on the design, implementation, and verification of systems whose primary components include computers. CSDL research addresses the design of computing systems ranging from small embedded elements to large distributed computing environments covering all aspects of the system lifecycle from requirements analysis through testing and validation.

Lab resources:

Equipment:

- Xilinx FPGA prototyping systems
- Reconfigurable distributed computing cluster
- Wireless radio testbed

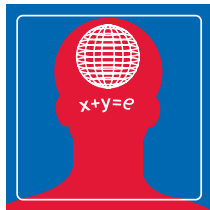
Hardware and software design experience:

- Rosetta system-level specification language and analysis tools

- KU Real Time (KURT) Linux
- Hybrid threads
- Reconfigurable computing platforms
- Real-time, secure, embedded systems
- Protocols for ad hoc sensor networks
- Agile software radios

e-Learning Design Lab (eDL)

Lab Directors: **James Miller, Ed Meyen**



The e-Learning Design Laboratory (eDL) responds to the emerging challenges and opportunities in online education. eDL studies and develops new learning environments and tools for students of all ages, with a focus on postsecondary and professional development. This includes the study, development, and research of new designs, principles, practices, and policies.

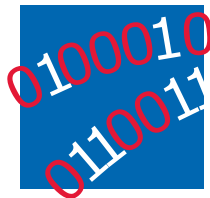
Lab resources:

- Module creation tools
- e-Learning instructional design
- Authoring tools

- Online assessment tools
- e-Learning evaluation tools

Intelligent Systems Lab (ISL)

Lab Director: **Susan Gauch**



The Intelligent Systems Laboratory (ISL) advances knowledge in artificial intelligence, intelligent agents, information retrieval, data mining, and robotics. ISL is customizing IT services, creating smarter and user-friendlier environments and devices.

Lab resources:

Multiagent development tools:

ACCS, C++, CORBA, Java

Information retrieval and Web tools:

KUIR Information Retrieval Library, Php, XMLSpy, MySQL, Perl

Data Mining Tools:

SNOB, Cobweb, ID3, C4.5, statistical analysis packages

Artificial intelligence development tools and languages:

Lisp, CLOS, CLIPS, Prolog, GBB, OPS, MEM-1

Image processing and computer vision tools:

KUIM image processing library, high-speed video, and data cable/fiber link

Human-intelligent system interaction tools:

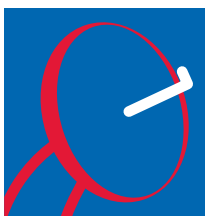
Mobile robots, VR user interface, head-mounted display, force feedback joysticks

PeopleBot, two Nomad Scouts, three Kheperas, one Pioneer robot

Software packages for virtual prototyping, kinematics modeling, and dynamics modeling (such as VisualNastran 4D and Working Model)

Radar Systems and Remote Sensing Lab (RSL)

Lab Director: **James Stiles**



The Radar Systems and Remote Sensing Laboratory (RSL) conducts research in radar and other electromagnetic sensing problems, including advanced system concepts, radar image formation, adaptive radar signal processing, and radar simulation.

Lab resources:

50 GHz microwave network analyzer

40 GHz digital oscilloscope

Logic analyzers

Network analyzers

Spectrum analyzers, oscilloscopes, and function generators

Prototype PC board fabrication tools and facility

RF signal generators

Automated ground penetrating radar (GPR) test facility

Outdoor antenna test facility

Student Excellence



Alexander Garrett

Alexander Garrett came to ITTC after taking a bioinformatics course with EECS Assistant Professor **Terry Clark**. Garrett wanted to pursue research in molecular modeling and simulation.

In addition to building and visualizing molecules, these computer-based techniques perform incredibly complex calculations on molecular systems. Analyzing the complicated, dynamic systems within living organisms is critical to understanding how cellular processes work together to perform healthy functions for life.

At ITTC's Bioinformatics and Computational Life Sciences Laboratory, Garrett is analyzing the internal energies of the DNA molecule bound to the nucleosome core protein. The interaction between proteins and DNA is important in such cellular events as DNA replication and gene regulation. The regulation of gene expression is crucial for the cell's ability to respond to a constantly changing environment. This research will help develop methods for



Wesley Peck

Wesley Peck enrolled in the computer science master's program at his alma mater, KU, after graduating with his undergraduate degree in 2003. One semester into the program, Peck knew he wanted to pursue a Ph.D. He is expected to

graduate with his doctorate in computer science in 2006 and is planning to work in industry.

Peck is one of the ITTC researchers developing system software for hybrid chips to be inserted into future real-time and embedded control (RTEC) systems. RTEC systems can be found in high-end automobiles, airplanes, or machines on a factory floor—any place where sets of computers work together to perform functions.

The hybrid chips will help create embedded systems that are easier to use and more cost efficient. The time researchers and programmers need to develop and debug

simulating greater molecular complexity of cell systems along with an increased understanding of DNA energetics.

"I am learning that DNA is much more than just a string of bases that is converted into protein—DNA contains the recipe and ingredients for its own 'cooking,'" says Garrett, who is completing his master's degree in computer science.

Garrett is helping develop and monitor a genomic database combined with scientific annotations on each gene. Researchers are rapidly trying to integrate many global sources of genomic information under one standard schema. ITTC will integrate biological data from numerous areas within KU life-sciences research and is positioning itself to be a campus cornerstone for biological information management, says Garrett.

After graduation from the master's program, Garrett would like to continue his education in computational biology at the doctoral level. He also conducts research at the KU Genomics Facility. He is studying the processes of learning, and the neuronal response to oxidative stress, such as in Alzheimer's disease.

these systems will drastically be cut, speeding up their time to market. ITTC researchers are using commercial off-the-shelf parts, further reducing the development costs of embedded systems.

David Andrews, associate professor of EECS, leads the "Extending the Thread Execution Model for Hybrid CPU/FPGA Architectures" project. Under Andrews' direction, Peck manages software design and development and integration of hardware components with the software. He also helps mentor younger students working on the project. Peck is expected to contribute to the broader research in the area of embedded systems and reconfigurable computers by writing papers and attending conferences. In December of 2004, he attended the Real-Time Systems Symposium (RTSS) in Lisbon, Portugal; and he participated in the Emerging Technologies and Factory Automation (ETFA) conference in Catania, Sicily, during September 2005.



Jennifer Streb chose the University of Kansas because of its proximity to her family. The Olathe, Kan., native wanted to stay close to home while earning her computer engineering degree. Streb did not plan on attending graduate school

after her 2004 KU commencement. But in her final semester as an undergraduate, she started learning of Professor **Perry Alexander**'s research. Alexander, director of ITTC's Computer Systems Design Laboratory (CSDL), introduced Streb to ITTC and the programming language Haskell, which makes it easier and cheaper to run large software systems. Impressed with the Center and Alexander's research, Streb enrolled in graduate school the following semester.

"The research that I do is extremely important to my education," says Streb. "The nice thing about this kind of research is that it can be linked to almost anything. I've used the techniques to write languages for embedded sys-

tems as well as for those representing dance choreography. Obviously, the two fields have little, if anything, in common. There will always be a need for this type of research, which leaves me with a lot of room to grow."

Streb is helping make embedded systems safer, more reliable, and more secure. Embedded systems are found in everything from mobile telephones and personal digital assistants (PDAs) to medical equipment and automobiles. Users rely on these systems to operate safely and accurately when needed, says Streb. She is developing an interpreter structure that will use abstract interpretation, which analyzes complex systems more efficiently. By looking at the abstract representation, researchers can perform analyses that were too complex for the original system. Essentially, abstract interpretation allows researchers to perform additional tests on embedded systems to ensure they work correctly.

Streb is considering staying at KU for her Ph.D. in computer science.



Jeffrey Young is a National Science Foundation Fellow who has chosen the University of Kansas for graduate work in computer science. As an NSF Fellow—selected, as are all such Fellows, for his potential to advance science, mathematics,

or engineering—he could attend any accredited university, within the United States or internationally, that offers advanced degrees in these particular fields.

At ITTC, Young is reunited with his mentor, **Ron Sass**, now a research assistant professor at ITTC. The two started conducting research when Young was an undergraduate at Clemson University, in South Carolina, and Sass a member of its faculty. The two continue developing powerful, easy-to-use tools that aid researchers in quickly deciphering DNA sequences, satellite imagery, and other large data sets. Young is developing software for scientists and other non-engineers to program reconfigurable devices. These devices allow one chip to perform a myriad of tasks while

mining large data sets. Reconfigurable computers can be adapted to specific applications, resulting in dramatically faster performance for certain classes of applications.

Young has been conducting scientific research and garnering awards for it since his high school days at the South Carolina Governor's School for Science and Math. He moved to Clemson University, where he was a Clemson National Scholar. As an undergraduate, he also earned a Barry M. Goldwater scholarship during his junior year. Young received his computer engineering degree from Clemson University in May 2005.

During his senior year at Clemson, Young presented a paper at the 2004 International Conference on Embedded and Ubiquitous Computing that he co-authored with Sass. According to Young, the presentation and his research with Sass gave him the experience needed for the Fellowship.

"We are thrilled that Jeff has chosen KU for his graduate work," Sass said. "He is an excellent student, has a knack for research, and, in the short time he has been here, demonstrated that he is a real team player."



Victor S. Frost

Director, ITTC

Dan F. Servey Distinguished Professor, EECS

Victor Frost has performed research for many corporations, including Sprint, NCR, BNR, NEC, Telesat Canada, AT&T, McDonnell Douglas, DEC, and COMDISCO Systems. He has been principal investigator on 31 research projects and has published more than 100 journal and conference articles. Frost has served as a guest editor for the *IEEE Communications Magazine* and *IEEE Journal on Selected Areas in Communications*. He is currently an area editor for *ACM Transactions on Simulation and Modeling of Computer Systems*.

Frost's research interests are in the areas of network quality of service, integrated communication networks, and high-speed

networks; they have included projects such as MAGIC and AAI high-speed, wide-area testbeds.

He is a Fellow of the IEEE and received the Presidential Young Investigator Award from NSF in 1984.

Frost has served on State of Kansas NSF EPSCoR and DoD DEPSCoR committees, as well as the Kansas Inc. Telecommunications Task Force. He has made four presentations to committees of the Kansas Legislature. He is a member of the Board of Trustees for KU's Center for Research, Inc., and a member of the Board of the Lawrence Technology Association.



Tim Johnson

Executive Director, ITTC

Tim Johnson has more than 20 years of industry and university experience in managing, researching, developing, transferring, and commercializing engineering and software technologies.

Since 1996, Johnson has served as executive director for ITTC. He has helped develop policies and procedures and managed the operational, technology transfer, commercialization and selected applied-research activities of ITTC.

Since 1982, Johnson has worked in a variety of industry and university concerns, including Kansas Power and Light; Kansas State University; Computer Sciences Corporation in Falls Church, Va.; and the University of Wyoming in Laramie, Wyo. In 1991, Johnson joined the Center for Excellence in Computer-Aided Systems Engineering (CECASE) at KU; in December 1996, he assisted with the formation of ITTC.

Johnson is active in regional organizations supporting information technology, technology transfer, and economic development. He has served on the Kansas Innovation Center's

Advisory Board and Operations Committee, Silicon Prairie Technology Association's Information Technology Committee, and Kansas Technology Enterprise Corporation's Telecommunications Committee and Information Technology Committee.

Johnson is a founding and board member of the Lawrence Technology Association and a founding and steering committee member of Kansas City's information technology support organization ITKC. His research, technology transfer, and commercialization activities have resulted in more than 35 presentations and technical publications. He is a member of the Association of University Technology Managers and an IEEE member whose professional memberships have included the IEEE Communications Society, Signal Processing Society, Computer Society, and Engineering Management Society.

Johnson received his bachelor's degree from Memphis State University in 1982, and his master's in 1985, with continued doctorate studies, while attending Kansas State University—all in electrical engineering.



Keith Braman

Associate Director for Technology Transfer

Keith Braman manages ITTC's technology transfer, intellectual property, and state-affiliated economic development activities. He received a juris doctorate

from Washburn University and B.S. and M.E. degrees in aerospace engineering from KU.

Before joining ITTC in 2000, he was a senior manager of information systems and regulatory affairs for the Kansas Department of Social and Rehabilitative Services—Division of Health Care Policy. He has been vice president of operations and general counsel for KVA Product Development Group, LLC, in Topeka, which provided engineering consulting services for the design and manufacture of medical devices. Prior to working for KVA, Braman practiced law as a solo practitioner for several

years, focusing on criminal, intellectual property, and corporate transactional law. He also has worked for McDonnell Douglas Helicopter Co. as a flight controls engineer and technical area chief of flight dynamics. As a serial entrepreneur, and in addition to operating his own law office, Braman has worked as an engineering consultant in the area of flight-test research, software development, computer-aided design, and program management and has held founding positions in construction, real estate, and retail companies.

Braman is a member of the Kansas and Nevada state bars, the American Bar Association, the American Intellectual Property Law Association, and the Association of University Technology Managers (AUTM) in addition to being a member of the engineering honor society Sigma Gamma Tau.

Technical Staff



Torry Akins

Research Associate

Torry Akins is helping to develop the sensors needed for the “Polar Radar for Ice Sheet Measurements (PRISM)” project.

He is also the principal investigator on an ITTC project, “Cryospheric Advanced Sensor (CAS)”, sponsored by the Jet

Propulsion Laboratory (JPL) of the California Institute of Technology. He received his B.S. and M.S. degrees in electrical engineering from the University of Kansas in 1996 and 1998, respectively. After earning his master's, he left to join the Radar Science and Engineering section of JPL, where he worked on the development of a space-qualified, real-time data processor. He returned to ITTC and the Radar Systems and Remote Sensing Laboratory (RSL) during the summer of 2002.



Brett Becker

Network Specialist

As a network specialist and system administrator, Brett Becker is responsible

for the design, operations, and installation of the Center-wide server infrastructure and network. Becker has conducted wireless network visualization research, which aims to inform the public of security issues inherent in current wireless networking technologies. Becker completed his master's degree in computer engineering in December 2004.



Marilyn Cozad

Software Engineer/Webmaster

Marilyn Cozad supports technology transfer projects and is the Center's

Webmaster. She focuses on applied technology projects involving the development of Web database applications using Web technology integrated with relational database management systems (RDBMS). She received bachelor's degrees in accounting and in computer information systems, both from Washburn University of Topeka.



Daniel DePardo

Research Engineer

Dan DePardo supports the Networking and Wireless Systems Lab and other Center electronic hardware needs. His areas of expertise include microstrip antenna design, surface acoustic wave (SAW) delay line and filter design, photolithography techniques, cleanroom procedures, hybrid circuitry design, environmental testing techniques, Mil-spec soldering and

assembly, radio frequency interference (RFI) and electro-magnetic interference (EMI) suppression techniques, along with radio frequency and microwave components, circuitry, and systems in general. His current efforts include NSF-sponsored development of frequency-agile orthogonal frequency domain multiplexing (OFDM) transceivers, spectrum mapping, and wideband wireless systems. DePardo received a U.S. patent for a wideband planar antenna design. Using the patented technology, certain flat-panel antenna designs can achieve unusually wide RF bandwidth characteristics.



Adam Hock

Senior Systems Administrator, Bioinformatics

Adam Hock is the senior systems administrator for the Integrated Bioinformatics

Information Infrastructure. He oversees system integration, administration, and maintenance for the computer cluster as well as the development of new software tools. Before joining ITTC, Hock was an engineer at Atipa Technologies, a provider of information technology solutions based on the Linux computer operating system.



Michael Hulet

Senior Systems Administrator

Michael Hulet is the senior network administrator for ITTC. He provides advanced computer hardware, software, and network support for the operational

and research needs of the Center. Hulet joined ITTC as a computer systems administrator in 1998. He has a bachelor's degree in electrical and electronics engineering from North Dakota State University and a master's degree in systems management from the University of Southern California. He was employed as an electronics engineer for the Naval Warfare Assessment Division in Norco, Calif., before joining ITTC.



David Johnson

Systems Administrator, Bioinformatics

David Johnson is the systems administrator for the Integrated Bioinformatics

Information Infrastructure. Johnson's duties include administering the bioinformatics database and software and developing new bioinformatics tools. He is finishing his thesis for his master's degree in computer science from the University of Oklahoma.

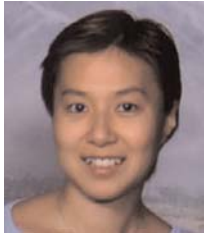


Ed Komp

Research Engineer

Ed Komp has more than 15 years' experience in designing, implementing, and managing commercial software products. His primary interests include specialized computer language design for application-specific domains, functional

programming, software development environments, and networking. He joined the Center in 1998. He received his B.A. in mathematics and his M.S. in computer science from KU in 1976 and 1979, respectively. He was the primary software architect for the Block Oriented System Simulator (BOSS) and helped found a local company to commercialize this tool. He also was the primary software architect and manager for the Block Oriented Network Simulator (BONeS), a second commercial product success.



Danico Lee

Lead Software Engineer

Danico Lee joined ITTC in 2002, where she is now a lead software engineer. She manages and works on multiple select ITTC applied research and development projects. One of the projects she worked on has led to a pending U.S. patent. Lee pro-

vides technical leadership for requirements, specification, design, implementation, and testing on software projects. Her areas of expertise include applied artificial intelligence, 3-Tier systems engineering, object-oriented software design, relational database modeling, and Web application development. She also meets with Kansas companies and provides technical assistance. Lee has a B.S. and an M.S. in computer science from the University of Kansas.



Wes Mason

Network Specialist

Wes Mason spent nine months as an ITTC student system administrator before joining the Center as a full-time network spe-

cialist in the summer of 2005. His duties include Windows/Linux system administration and maintenance, development of new system automation tools, maintenance and updates to Kickstart and Unattended, and technical support for ITTC personnel. Before coming to ITTC, he worked for Atipa Technologies as a cluster engineer. He managed hardware and software cluster integration along with onsite installation.



Leon Searl

Software Research Engineer

Leon Searl works on multiple projects as a software and hardware engineer at ITTC. He is working on the “National Radio Networking Research Testbed (NRNRT)” project and consulting

on the “KU Technology Evaluation Satellite (KUTEsat)” project. Searl worked at TISL (Telecommunications and Information Sciences Lab, a predecessor of ITTC) while he was an electrical engineering student. Before returning to KU, Searl worked with TRW Space and Defense Group and Cadence Design Systems. He owned his own ultralight aircraft company. He received his B.S. and M.S. degrees from KU in 1985 and 1987, respectively.



Dennis Sundermeyer

Electronics Technician

Dennis Sundermeyer joined ITTC in January 2003 as the Electronics Technician for the “Polar Radar for Ice Sheet

Measurements (PRISM)” project. He brings more than 25 years of experience in electronics to the project. He is helping ITTC students with their designs for PRISM radar, especially the mechanical portions. Sundermeyer has traveled to Greenland the last two summers with the PRISM team to assist in the radar's testing.



Huilin Xiong

Postdoctoral Researcher

Huilin Xiong received his Ph.D. degree, majoring in pattern recognition, from China's Huazhong University of Science

and Technology in 2000. He spent one year at the Chinese University of Hong Kong as a researcher and then joined Concordia University in Canada as a postdoctoral fellow. Xiong's research interests include pattern recognition, machine learning, and image processing. At ITTC, he is a postdoctoral researcher working with Xue-wen Chen, assistant professor in electrical engineering and computer science.



Jiangsheng Yu

Postdoctoral Researcher

Jiangsheng Yu is ITTC's second new post-doctoral researcher in bioinformatics. Yu comes to ITTC from Peking University's

Department of Computer Science and Technology. His present research interests include statistical machine learning and Bayesian data analysis with applications to bioinformatics. Yu has taught courses in such areas as algorithm design and analysis, probability theory and mathematical statistics, decision theory and Bayesian analysis, and artificial intelligence.

Fiscal Year 2005 brought recognition, from both within and outside the University, for the excellent work of a number of ITTC-related faculty investigators.

Recognized at KU

Two of the Center's affiliated faculty received promotions from the University of Kansas in August 2004. **Christopher Allen**, professor of EECS, and **Susan Gauch**, director of ITTC's Intelligent Systems Laboratory (ISL), were **promoted to full professor in the School of Engineering**. Allen joined the KU faculty in August 1994. He has earned such University honors as the John E. Sharp and Winifred E. Sharp Teaching Professorship and the W.T. Kemper Fellowship for Teaching Excellence. Gauch became a member of the KU faculty in 1993. Her awards include the PC Professional (Germany) Editor's Choice Award for "Profusion: Best Advanced Meta-Search Engine" and numerous Miller Awards from the School of Engineering.

In August 2004, EECS Professors **Susan Gauch** and **Jerzy Gryzmala-Busse** received **W.T. Kemper Fellowships**. The Fellowship recognizes outstanding KU teachers and advisers. A surprise patrol led by KU Chancellor Robert Hemenway presented the professors with a \$5,000 check on the first day of fall classes. Gauch was also awarded a KU School of Engineering **Bellows Scholarship** for academic year 2004-2005, as were also **Victor Frost** and **Perry Alexander** for academic year 2005-2006.

Additional awards through the KU School of Engineering during FY2005 included the following: EECS Associate Professor **David Andrews**, **Miller Scholar**; EECS Associate Professor **James Stiles**, **Sharp Teaching Professorship** (2004-2007); and EECS Professor **Prasad Gogineni**, **Spahr Teaching Professorship**.

Recognized Beyond KU

Chris Allen earned a third **U.S. patent for his work with polarization-mode dispersion (PMD)**. At very high data rates, PMD randomly corrupts signal quality on fiber-optic cable. As more words, pictures, audio and video files are pushed more quickly through the cable, the likelihood of scrambling increases. While PMD cannot easily be distinguished from other kinds of transmission problems, ITTC researchers have developed a technique for detecting PMD-induced errors so that corrective action may be taken. Allen, along with Sprint's

Doug Richards and **Doug Hague**, received the patent for "Identifying a Polar Mode Dispersion Event" in August 2004.

James Roberts, KU vice provost for research, earned the **Ronald J. Schmitz Award "for outstanding service to the Frontiers in Education Conference."** Roberts was honored for his outstanding and continued service to engineering education at the 2004 conference. The international conference promotes the widespread dissemination of innovations in engineering and computer science education.

James Miller, co-director of ITTC's e-Learning Design Laboratory, received the **Boeing Company A.D. Welliver Faculty Summer Fellowship** for the summer of 2004. The Fellowship aims to provide faculty with a better understanding of engineering within industry that will aid professors in preparing future graduates for engineering in a global industrial environment.

Ronald Sass received an **IBM Faculty Award** to improve the performance of embedded systems. Embedded systems, a combination of computer hardware and software, are found in everything from automobiles, medical equipment, and airplanes to vending machines, toys, and mobile phones. Sass is developing systems of reconfigurable hardware, allowing one chip to perform a myriad of tasks within these different products.

Daniel Deavours was an **invited guest speaker** at a series of events this spring. As principal author of a report assessing the performance of radio frequency identification (RFID) tags, Deavours is providing reliable and unbiased information on commercially available RFID devices. In early March, Deavours participated in the **Midwest RFID Symposium**. He discussed RFID tag durability studies at **Underwriters Laboratories, Inc., in Chicago** on March 10 and 11. Deavours traveled to Philadelphia to take part in the **RFID Pharmaceutical Focus conference** on March 30 and 31, highlighting how RFID can benefit the pharmaceutical industry. On April 10 and 11, Deavours spoke at the premiere RFID conference, **RFID Journal Live!**, and manned a booth for ITTC's RFID Alliance Lab.

Joseph Evans completes (in August 2005) his two-year service as a **program director** with the Division of Computer and Network Systems, Directorate of Computer and Information Science and Engineering, at the **National Science Foundation**. His programs include the Networking Technology Systems (NeTS) program, with particular focus on the Programmable Wireless Networking area.

ITTC Research Investigators

Arvin Agah

Associate Professor and
Associate Chair for
Graduate Studies, EECS

Research Interests:

- Autonomous mobile robots for harsh environments
- Biomedical robotics
- Distributed robotics
- Multi-agent systems
- Software engineering



Education:

Ph.D., Computer Science, University of Southern California, 1994
M.S., Biomedical Engineering, University of Southern California, 1993
M.S., Computer Science, Purdue University, 1988
B.A., Computer Science, University of Texas, 1986

Teaches robotics, artificial intelligence, intelligent agents, software engineering, computer systems design.

Honors and Awards include the KU EECS Cerner Teaching Award, June 2004; KU Center for Teaching Excellence Celebration of Teaching Award, May 2004; KU Henry E. Gould Award for Outstanding Teaching, 2000; KU Miller Faculty Development Award, June 2001; Engineering Expo 2001 Educator Award, February 2001.

W. Perry Alexander

Professor, EECS

Research Interests:

- Formal specification, synthesis, and verification
- Systems-level design
- Systems-level description languages
- System architectures
- Component retrieval



Education:

Ph.D., Electrical Engineering, University of Kansas, 1992
M.S., Electrical Engineering, University of Kansas, 1988
B.S., Electrical Engineering, University of Kansas, 1986
B.S., Computer Science, University of Kansas, 1986

Teaches digital systems design, programming language paradigms and semantics, formal methods and modeling in software and hardware systems development.

Honors and Awards include Kemper Teaching Fellow, 2003; ASEE Midwestern Region Dean's Award for Teaching Excellence, 2003; KU Miller Faculty Development Award, 2002–2003; Harry Talley Teaching Award, KU EECS Department, 2002; Center for Teaching Excellence Honoree, 2002; KU Engineering Expo EECS Department Teaching Award, 2000; Senior Member of IEEE; University of Cincinnati (UC) College of Engineering Neil A. Wandmacher Teaching Award, 1998; UC Electrical and Computer Engineering and Computer Science (ECECS) HKN Professor of the Year, 1992–1993, 1996–1997; UC Engineering Tribunal Professor of the Quarter, winter 1994, fall 1998; UC ECECS Department Teaching Award, 1996–1997; UC ECECS Department Research Award, 1993–1994.

Christopher Allen

Professor, EECS

Research Interests:

- Microwave remote sensing
- Radar design and analysis
- Synthetic-aperture radar
- High-speed digital circuits and applications
- Fiber-optic communication systems
- Photonic systems and devices



Education:

Ph.D., Electrical Engineering, University of Kansas, 1984
M.S., Electrical Engineering, University of Kansas, 1982
B.S., Electrical Engineering, University of Kansas, 1980

Teaches circuits, electronic circuits, senior design laboratory, fiber-optic communication systems, high-speed digital circuit design, microwave remote sensing.

Honors and Awards include Bellows Scholar, 2005; Eta Kappa Nu; Phi Kappa Phi; Tau Beta Pi; Sharp Teaching Professorship, 2002–2005; KU Miller Faculty Development Award, 2001; W.T. Kemper Fellowship Award for Excellence in Teaching, 2001; Ned N. Fleming Trust Award for Excellence in Teaching, 2001; KU Miller Professional Development Award for Research, 1999; KU EECS Harry Talley Excellence in Teaching Award, 1998; Center for Teaching Excellence honoree, 1998.

David Andrews

Associate Professor, EECS

Research Interests:

- Computer architecture
- Distributed and parallel systems
- Embedded and real-time systems
- Reconfigurable computing



Education:

Ph.D., Computer Science, Syracuse University, 1992
Computer Engineer Degree, Syracuse University, 1990
M.S., Electrical Engineering, University of Missouri-Columbia, 1984
B.S., Electrical Engineering, University of Missouri-Columbia, 1983

Teaches digital design, computer architecture, reconfigurable computing, embedded systems.

Honors and Awards include KU Miller Scholar, 2004; Senior Member of IEEE, 2001; Who's Who in Science and Technology, 2001; Outstanding Service Award, Electrical Engineering, University of Arkansas, 1996–1997; Outstanding Researcher Award, Electrical Engineering, University of Arkansas, 1995; General Managers Award, General

Ronald Aust

Associate Professor,
Teaching and Leadership

Research Interests:

Designing and developing—

- Multi-state educational networks (including UNITE system and Explorer database)
- Network technologies to support collaborative learning and community publishing of educational resources



Education:

Ph.D., Curriculum and Instruction, University of Washington, 1984
M.S., Education, Western Washington University, 1979
B.S., Education, Western Washington University, 1975

Teaches designing multimedia learning environments and instructional design.

David A. Braaten

Associate Professor of
Atmospheric Science,
Geography

Research Interests:

- Snow accumulation
- Ice-sheet processes
- Remote sensing



Education:

Ph.D., Atmospheric Science, University of California-Davis, 1988
M.S., Meteorology, San Jose State University, 1981
B.S., Meteorology, State University of New York, 1977

Teaches introduction to meteorology, dynamic meteorology, advanced dynamic meteorology.

Honors and Awards include the Antarctic Service Medal, National Science Foundation and Department of the Navy, 1995.

Swapan Chakrabarti

Associate Professor, EECS

Research Interests:

- Designing hardware and software for True 3-D display systems
- High-speed computation of mathematical functions using analog neural networks
- Digital signal processing



Education:

Ph.D., Electrical Engineering, University of Nebraska-Lincoln, 1986
M.S., Computational Physics, University of Nebraska-Lincoln, 1982
M.S., Physics and Electronics, Calcutta University, India, 1976
B.S., Physics, Calcutta University, India, 1976

Teaches digital logic design, algorithmic problem solving, microcomputer applications, computer architecture, graphics in engineering research, computer vision, digital signal processing (including adaptive systems, neural networks, fuzzy systems).

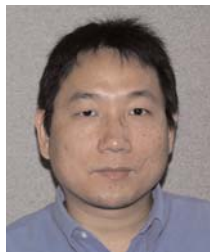
Honors and Awards include honorary member, Golden Key National Honor Society, 1996; KU Ned N. Fleming Teaching Award for Outstanding Classroom Teaching, 1992.

Xue-wen Chen

Assistant Professor, EECS

Research Interests:

- Bioinformatics
- Machine learning
- Statistical modeling
- Data mining
- Human-computer interaction



Education:

Ph.D., Electrical and Computer Engineering, Carnegie Mellon University, 2001
M.S., Opto-electronics, Sichuan University, 1992
B.S., Theoretical Physics, Sichuan University, 1986

Teaches bioinformatics, computer science.

Honors and Awards include Senior Member IEEE, 2004.

Terry Clark

Assistant Professor, EECS

Research Interests:

- Bioinformatics
- Data management
- Parallel computing



Education:

Ph.D., Computer Science, University of Houston, 1996
M.S., Computer Science, University of Houston, 1988
M.S., Chemistry, University of Houston, 1985
B.S., Chemistry, Western Washington University, 1982

Teaches bioinformatics.

Daniel Deavours

Research Assistant
Professor, ITTC

Research Interests:

- Performance and dependability evaluation
- Markov models and numerical methods
- Discrete-event simulation
- Modeling languages
- Data-flow architectures
- Reconfigurable computing machines



Education:

Ph.D., Electrical Engineering, University of Illinois at Urbana-Champaign, 2001
M.S., Electrical Engineering, University of Illinois at Urbana-Champaign, 1997
B.S., Computer Engineering, University of Illinois at Urbana-Champaign, 1994

Kenneth Demarest

Professor, EECS

Research Interests:

- Lightwave communication systems
- Electromagnetic theory
- Antennas



Education:

Ph.D., Electrical Engineering, The Ohio State University, 1980
M.S., Electrical Engineering, The Ohio State University, 1976
B.S., Electrical Engineering, John Brown University, 1974

Teaches circuits, fiber optic engineering, electromagnetics, microwave systems, noise reduction in electrical systems, antennas, radar engineering, laser engineering.

Honors and Awards include Eta Kappa Nu.

Tyrone Duncan

Professor, Mathematics

Research Interests:

- Stochastic adaptive control
- Stochastic optimal control
- Mathematics of finance
- Stochastic analysis
- Telecommunications
- Mathematics education



Education:

Ph.D., Electrical Engineering, Stanford University, 1967
M.S., Electrical Engineering, Stanford University, 1964
B.E.E., Electrical Engineering, Rensselaer Polytechnic Institute, 1963

Teaches stochastic analysis and its applications, stochastics of mathematical finance, stochastic control, stochastic adaptive control, fractional Brownian motion and its applications, probability theory.

Honors and Awards include IEEE Fellow, 1999; KU Olin K. Petefish Award in the Basic Sciences, 1999.

Joseph B. Evans

Deane E. Ackers

Distinguished Professor,
EECS

Research Interests:

- Mobile networking and wireless systems
- High-performance networks
- Pervasive computing systems
- System implementations



Education:

Ph.D., Electrical Engineering, Princeton University, 1989
M.S., Electrical Engineering, Princeton University, 1986
M.S., Engineering, Princeton University, 1984
B.S., Electrical Engineering, Lafayette College, 1983

Teaches networking implementation, DSP implementation, computer systems design, integrated circuit design, electronics, programming.

Honors and Awards include Program Director, Computer and Information Science and Engineering Directorate, National Science Foundation, 2003–2005; Eta Kappa Nu; Tau Beta Pi; KU Spahr Professor, 2000–2003; KU Miller Professional Development Award for Research, 1996; AT&T Bell Laboratories Ph.D. Scholarship, 1984–1988; Garden State Graduate Fellowship, 1983–1987.

Victor S. Frost

Dan F. Servey
Distinguished Professor,
EECS; Director, ITTC

Research Interests:

- Internet traffic management and quality of service
- High-performance networks
- Network measurement, modeling, control, and simulation



Education:

Ph.D., Electrical Engineering, University of Kansas, 1982
M.S., Electrical Engineering, University of Kansas, 1978
B.S., Electrical Engineering, University of Kansas, 1977

Teaches communication networks and systems.

Honors and Awards include KU Bellows Scholar, 2005; KU

Miller Faculty Development Award, 2002; IEEE Fellow, 1998; Dan F. Servey Distinguished Professor of Electrical Engineering and Computer Science, 1996; KU Miller Professional Development Award for Service, 1991; KU Miller Professional Development Award for Research, 1986; National Science Foundation Presidential Young Investigator Award, 1984.

John M. Gauch

Associate Professor, EECS

Research Interests:

- Digital image processing (segmentation, enhancement)
- Computer vision (stereo, motion tracking)
- Multimedia processing



Education:

Ph.D., Computer Science, University of North Carolina at Chapel Hill, 1989
M.S., Computer Science, Queen's University at Kingston, Canada, 1982
B.S., Computer Science, Queen's University at Kingston, Canada, 1981

Teaches algorithmic problem solving, structured programming, computer vision, image processing, computer graphics, digital image processing, multimedia systems.

Honors and Awards include KU Miller Faculty Development Award, 2000, 2003; KU Bellows Scholar, 1999, 2002; Archie and Nancy Dykes Award for Undergraduate Teaching and Mentoring, 2001.

Susan E. Gauch

Professor, EECS

Research Interests:

- Multimedia databases
- Intelligent search agents
- Personalized search
- Conceptual search



Education:

Ph.D., Computer Science, University of North Carolina at Chapel Hill, 1990
M.S., Computer Science, Queen's University at Kingston, Canada, 1982
B.S., Mathematics and Computer Science, Queen's University at Kingston, Canada, 1981

Teaches programming, information retrieval, database systems, software engineering.

Honors and Awards Kemper Award for Excellence in Teaching, 2004; KU Bellows Scholar, 2004; KU Miller Faculty Development Award, 1999, 2000, 2003; KU Miller Professional Development Award for Research, 1998; Office of Naval Research Fellowship, 1988; QU N.F. Dupuis Prize in Mathematics, 1978.

Prasad Gogineni

Deane E. Ackers

Distinguished Professor,
EECS; Director, CReSIS

Research Interests:

- Radar systems
- RF and microwave engineering
- Radar remote sensing
- Microwave radiometers



Education:

Ph.D., Electrical Engineering, University of Kansas, 1984
M.S., Engineering, Kerala University, Trivandrum, India, 1976
B.E., Mysore University, India, 1973

Teaches radar systems, microwave engineering, Electromagnetics II, senior design lab, electronics design lab, and others as required.

Honors and Awards include KU Spahr Professorship, 2004; Fulbright Scholar, 2002; Louise E. Byrd Graduate Educator Award, 2002; KU Miller Faculty Development Award, 2002; NASA Group Award to Antarctic Mapping Mission, 2000; KU Miller Professional Development Award for Service, 2000; IEEE Fellow, 1999; NASA Terra Award, 1998; Best-of-Session Award from the Third International Airborne Remote Sensing Conference, 1997; KU Miller Professional Development Award for Research, 1991; Taylor and Francis Best Letter Award, 1991.

Jerzy Grzymala-Busse

Professor, EECS

Research Interests:

- Knowledge discovery
- Data mining
- Machine learning
- Expert systems
- Reasoning under uncertainty
- Rough set theory



Education:

Doctor Habilitatus, Engineering, Technical University of Warsaw, Poland, 1972
Ph.D., Engineering, Technical University of Poznan, Poland, 1969
M.S., Mathematics, University of Wroclaw, Poland, 1967
M.S., Electrical Engineering, Technical University of Poznan, Poland, 1964

Teaches data mining, expert systems, knowledge acquisition, artificial intelligence, concurrency models, Petri nets, data structures, computer architecture and networking, computer organization, theory of computing, switching theory, automata theory, computability, discrete structures, and probabilistic analysis.

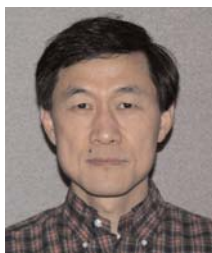
Honors and Awards include Kemper Award for Excellence in Teaching, 2004; KU Miller Faculty Development Award, 2002.

Ronqing Hui

Associate Professor, EECS

Research Interests:

- Fiber-optic communications
- Photonic devices
- Optical sensors



Education:

Ph.D., Electronics Engineering, Politecnico di Torino, Torino, Italy, 1993
M.S., Lightwave Technology, Beijing University of Posts and Telecommunications, Beijing, China, 1988
B.S., Microwave Communications, Beijing University of Posts and Telecommunications, Beijing, China, 1982

Teaches fiber-optic communication systems and networks, optical measurements, microelectronic circuits, semiconductor materials and devices, general electric circuits.

Honors and Awards include KU Miller Professional Development Award for Research, 2002.

Ed Meyen

Professor, Special Education

Research Interests:

- Online instructional design
- Web-based instructional tools
- Intellectual property issues
- Online instructional applications for students with disabilities
- Emerging instructional technologies



Education:

Ph.D., University of Iowa, Education, 1968
M.A., University of Northern Colorado, Special Education, 1959
B.A., University of Northern Colorado, Education, 1958

Teaches curriculum design, instructional design, instructional technology, graduate seminars.

James Miller

Associate Professor, EECS

Research Interests:

- Computer graphics
- Scientific visualization
- Geometric and solid modeling
- Technology in education
- Object-oriented technology



Education:

Ph.D., Computer Science, Purdue University, 1979
M.S., Computer Science, Purdue University, 1976
B.S., Computer Science, Iowa State University, 1975

Teaches programming, computer graphics, geometric modeling, visualization.

Honors and Awards include Boeing Company A.D. Welliver Faculty Summer Fellowship, 2004; KU Center for Teaching Excellence (CTE) Excellence in Teaching Award, 2000; Phi Beta Kappa, 1975; Phi Kappa Phi, 1974; Pi Mu Epsilon, 1974.

Gary J. Minden

Professor, EECS

Research Interests:

- Large-scale systems, including
- Wide-area distributed systems
 - Mobile communication systems
 - Adaptive computational systems
 - Active networking



Education:

Ph.D., Electrical Engineering, University of Kansas, 1982
B.S., Electrical Engineering, University of Kansas, 1973

Teaches introduction to digital logic design, information security, active networking.

Honors and Awards include KU Miller Professional Development Award for Service, 2002; KU Miller Faculty Development Award, 1999, 2000.

Richard K. Moore

Distinguished Professor Emeritus, EECS

Research Interests:

- Radar systems
- Radar remote sensing
- Radio wave propagation
- Radar oceanography
- Microwave radiometers



Education:

Ph.D., Electrical Engineering, Cornell University, 1951
B.S., Electrical Engineering, Washington University, 1943

Teaching Duties: Advises graduate students.

Honors and Awards include Australia Prize (for remote sensing), 1995; Italian Center for Remote Sensing Award, 1995; Fellow AAAS, 1993; National Academy of Engineering, 1989; KU Irvin Youngberg Award in the Applied Sciences, 1989; KU Louise E. Byrd Graduate Educator Award, 1984; IEEE Centennial Award, 1984; IEEE Geoscience and Remote Sensing Society Distinguished Achievement Award, 1982; IEEE Council on Oceanic Engineering Outstanding Technical Achievement Award, 1978; Alumni Achievement Award, School of Engineering and Applied Science, Washington University, 1978; Life Fellow IEEE (Fellow in 1962).

R. Douglas Niehaus

Associate Professor, EECS

Research Interests:

- Real-time and embedded systems
- System and network performance evaluation
- High-performance simulation of computer systems and networks
- Concurrent and distributed programming tools and environments



Education:

Ph.D., Computer Science, University of Massachusetts at Amherst, 1994

M.S., Computer, Information, and Control Engineering, University of Michigan, 1981

B.S., Computer Science, Northwestern University, 1980

Teaches introduction to operating systems, advanced operating systems, real-time and embedded system implementation, concurrent and distributed systems.

Bozenna Pasik-Duncan

Professor, Mathematics

Research Interests:

- Identification and adaptive control of stochastic systems
- Science, engineering, and mathematics education for K–12
- Stochastic analysis and its applications to finance, manufacturing, biomedicine, and telecommunications



Education:

Doctor Habilitatus, Mathematics, Warsaw School of Economics, 1986

Ph.D., Mathematics, Warsaw School of Economics, 1978

M.S., Mathematics, Warsaw University, 1970

Teaches probability theory, stochastic processes, mathematical statistics, stochastic modeling, stochastic adaptive control, calculus, stochastic calculus, differential equations, randomness in the modern world.

Honors and Awards include Louise Hay Award, Association of Women in Mathematics, 2004; KU Honor for an Outstanding Progressive Educator (HOPE) Award, 2003; Mortar Board Outstanding Educator Award, 2003; Frank B. Morrison Teaching Award, 2002; IEEE Fellow, 2001; IEEE Control Systems Society Distinguished Member Award, 2000; IEEE Third Millennium Medal for Outstanding Achievements and Contributions, 2000; Leader, China Control Systems Delegation, 2000; Tau Beta Pi; G. Baley Price Award for Excellence in Teaching, 1999; Kemper Fellowship for Teaching Excellence and Advising in Public Outreach, 1996; NSF Career Advancement Award, 1991–1993; International Research Experience (IREX) Fellowship to the United States (Berkeley, Harvard, MIT), 1982; Ministry of Higher Education and Sciences Award for Excellence in Teaching and Research, Poland, 1975; several Chancellor's Awards for research and teaching, Warsaw School of Economics, Poland, 1977–1978.

David W. Petr

Professor and Associate
Chair for Undergraduate
Studies, EECS

Research Interests:

- Traffic and congestion management for communications networks
- Traffic integration and quality of service (QoS) for wireless and wireline networks
- Performance analysis and simulation
- Evaluation of students' confidence in answers



Education:

Ph.D., Electrical Engineering, University of Kansas, 1990
M.S., Electrical Engineering, Stanford University, 1978
B.S., Electrical Engineering, Southern Methodist University, 1976

Teaches integrated telecommunication networks, analysis of communication networks, random signal theory, optimization with communication applications, introduction to communication systems, signal analysis, circuits.

Honors and Awards include EECS Harry Talley Excellence in Teaching Award, 2003; Ben Dasher Best Paper Award for the ASEE/IEEE Frontiers in Education conference, October 2000; KU School of Engineering Sharp Teaching Professorship, 2000–2003; Visiting Erskine Fellowship, University of Canterbury, New Zealand, 2000; Excellence in Teaching Award, KU Center for Teaching Excellence, 1999; Member of Sigma Xi, 1992; Senior Member of IEEE, 1991; KU nominee for NSF Presidential Faculty Fellow, 1991.

Glenn Prescott

Professor, EECS

Research Interests:

- Software radio systems
- Spread spectrum and military communication systems
- Radio and radar signal processing
- DSP applications of field-programmable gate arrays
- Design and implementation of wireless communication systems



Education:

Ph.D., Electrical Engineering, Georgia Institute of Technology, 1984
M.S., Electrical Engineering, University of Missouri, 1976
B.S., Electrical Engineering, Georgia Institute of Technology, 1974

Teaches linear systems, electronics design laboratory, senior design laboratory, digital signal processing, digital communications, DSP for communications and radar, advanced modulation and coding.

Honors and Awards include NASA Special Service Award, 2000; KU School of Engineering Sharp Teaching Professorship, 1998–2001; NASA Terra Award, 2000.

James Roberts

Professor, EECS; Vice
Provost for Research

Research Interests:

- Wireless communication systems
- CDMA and spread spectrum systems
- Coding and information theory



Education:

Ph.D., Electrical Engineering, Santa Clara University, 1979
M.S., Electrical Engineering, Massachusetts Institute of Technology, 1968
B.S., Electrical Engineering, University of Kansas, 1966

Teaches circuits, electronic circuits, senior design laboratory, fiber optic communication systems, high-speed digital circuit design, microwave remote sensing.

Honors and Awards include Ronald J. Schmitz Award for Outstanding Service to the Frontiers in Education Conference, 2004; appointment to the Board and Executive Committee of Kansas BIO, Inc., 2004; Member of the Joint Steering Committee for the Ft. Leavenworth/KU Partnership, 2004; IEEE Fellow, 2002; Tau Beta Pi; Eta Kappa Nu; Sigma Xi; Federal Government Distinguished Station Award (team award), 1987.

Hossein Saiedian

Professor and Associate
Chair, EECS

**Education:**

Ph.D., Computing and Information Sciences, Kansas State University, 1989
M.S., Mathematics, Emporia State University, 1984
B.S., Information Systems, Emporia State University, 1981

Teaches software engineering; develops and expands software engineering program, EECS; expands EECS programs at Regents Center for Kansas City (KC) metropolitan audience.

Honors and Awards include IEEE Certified Software Development Professional, 2002; IEEE Senior Member, 2001; Excellence in Teaching Award, University of Nebraska at Omaha, 2000; Distinguished Research Award, University of Nebraska at Omaha, 2000; top 10 software engineering scholars list, *Journal of Systems and Software*, 1998.

Research Interests:

- Software engineering, including
- Software process improvement
 - Formalism in software development
 - Object-oriented software development
 - Software engineering education
 - Software architecture

Ronald R. Sass

Research Assistant
Professor, ITTC

**Education:**

Ph.D., Computer Science and Engineering, Michigan State University, 1999
M.S., Computer Science, Michigan State University, 1992
B.S., Computer Science and Engineering, University of Toledo, 1989

Teaches introduction to digital logic.

Honors and Awards include IBM Faculty Award, 2004.

Research Interests:

- Reconfigurable computing
- High-performance computing and networking
- Embedded Systems

K. Sam Shanmugan

S.W. Bell Distinguished
Professor, EECS

**Education:**

Ph.D., Electrical Engineering, Oklahoma State University, 1970
M.S., Electrical Engineering, Indian Institute of Science, Bangalore, India, 1966
B.S., Electrical Engineering, Madras University, India, 1964

Teaches communication systems, simulation, probabilistic analysis, signals, and systems.

Honors and Awards include EECS Acting Chair, July 1, 2002–July 31, 2003; HOPE Award Finalist, 1994; KU Higuchi Award for Research, 1990; Burlington-Northern Outstanding Teaching Award, 1987; KU Henry E. Gould Award for Distinguished Service to Undergraduate Engineering Education, 1982; Amoco Foundation Outstanding Teacher Award, 1982; Society of Automotive Engineers Ralph R. Teetor Outstanding Young Engineer Award, 1979.

Research Interests:

- Smart antenna systems
- Signal (image) processing
- Random signals and communications theory
- Wireless and adaptive communication systems and networks
- Communication systems simulation and analysis

Trevor Sorensen

Associate Professor, Aerospace Engineering

Research Interests:

- Student-designed, -built, and -operated satellites
- BalloonSats
- Space environment (Earth and planetary)
- Lunar missions and science
- Remote sensing satellites and missions
- Improvement of spacecraft operations
- Autonomous spacecraft operation
- Long-lived space missions



Education:

D.E., Aerospace Engineering, University of Kansas, 1979
M.S., Aerospace Engineering, University of Kansas, 1976
B.S.A.E., Aerospace Engineering, University of Kansas, 1973

Teaches orbital mechanics, spacecraft systems, space system design, spacecraft attitude dynamics and control.

Honors and Awards

include AIAA Distinguished Service Award, 2005; Chair, AIAA Space Operations and Support Technical Committee, named Most Outstanding Technical Committee in AIAA Space and Missiles Group, 2005; American Astronautical Society Fellow, 2003; NASA/ASEE Summer Faculty Fellowship, 2001, 2003, 2004; AlliedSignal Aerospace Bold Thinking Award 1997–1998; University of Kansas Aerospace Engineering Alumni Honor Roll, 1997; NASA Medal for Exceptional Scientific Achievement, 1994; Engineer of the Year nominee, *Design News Magazine*, 1994; AlliedSignal Technical Service Corp.'s Special Recognition Award, 1994; NRL Certificate of Appreciation for contribution to SDIO/LACE Program, 1991; McDonnell-Douglas Certificate of Merit for contribution to Shuttle Program, 1985; NASA Group Achievement Award (STS-41C Rendezvous and Proximity Operations), 1984.

James Stiles

Associate Professor, EECS

Research Interests:

- Radar signal processing
- Applications of information and estimation theory in remote sensing
- Radar remote sensing of vegetation
- Propagation and scattering in random media
- Ground-penetrating radar



Education:

Ph.D., Electrical Engineering, University of Michigan, 1996
M.S., Electrical Engineering, Southern Methodist University, 1987
B.S., Electrical Engineering, University of Missouri, 1983

Teaches electronics, electromagnetics, radar, microwave engineering.

Honors and Awards include KU School of Engineering Sharp Professorship, 2004–2007; Interactive Session Prize Paper Award, IEEE Geoscience and Remote Sensing Society, 2002; KU Miller Professional Development Award for Research, 2001; KU EECS Harry Talley Teaching Award, 2000.

Costas Tsatsoulis

Professor and Chair, EECS

Research Interests:

- Multiagent systems
- Case-based reasoning
- Machine learning
- Intelligent image analysis



Education:

Ph.D., Electrical Engineering, Purdue University, 1987
M.S., Electrical Engineering, Purdue University, 1984
B.S., Electrical Engineering, Purdue University, 1983
B.A., German, Purdue University, 1987

Teaches computer system software, artificial intelligence, knowledge-based systems, case-based reasoning, multiagent systems, introduction to database systems.

Honors and Awards include KU Spahr Professor, 2000–2003; KU Bellows Fellowship, 1999; Senior Member of IEEE, 1998; Big-12 Faculty Fellowship, 1997; State of Kansas AT&T Engineering Education Excellence Award, 1995; KU Miller Professional Development Award for Research, 1994; Sigma Xi honorary research society, 1992.

Victor L. Wallace

Professor Emeritus, EECS



Research Interests:

- Interactive graphics, scientific visualization, and human interface design
- Network performance modeling (analytical models for correlated traffic and queues)
- Queuing theory for modern computer networks and systems

Education:

Ph.D., Electrical Engineering, University of Michigan, 1969
B.S., Electrical Engineering, Polytechnic Institute of Brooklyn, 1955

Teaching Duties: Advises graduate students.

Honors and Awards include Computer Graphics Pioneer Award, ACM SIGGRAPH, 1984; Irving Faye Memorial Award, Polytechnic Institute of Brooklyn, 1955; Senior Life Member, IEEE; Eta Kappa Nu; Upsilon Pi Epsilon; Tau Beta Pi; Sigma Xi; Who's Who in Science and Technology; Who's Who in America.

New Investigators for FY2006

Shannon Blunt

Assistant Professor, EECS



Research Interests:

- Radar and communications signal processing
- Adaptive pulse compression
- Space-time adaptive processing (STAP)
- Statistical signal processing
- Estimation and detection theory
- Optimization theory

For the past three years, **Shannon Blunt** worked with the Radar Division of the U.S. Naval Research Laboratory (NRL)

in Washington, D.C., conducting waveform diversity research. He received his Ph.D. in electrical engineering from the University of Missouri-Columbia in 2002.

As a new EECS assistant professor at KU, Blunt is investigating the means of making the simultaneous operation of multiple radars feasible. In particular, he is working on waveform diversity, the process through which multiple, interfering, received radar signals are accurately separated. By applying diversity

techniques to radar systems, radars may better co-exist with each other as well as with communication systems within the radio frequency (RF) spectrum.

Competing military and commercial demands for spectrum are growing rapidly. The medium is crowded, as cell phones, personal digital assistants (PDAs), and other wireless devices devour the spectrum. Waveform diversity will ease the congestion by allowing RF devices to adaptively mitigate the interference they experience from other devices.

From the detection and tracking of military targets to the assessment of croplands, such advances in technology will enable greater remote sensing of the environment. Distributed, collaborative radars will permit "radar networks" to conduct high-resolution surveillance seamlessly across large areas.

"I chose KU because of the well-respected and recognized Radar Systems and Remote Sensing Lab within ITTC," says Blunt, who is teaching EECS 744, Digital Signal Processing I, this fall. "I believe it will provide an excellent environment within which to collaborate and pursue my research interests."

Additional information on waveform diversity can be found at the international conference Web site, www.waveformdiversity.org, for which Blunt is currently serving on the technical committee.

Jianwen Fang

Research Assistant Professor, ITTC

Research Interests:

- Bioinformatics and computational biology
- Machine learning
- Data mining
- Database and software development
- Drug discovery



Jianwen Fang joined the Center as a research assistant professor in the spring of 2005. He holds joint

positions, as he continues as a bioinformatics specialist in KU's Bioinformatics Core Facility, which provides high-performance computational tools for life sciences research. In his specialist role, Fang has numerous opportunities to interact with ITTC researchers. He is associated with ITTC's Bioinformatics and Computational Life-Sciences Laboratory (BCLSL).

"The friendly and productive environment of ITTC and the prospect of collaboration with other faculty attracted me to the Center," says Fang.

Fang is developing "smart" computational methods to analyze data and speed up the drug development process. He is mining protein-protein interaction data to predict unknown interactions, protein functions, and sub-cellular localization of proteins in living systems. This will aid in the identification of potential drug targets. Fang's other research areas include proteomics data management and mining, genomic data analysis, protein structure modeling, biomolecular simulation, and software development.

Before coming to KU, Fang was a bioinformatics programmer and research associate at Wayne State University. He earned his Ph.D. in biochemistry and master's in computer science at Wayne State, and his bachelor's degree in applied chemistry at Peking University in China.

Fang's goals include bringing in major funding to support bioinformatics research and using his experience and training in computer science and life sciences to bridge the gap between computer scientists and engineers and those in life sciences.

Donna Haverkamp

Assistant Professor, EECS

Research Interests:

- Image processing and computer vision
- Artificial intelligence
- Applying artificial intelligence techniques to image interpretation problems



Donna Haverkamp has worked as a senior research scientist for the Fortune 500 com-

pany SAIC and Space Imaging, a leading supplier of satellite-based information. Her expertise lies in intelligent image-understanding systems. These systems identify objects in images and establish relationships among the different elements. From medical image interpretation to troop planning, the transformation of images to meaningful data is critical.

Haverkamp brings real-world experience into the laboratory and classroom. She understands the needs of industry and has garnered government funding for projects. She joins ITTC's Intelligent Systems Laboratory (ISL) and is teaching EECS 649, Introduction to Artificial Intelligence, fall semester 2005.

"I hope to help establish a strong program in EECS regarding image processing and computer vision, as well as to make KU known as a strong research contributor in this area," says Haverkamp.

Haverkamp utilizes intelligent image-understanding techniques to recognize objects and to transform data into information. She is researching image segmentation, classification, and representation along with feature and object extraction. Matching the capabilities of the human visual system and cognitive processes is no easy task, says Haverkamp. Problems arise in noisy and cluttered imaging environments, in particular.

Haverkamp earned her Ph.D. in electrical engineering from KU in 1997 and is excited to be returning to her alma mater.

Gerald Lushington

Director of Labs, Structural Biology Center

Research Interests:

- Structure-based drug design
- Quantitative structure-activity relationships as applied to bioactivity and toxicology predictions and chemical library refinement
- Molecular dynamics analysis of proteins
- Quantum chemical and mixed quantum-classical prediction of enzyme activity

Graphics and Modeling Laboratory and of the K-INBRE Bioinformatics Core Facility. He holds courtesy faculty appointments in KU's Medicinal Chemistry and Chemistry Departments, and is an ITTC-affiliated researcher.

As one of the first persons at KU with a significant interest in bioinformatics, Lushington developed a close association with



Gerald Lushington

arrived at KU in August 2001. Since that time he has acquired a substantial list of responsibilities, serving as the director of KU's Molecular

ITTC. ITTC personnel sought advice from Lushington while developing the Center's Bioinformatics and Computational Life-Sciences Laboratory (BCLSL). Subsequent collaborations have emerged as a result, making the interaction a critical part of his current research efforts, says Lushington.

His primary research interests include molecular modeling and visualization applications ranging from molecules and proteins to chemical informatics and computational drug design. Molecular modeling is the computational simulation of the behavior of chemical systems. For example, a scientist looking to develop a new therapeutic drug that acts on a specific protein may use computational methods to rapidly screen millions of possible drug molecules. The researcher will identify a select few and try to synthesize the compounds or test them. Similar computational methods are having significant impacts on numerous chemical and biological research and development efforts and have become a critical part of the scientific process.

Before coming to KU, Lushington spent one year as a research associate at the Army Research Laboratory and the next four as a scientific specialist at the Ohio Supercomputer Center. He earned his Ph.D. in theoretical chemistry from the University of New Brunswick in 1996.

Erik Perrins

Assistant Professor, EECS

Research Interests:

- Digital communication theory
- Advanced modulation techniques
- Channel coding
- Synchronization in wireless modems
- Complexity reduction in receivers
- Effective implementation architectures for communication systems

other information technologies. The evolution of these technologies will be dependent on the progression of communication architecture.

Erik Perrins, assistant professor of EECS, is tackling some of the challenges in digital communications, with emphasis on both theoretical and practical problems. In regard to the former, Perrins researches wireless communications, advanced modulation techniques, channel coding, and synchronization. Modulation allows carriers to transmit larger amounts of information while conserving limited resources, such as power and spectrum. Channel coding protects information from corruption



Advances in communications, especially digital transmissions, facilitated the development of the Internet, wireless devices, and

by noise, while synchronization involves such problems as time-aligning the transmitter and receiver.

Theoretical advances are often plagued by practical problems, such as high computational complexity. Perrins is researching simplification techniques that allow complex problems to be reduced to simpler ones, thus requiring fewer resources. He is also looking at the effective implementation architectures for communication systems. These practical research problems lie in the intersection of wireless communications and digital hardware design.

"My goal over the next few years is to establish a strong research program in these areas," says Perrins. "I look forward to working on these problems with students, both in the classroom and in the lab."

Perrins chose KU because of its strong communications research. He believes the productive and supportive environment will lead to several collaborative opportunities. Perrins brings seven years of industrial experience, which is a valuable complement to his academic experience. He has an affinity for the theory and science of engineering while having an understanding of how to bridge the gap between the classroom and the world of potential applications. Perrins is associated with ITTC's Communications and Networking Systems Laboratory (CNSL). His teaching at KU includes EECS 690, Special Topics: Implementation of Digital Communication Systems; and EECS 962, Advanced Modulation and Coding.

James Sterbenz

Associate Professor, EECS

Research Interests:

- Survivable, resilient, and disruption-tolerant networking
- Mobile wireless networking for ubiquitous personal computing
- High-speed (bandwidth), low-latency networking and communication
- Programmable, active, and cognitive networks



After earning his Doctor of Science degree from Washington University in 1991, **James Sterbenz** resumed his work with IBM as an advisory engineer

scientist. He joined GTE Laboratories in the mid-1990s. As senior network scientist and research group manager for BBN Technologies, Sterbenz led government-funded research, in Cambridge, Mass., from 1999 to 2003.

In nearby Amherst, Sterbenz began his academic career at the University of Massachusetts. The following year he also taught at Northeastern University in Boston. Since 2004, Sterbenz has been a visiting professor at the University of Lancaster in the United Kingdom, teaching and conducting

research in autonomic resilient networks as co-leader of the ResiliNets initiative.

Sterbenz began looking for a permanent academic home. He had met several ITTC researchers through DARPA-funded projects and the IEEE Communications Society Technical Committee on Gigabit Networking. He knew ITTC would provide an excellent research infrastructure, but he wanted to teach as well. The associate professor position at KU allows him to do both. Sterbenz says it was the next logical step in his long transition from industry to academia.

His research radically rethinks the status quo of existing network infrastructure, rather than making incremental changes to it. His primary focus areas include survivable, resilient, and disruption-tolerant networking; mobile wireless networking for ubiquitous personal computing; high-bandwidth, low-latency networking and communication; and programmable, active, and cognitive networks.

“I hope to build up a research program in survivable and resilient networking, in collaboration with Lancaster University as well as several other American and European collaborators,” says Sterbenz, who is affiliated with ITTC’s Communications and Networking Systems Laboratory (CNSL).

Sterbenz will teach a variety of networking classes, including new graduate courses on survivable and resilient networking, and mobile wireless networks.

Weichao Wang

Assistant Professor, EECS

Research Interests:

- Secure routing in wireless networks
- User privacy protection
- Key distribution and update
- Representation of security data
- Self-organized intrusion detection



Weichao Wang received his Ph.D. degree in comput-

er science from Purdue University in 2005. As a teaching assistant, Wang honed his skills as an educator and motivator. He also gained important research experience, contributing to several proposals that received industry or government funding.

The China native chose the University of Kansas because of its supportive and collaborative research atmosphere. He is working with fellow researchers to bolster security within computer systems. This will enable users to enjoy the convenience of

these systems without worrying about the disclosure of personal information or violation of privacy.

“KU provides a perfect environment for young researchers like me who would like to contribute to both education and research,” says Wang.

Associated with ITTC’s Communications and Networking Systems Laboratory (CNSL), Wang is working to prevent and detect malicious activities in ad-hoc and sensor networks by developing methods that integrate networking, security, scientific visualization, and other components. He is designing protocols and mechanisms to improve information security and privacy within wireless networks and pervasive systems. The latter are composed of tiny computers housed in “smart” devices, allowing users to access their information anytime, anywhere.

Wang is teaching cryptography at KU’s Edwards campus this fall. Students use mathematics, computer science, and electrical engineering to develop “keys” that encrypt data and protect the information from unauthorized users. Only those with keys should be able to unlock the coded data.

Alexander Wyglinski

Research Assistant
Professor, ITTC



Research Interests:

- Signal processing for digital communications
- Wireless communications
- Cognitive radios
- Ad hoc wireless networks

University, located in his hometown of Montreal, Quebec, Canada. His dissertation research dealt with increasing the data rates of current wireless local-area-network (WLAN) implementations by devising several novel and practical adaptive algorithms. Several high-profile research projects, especially the Agile Radio endeavor, attracted Wyglinski to ITTC; he joined the Center in July 2005 as a research assistant professor and is affiliated with the Center's Communications and Networking Systems Laboratory (CNSL).

Ubiquitous wireless access is one of the main catalysts fueling the information age. Whereas the idea of having instant

Alexander Wyglinski received his Ph.D. degree in Electrical Engineering in 2004 from McGill

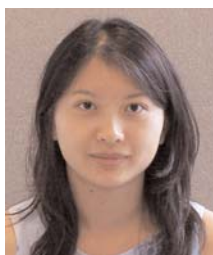
access to the Internet anytime anywhere was unheard of just a few years ago, today this is an expectation. Public places such as airports, hotels, universities, coffee shops, and even whole city blocks are examples of where wireless access hotspots are provided via a WLAN.

Wyglinski thinks we can do substantially better with the technology that is driving today's WLAN systems. "Current WLAN implementations significantly underutilize their potential for transmitting information faster and reliably to users within the network," says Wyglinski. "We have the technology to build WLAN systems with higher data rates and wireless coverage equivalent to cellular telephones." His research interests focus on the development of the next generation of wireless access systems, which would enable higher data rates to more users in large geographical areas. One of Wyglinski's main interests is the development of adaptive algorithms that would enhance current WLAN implementations. Eventually these algorithms will be implemented in a prototype system and be incorporated into the next generation of wireless access systems.

"ITTC is a great place to conduct research in the area of wireless access systems. The in-house expertise and research facilities available here will help me help make the future of seamless wireless access a reality."

Anne Ya Zhang

Assistant Professor, EECS



Research Interests:

- Bioinformatics and computational biology
- Machine learning
- System biology
- Statistical learning
- Data mining/text mining

matics. She received her Ph.D. degree in information sciences and technology from Pennsylvania State University in 2005 and her bachelor's degree in biological sciences and biotechnology from China's Tsinghua University in 2000.

Zhang chose the University of Kansas because of its support of bioinformatics, which uses computer technology and information sciences to organize, interpret, and predict biological structure and function. Among its efforts, KU is establishing a multidisciplinary bioinformatics committee to continue its national leadership in life-sciences research. Zhang works with ITTC's

Anne Ya Zhang's education and experience meet at the intersection known as bioinfor-

Bioinformatics and Computational Life-Sciences Laboratory (BCLSL) and sees many opportunities for collaboration among her fellow researchers at the University. Along with conducting research, she will be teaching bioinformatics and machine learning methods this fall.

"I am excited to be at the University of Kansas. It is a great opportunity for me with so many possibilities for cutting-edge bioinformatics research," says Zhang. "I look forward to sharing and expanding my knowledge with the campus and community."

Thousands of proteins exist in the human body. They form bones and muscles, alert the immune system to invaders, and perform other vital functions necessary to sustain a healthy body. When these fundamental components of cells malfunction, the consequences are severe. Faulty proteins are thought to cause such illnesses as Alzheimer's disease, cystic fibrosis, and numerous cancers.

The proteome, or complete set of proteins, is organized in an intricate web called the protein-protein interaction (PPI) network. Zhang, an EECS assistant professor, is developing computational tools to help biologists analyze data on this network. Knowledge of protein function will help scientists design drugs to treat illnesses that are more effective with fewer side effects, Zhang said.

Sponsors of Projects Active in FY2005

U.S. Federal Agencies

Air Force Research Lab (AFRL)
Department of the Army
 U.S. Army Edgewood Chemical Biological Center
 (ECBC)/Dept. of Defense (DoD)
 U.S. Army Headquarters
Department of Energy Oak Ridge National Laboratory
National Aeronautics and Space Administration (NASA)
 NASA Jet Propulsion Laboratory (JPL) at California
 Institute of Technology (CIT)
 NASA Goddard Space Flight Center
 NASA Experimental Program to Stimulate Competitive
 Research (EPSCoR)
 NASA Headquarters
National Institutes of Health (NIH)
 NIH Center for Research Resources (CRR)
 NIH U.S. Health Resources and Services Administration
 (HRSA)
National Science Foundation (NSF)
 NSF Education and Human Resources (EHR)
 NSF Engineering (ENG)
 NSF Computer and Information Science and Engineering
 (CISE)
 NSF Mathematical and Physical Sciences (MPS)
 NSF Office of Polar Programs (OPP)
 NSF EPSCoR (K*Star)
Naval Research Laboratory (NRL)

State of Kansas

Kansas Technology Enterprise Corporation (KTEC)

Industry

Bluetooth Special Interest Group (SIG), Inc.
Butler Heavy Structures
EDaptive Computing, Inc.
Honeywell Federal Manufacturing and Technologies (FM&T),
 LLC (flow-through from U.S. Dept. of Energy)
International Business Machines Corporation (IBM)
Rush Tracking Systems
Science Applications International Corporation (SAIC)

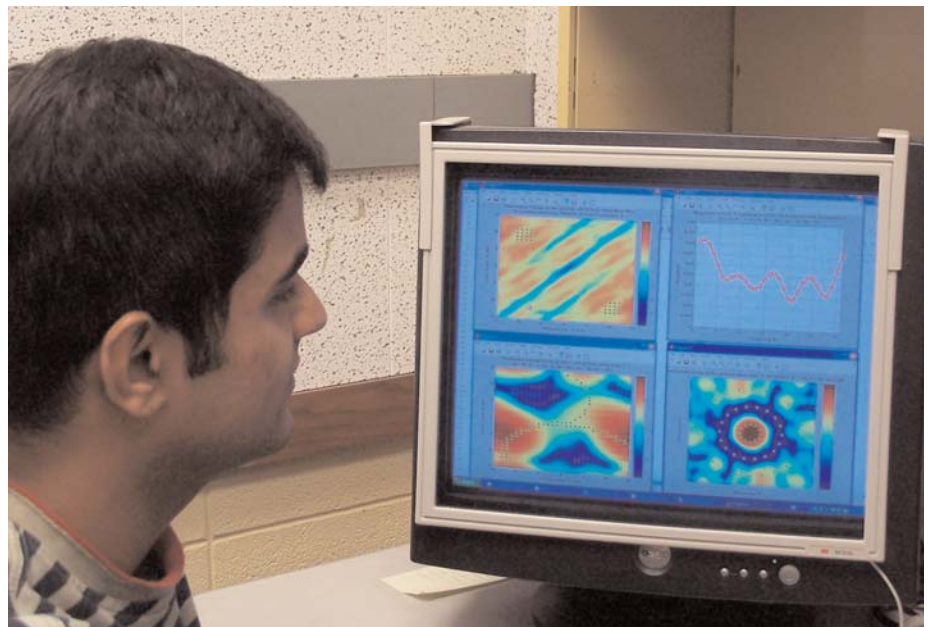
Universities

University of Kansas Medical Center (flow-through from NIH)
Oregon State University (flow-through from NASA)
University of California-Riverside (flow-through from NSF)
University of Massachusetts-Lowell (flow-through from NASA)
University of Missouri-Kansas City (flow-through from NIH)
Washington University in St. Louis (flow-through from Air Force
 Research Lab)

Not-for-Profit Agencies

J.R. and Inez W. Jay Biomedical Research Committee
Network for Earthquake Engineering Simulation (NEES)
 Consortium, Inc.

Graduate student Vishal Sinha works with analysis results from the “Optimal Space-Time Waveform Design for Adaptive, Multi-Mode Radar” project, led by Jim Stiles, director of ITTC’s Radar Systems and Remote Sensing Laboratory (RSL). Stiles’ team and Science Applications International Corp. (SAIC) engineers are working together on research funded by the Air Force Research Lab (AFRL). They are discovering how to construct adaptive space-time transmit waveforms that are optimal with respect to specific performance criteria. This will allow for faster, more accurate, and simultaneous detection/estimation across disparate set illuminated objects, such as the simultaneous imaging of stationary targets and detection of moving targets.



Radio Frequency Identification (RFID) Tags

Organizations from Wal-Mart to the U.S. Department of Defense are requiring ultra-high-frequency (UHF) radio frequency identification (RFID) tags, which greatly improve supply chain security and efficiency. RFID enables a more timely response to market fluctuations, as it connects objects to the Internet. Manufacturers will no longer have to rely on projections but will be able to quickly assess inventories online. They can ensure products arrive at the right location at the right time. RFID tags house tiny computer chips that contain unique serial numbers, which makes counterfeiting quite difficult, said **Daniel Deavours**, lead investigator on the project and an ITTC research assistant professor.

Since the increase in demand, manufacturers are scrambling for objective information on emerging RFID technologies. ITTC has partnered with Rush Tracking Systems, a private Kansas-based firm, and RFID Journal, a leading media company, to create the RFID Alliance Lab, which has generated two performance reports. The first report compares tag performance in free air, near different product types such as liquid and metal, and under real-world conditions. The second report details what percentage of the tags received actually work and the difference in performance among tags of the same model.

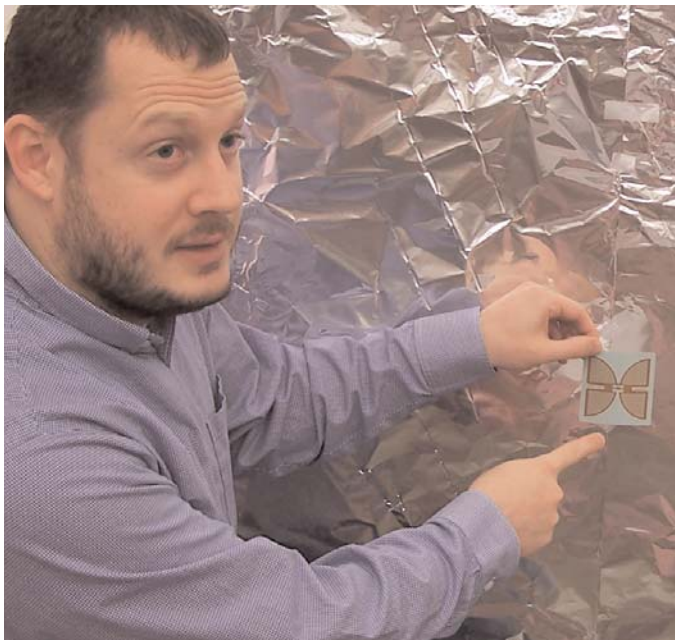
RFID tags listen for radio signals that are sent from a “reader,” which can be located in a truck, warehouse, or other connection point. Readers are made up of one or more antenna that

wirelessly take attendance and send that information through a secure network to the Internet.

Over the past year, Deavours has conducted hundreds of performance tests on various tags. Incredibly small amounts of metals and liquid—such as thin foil found in potato chip bags, or dishwasher detergent—nearly always stymied communication. In the spring of 2005, Deavours began thinking of a possible solution, leading to the development of a universal tag. Its design involves a thin spacing between the antenna and a thin metal foil. The tag is no thicker than 2 mm, and future tags may be even thinner, says Deavours.

“This solves a nagging problem with UHF RFID tags that has plagued the industry for a long time. We had seen a lot of attempts at solutions from industry, but none had been satisfactory. Tags we’ve developed in the RFID Alliance Lab work better on metal than most tags do in free space,” says Deavours.

Deavours submitted his proposal as one of ITTC’s internal technology commercialization projects, which are supported with funding from the Kansas Technology Enterprise Corporation (KTEC). KTEC has sponsored the research and development of several prototype tags, and one U.S. patent application has been filed. ITTC, KTEC’s center of excellence for information technologies, is exploring commercialization opportunities for the developed tags with regional and national companies.



Dan Deavours, an ITTC research assistant professor, displays an RFID tag placed near aluminum foil. Incredibly small amounts of metal and liquid prevent RFID tags from functioning properly. Deavours has invented a new tag design to alleviate this problem and has applied for a U.S. patent.



Graduate student Afzal Syed holds an RFID tag against Styrofoam in preparation for a test. Syed and other ITTC researchers have conducted numerous performance tests on various configurations of RFID tags in the RFID Alliance Laboratory.

In scientific research, traditional laboratory notebooks are critical to the discovery process, establishing a permanent and legal record. Using these notebooks as guides, ITTC researchers are developing software to electronically process and manage the vast amounts of bioinformatics data being generated as part of rapidly growing life-sciences research efforts. The Computational Bioinformatics Journal will transform the collection, analysis, organization, and storage of information. The “Journal” will make reproduction of experimental results easier and enable collaboration among researchers who are geographically separated.

Each journal will contain research that addresses a specific biological question and will function as a “write-once” mechanism. Just as scientists are not allowed to tear pages out of paper laboratory notebooks, safeguards will ensure that recorded computational entries will remain within the Journal, says **Ed Komp**, team leader on the project and a lead ITTC research engineer.

Currently, many scientists delete old files to deal with limited disk space. But if they need to reproduce previous experiments, information needed to duplicate results may have been lost. Through storage space created by ITTC’s new bioinformatics computational facility, all experimental definitions, inputs, and outputs are saved. The data warehouse provides a complete research record that significantly improves scientists’ ability to repeat others’ experiments. The premise of this research is that disk space will continue on its cost/volume curve, enabling new approaches, such as this Journal.

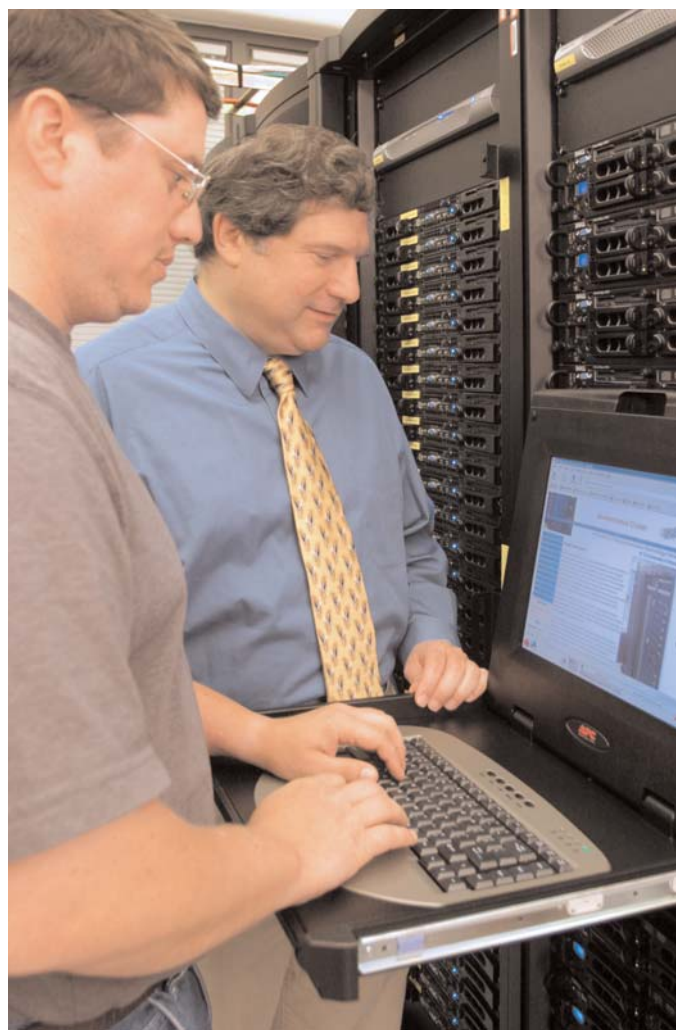
Electronic documentation allows flexible searching of data collected in one’s own journal(s) as well as those of other researchers who have permitted access. The Journal

will aid in collaboration and offer new approaches to analyzing results. If scientists wish to isolate specific data, the Journal allows them to reorder or exclude information easily. The ITTC system also organizes and presents large collections of data and relationships among them.

Researchers can readily paste facts and figures into their journals or save downloaded data. The Journal time-stamps and houses all generated research, ensuring authenticity and safe storage. The Journal enables cross-disciplinary biological studies, says **Victor Frost**, principal investigator on the project and ITTC director.

Creation of the Journal is an important milestone in ITTC’s “Development of an Integrated Bioinformatics Information Infrastructure” project, sponsored by the U.S. Army’s Edgewood Chemical Biological Center (ECBC). During the coming year, Komp’s team will improve the Journal’s accessibility to researchers while increasing its ability to manage critical, voluminous biological data.

Victor Frost, Dan F. Servey distinguished professor of EECS and ITTC director, observes as **Adam Hock**, ITTC’s senior network systems administrator for the Bioinformatics and Computational Life-Sciences Lab, tests the Lab’s new computer cluster. The cluster (depicted also on the cover of this *Annual Report*) is a key component of the ECBC-sponsored “Development of an Integrated Bioinformatics Information Infrastructure” project and hosts the Computational Bioinformatics Journal.



Unified Architecture for SensorNet

With the “Unified Architecture for SensorNet with Multiple Owners” project, ITTC joins Oak Ridge National Laboratories (ORNL) in developing a comprehensive sensor management system. The Department of Energy’s largest science and energy laboratory is directing the creation of a nationwide sensor network that will identify and assess chemical, biological, radiological, nuclear, and explosive (CBRNE) threats. SensorNet will process and disseminate critical information to emergency management decision makers and first responders.

Many ORNL partners are working on a wireless network that interconnects sensors and conveys data to a collection point. Principal investigator **Gary Minden**, director of ITTC’s Communications and Networking Systems Laboratory (CNSL), and his team are working on a different facet of SensorNet. They are developing a sensor network that can be rapidly deployed and elements of which are controlled by different organizations.

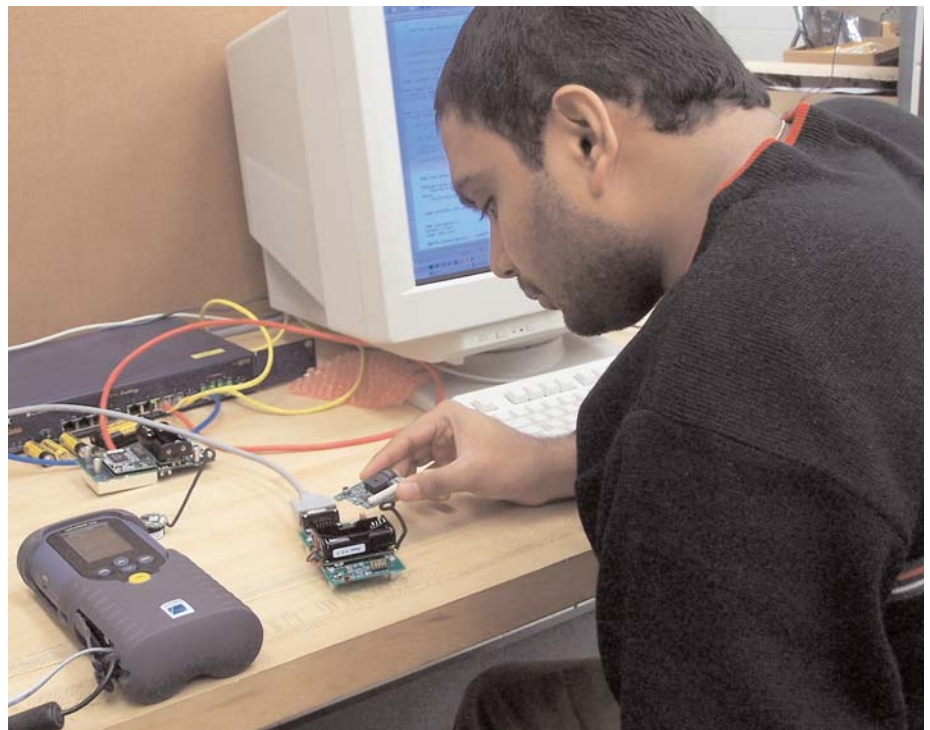
For example, in venues like the Kansas Speedway, different organizations are charged with the safety and security of the racetrack, race participants, and fans. NASCAR events bring multiple thousands of fans to the racetrack, but the intermittent nature of these events requires that

security, parking, wireless Internet, and other services be handled by subcontractors. Currently, the technological foundation does not exist to effectively integrate intelligence from these independent groups. Linking cameras, sensors, and communication between Speedway personnel could alert staff to possible incidents that may jeopardize spectator safety. Likewise, a number of public service organizations are involved in traffic control, medical support, firefighting, and utilities. These organizations need to be kept up to date on appropriate events during the five to six days of the race.

ITTC researchers will study low-cost sensor nodes in addition to the wireless interconnected network and the overall service architecture. These nodes—tiny, ubiquitous, networked sensors—possess data processors allowing them to perform simple computations, such as chemical detection and video transmission. The partially processed data can be sent to an on-site headquarters for additional analysis. These “smart” devices will enable enhanced computing, communication, monitoring, and analysis.

The Center will build a prototype and implement and evaluate it. The project’s researchers will deploy a simple system to understand how SensorNet works in the field.

Ph.D. student Pradeepkumar Mani programs tiny devices called “motes” for the SensorNet project. Sensors will be attached to the programmed motes. The mote will then collect data from the sensor and transmit the data to a collection point.



Veatros and Cadstone: Where Are They Now?

Veatros

Originating based on research conducted within ITTC, Veatros became a Lawrence-based, spin-off company in 2002. It markets the U.S. patented computer software product VidWatch, which continuously monitors television broadcasts for any discrepancies. For instance, when a broadcast company distributes a show such as “Friends,” that company allows each television station a certain amount of time for airing commercials. By monitoring the original and rebroadcast television signals simultaneously, VidWatch helps ensure that stations are not using more commercial time than allotted. Other products and customized solutions help media companies protect their intellectual property.

Veatros has recently developed two new products and is market ready with CompShare, says **Susan Gauch**, Veatros president and director of ITTC’s Intelligent Systems Laboratory (ISL). CompShare locates new commercials in specific markets, alerting advertisers of changes in competitors’ advertising campaigns. The second software product, which is still in testing, will allow time-sensitive information to appear during commercials. For example, if a company has free shipping for the next month, RT ComDetect will provide real-time detection of commercials and create pop-ups when needed.

Gauch has been invited to present Veatros at Project T2, a technology transfer conference, in California in November 2005.*

***Postnote, December 2005:** Gauch says Veatros was warmly received at Project T2, and she has had numerous follow-up conversations with participants. From contacts developed at T2, Gauch says they have engaged **Victor Hwang**, President of Larta Institute, as Chief Strategy Officer to identify and pursue new business opportunities for the company.

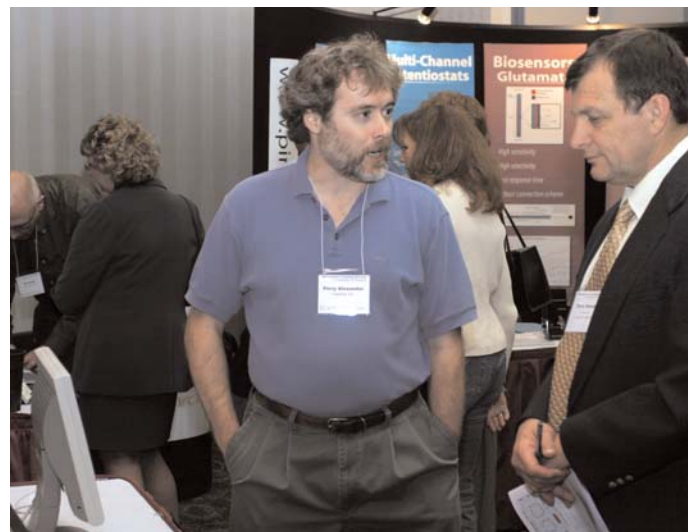
Perry Alexander, director of ITTC’s Computer Systems Design Laboratory (CSDL), discusses Cadstone, a company that he created in 2003 to market the systems-level design language Rosetta. Alexander was one of 34 exhibitors who participated in the 2004 Lawrence Technology Showcase, which approximately 225 people attended on November 3 at the Lawrence Holidome.

Cadstone

In 2003, **Perry Alexander**, director of ITTC’s Computer Systems Design Laboratory (CSDL), created the company named “Cadstone” to market the systems-level design language Rosetta. By allowing different subsystems within complex electronics to interact with one another, Rosetta software will help build faster, stronger, and more efficient electronics. The KU spin-off company is developing a suite of electronic design automation (EDA) tools to analyze designs written in the Rosetta system specification language. These tools will decrease product development costs by reducing the time and expense of detecting and correcting design defects. In addition, Cadstone’s design tools will increase revenue by allowing products with high-quality design to reach the market sooner.

The ITTC Technology Transfer program funded various aspects of Rosetta-related research, helping mature the Rosetta analysis environment before the creation of Cadstone. In FY2005, Cadstone obtained private funding for initial tool development, receiving an initial commitment for a \$300 thousand research contract pending budget approval. Alexander formed a formal Cadstone Board of Managers with several EDA industry leaders and initiated a subcontract with University of Kansas Center for Research (KUCR) for continued Rosetta-related research.

Cadstone plans to demonstrate and release beta versions of its flagship Rosetta analysis tool suite in the third quarter of 2006. These tools will include the first reference parser for Rosetta, simulation-based analysis capabilities, and the ability to define and compose simulations written in multiple domains. The Rosetta tool infrastructure will support writing and managing distributed models that support concurrent engineering among remote sites.



Projects Active FY2005

Automated Test Generation in Intelligent Systems (GENISYS)

EDaptive Computing, Inc.
W.P. Alexander

Automatic Synthesis of Hardware Features to Augment the POWER Architecture

International Business Machines Corporation (IBM)
R. Sass

Center for Excellence: Information and Telecommunication Technology Center

Kansas Technology Enterprise Corporation (KTEC)
T. Johnson; with V. Frost

Collaborative Project: Assessing the User-Base and Expanding the Usability/Reach of the Analytical Sciences Digital Library through Developmental Workshops

National Science Foundation (NSF)
C. Larive; with S. Gauch, T. Kuwana

Collaborative Project: Expansion and Enhancement of the Center of Excellence in Information Assurance Program

NSF
H. Saiedian

Collaborative Research: An Initiative for a Cyber Protection Center

NSF
H. Saiedian

Community Workshop on Computational Simulation and Visualization Environment for NEES

Network for Earthquake Engineering Simulation (NEES) Consortium, Inc.
K. Roddis

Comparative Analysis of EPC Compliant Devices

Rush Tracking Systems
D. Deavours

Computational Proteomics: Protein Interaction Prediction

National Institutes of Health (NIH)
X.-w. Chen; with J. Fang, R. Hanzlik

Computing Facility for Bioinformatics and Life Sciences Research

NIH
V. Frost; with X.-w. Chen, T. Clark

Constructing Gene Networks from Microarray Data for Age-Dependent Epileptogenesis

J.R. & Inez W. Jay Biomedical Research Committee
X.-w. Chen

Cryospheric Advanced Sensor (CAS): A Spaceborne Microwave Sensor for Sea Ice Thickness and Snow Cover Characteristics—Instrument Incubator Program (IIP)

National Aeronautics and Space Administration (NASA)
T. Akins; with S.P. Gogineni

Development of a Fused Ice Classification Scheme

Naval Research Laboratory (NRL)
C. Tsatsoulis

Development of a Monostatic/Bistatic Synthetic Aperture Radar System for Two-Dimensional Mapping of Basal Ice Conditions

NASA
S.P. Gogineni; fellowship for Ph.D. student John D. Paden

Development of a Spatial/Frequency Domain Interferometry Radar System for the Measurement of Sea-Ice Thickness

NASA
S.P. Gogineni; fellowship for Ph.D. student Brandon Heavey

Development of an Integrated Bioinformatics Information Infrastructure

U.S. Army
V. Frost; with G. Lushington, G. Minden, S. Gauch, T. Clark

Distributed Scheduling Aspects for Time-Critical Targeting

Washington University in St. Louis (flow-through from Defense Advanced Projects Agency [DARPA]/Air Force Research Lab [AFRL])

R.D. Niehaus

EHS: Dynamic Hardware Reconfiguration to Accelerate Java-Based Embedded Systems

NSF
R. Sass; with D. Andrews

Electronic Sensor System Engineering and Capture Environment (ESSENCE)

EDaptive Computing, Inc.
W.P. Alexander

Extending the Thread Execution Model for Hybrid CPU/FPGA Architectures

NSF
D. Andrews

First Award: Rapid Integration of Genomic Data from Multiple Sources

NSF/KTEC
T. Clark

Flexible Wireless Systems for Rapid Network Evolution

NSF
G. Minden

Future of Spectrum: Technologies and Policies Workshop

NSF
G. Minden

High Resolution Ice Thickness and Plane Wave Mapping of Near-Surface Layers

NSF
P. Kanagaratnam

Ice Thickness Measurements over the Antarctic Peninsula and Selected Outlet Glaciers

NASA
P. Kanagaratnam; with S.P. Gogineni

Identify Informative Genes for Cancer Classification (1st Award)

NSF/KTEC
X.-w. Chen

Information Systems Technologies for the Earth Science Technology Office

NASA
G. Prescott

Intelligent Knowledge Management Environments

U.S. Army
E. Meyen

Interoperability Testing of Bluetooth Devices: Implementation

Bluetooth Special Interest Group (SIG), Inc.
D. Deavours; with J. Juola (KU Dept. of Psychology)

Interoperability Testing of Bluetooth Devices: Prototype

Bluetooth SIG, Inc.
D. Deavours

ITR Collaborative Research: Enabling the Science Environment for Ecological Knowledge

NSF/KTEC
J. Beach; with A.T. Peterson, S. Gauch, D. Vieglaiss

ITR: Computation and Communication in Sensor Webs
NSF

J. James; with D. Andrews

ITR/SI+AP: A Mobile Sensor Web for Polar Ice Sheet Measurements

NSF/KTEC

S.P. Gogineni; with C. Allen, V. Frost, D. Braaten, G. Prescott, C. Tsatsoulis, A. Agah

Kansas Participation in Sea Winds Instrument Activities

Oregon State University (flow-thru from NASA)

R.K. Moore

Kansas Universities' Technology Evaluation Satellite: The MIST Mission

NASA Experimental Program to Stimulate Competitive Research (EPSCoR)/KTEC

T. Sorensen; with G. Prescott

KU High Altitude Balloon Experiment System and the KUBESat-1 Project

Honeywell Federal Manufacturing and Technologies (FM&T), Limited Liability Company (LLC) (flow-through from Dept. of Energy)

T. Sorensen

MIDP GPR Development

NASA

S.P. Gogineni

Model-Based Data Inversion to Estimate Accumulation Rate of Polar Ice Sheets

NASA

S.P. Gogineni; fellowship for Ph.D. student Vijaya Ramasami

Modular Wireless Avionics System for Autonomous UAVs

Kansas NASA EPSCoR

R. Colgren; with X.-w. Chen

National Radio Networking Research Testbed (NRNRT)

NSF

G. Minden

NeTS-NR: Collaborative Research: High-Speed Self-Configuring Networks Based on Cost-Effective Plug-and-Play Optical (PPO) Nodes

NSF

R. Hui (collaborative with Univ. of Texas, Dallas)

III-Nitride Wide Bandgap Semiconductors for Optical Communications

NSF

R. Hui

Optical-Domain Performance Monitoring for Next Generation Optical Networks

Nortel Networks

R. Hui

Optimal Space-Time Waveform Design for Adaptive, Multi-Mode Radar

Science Applications International Corporation (SAIC)

J. Stiles

Phased-Array Antenna System Development

Honeywell FM&T, LLC

C. Allen

Planetary Advanced Radio Sounder

University of Massachusetts-Lowell (flow-thru from NASA)

S.P. Gogineni

PMD Characterization of Installed Fiber

Sprint Corporation (United Management Company)

C. Allen

Quantifying the Temporal Characteristics of Congestion Events in the Internet

NSF

V. Frost; with T. Duncan

Radar Sounding and Airborne High-Resolution Mapping of Near-Surface Layers of the Greenland Ice Sheet

NASA

S.P. Gogineni; with D. Braaten

Reduced Brace Section (RXS): Proof of Concept

Butler Heavy Structures

K. Roddis

RICE—Radio Ice Cerenkov Experiment

NSF

D.Z. Besson; with D. Andrews, R.D. Niehaus

Sabbatical Research at the Naval Research Lab

NRL

R. Hui (collaborative with Univ. of Texas, Dallas)

Scalable Performance Models for Large Scale Networks with Correlated Traffic

University of Missouri-Kansas City

V. Wallace

Science and Technology Center: Ice Sheets and Sea Level Rise

NSF

S.P. Gogineni; with D. Braaten, C. Allen, A. Agah, K. Demarest, M. Ewing, V. Frost, R. Hale, J. Holvoet, K. Nordheden, G. Prescott, D. Andrews, R. Colgren, D. Downing, J. Feddema, S. Gauch, M. Hoeflich, X. Li, G. Tsoflias

Second NSF Workshop for High School Teachers of Mathematics and Science

NSF

B. Pasik-Duncan

Second Workshop for High School Students of Mathematics and Science

NSF

B. Pasik-Duncan

Stochastic Systems and Control

NSF

T. Duncan

System-Level Design of Embedded Systems

NSF

W.P. Alexander

System-Level Network Modeling

NSF

W.P. Alexander

Traffic Modeling for Network Engineering

Sprint Corporation (United Management Company)

D. Petr

Unified Data Format for Mass Spectrometry Analysis (UDF)/Laboratory Information Management System for Proteomics Applications

University of Kansas Medical Center (flow-thru from NIH)

G. Lushington; with J. Fang, J. Gauch

Validation of AMSR Snow Depth on Sea Ice Retrievals Using an Airborne Pulse Radar

NASA

S.P. Gogineni; with G. Prescott

Books and Book Chapters

Laboratory Support for MIPS-Style Processor Design.

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K. Demarest; *Handbook of Engineering Electromagnetics*; R. Bansals; Marcel-Dekker, September 2004, pp. 227–253.

Journal Articles

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E. Rignot, G. Casassa, S.P. Gogineni, W. Krabill, A. Rivera, R. Thomas; *Geophysical Research Letters*, Vol. 31(18401), 2004.

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Approximate Geometric Methods in Application to the Modeling of Fiber Placed Composite Structures.

K. Schueler, J.R. Miller, R. Hale; *ASME Journal of Computing and Information Science in Engineering*, Vol. 4(3), September 2004, pp. 251–256.

Bayesian Neural Network Approaches to Ovarian Cancer Identification from High-Resolution Mass Spectrometry Data.

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III-Nitride-Based Planar Lightwave Circuits for Optical Communications.

R. Hui, Y. Wan, J. Li, S.X. Jin, J.Y. Lin, H.X. Jiang; *IEEE Journal of Quantum Electronics*, Vol. 41(1), January 2005, pp. 100–110.

Ovarian Cancer Identification Based on Dimensionality Reduction for High Throughput Mass Spectrometry Data.

J. Yu, S. Ongarello, R. Fiedler, X.-w. Chen, G. Toffolo, C. Cobelli, Z. Trajanoski; *Bioinformatics*, Vol. 21(10), May 2005, pp. 2200–2209.

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Acronyms

AAI: ACTS ATM Internetwork

ACT(S): (NASA's) Advanced Communications Technologies (Satellite)

ATM: Asynchronous Transfer Mode

CPU/FPGA: Central Processing Unit/Field-Programmable Gate Array

EHS: Embedded and Hybrid Systems

IDEA: Institutional Development Awards (a Kansas program)

IEEE: Institute of Electrical and Electronics Engineers

K-INBRE: Kansas IDEA Network of Biomedical Research Excellence

MAGIC: Multidimensional Applications and Gigabit Internetworks Consortium

RFID: Radio Frequency Identification

WSEAS: World Scientific and Engineering Academy and Society

ITTC Support Staff



Left to right,
back row:
Nancy Hanson, Peggy Williams, Robin
Hinman;
second row from top:
Michelle Crick, Paula Conlin;
second row from front:
Michelle Ward, Kelly Mason;
front: Annie Francis.



Left:
Pamela Heimerich,
new Program
Assistant (for
ITTC Director)
starting October
2005.

ITTC support staff members help keep the Center functioning smoothly by handling daily administrative details. Below, in reverse alphabetical order, are the staff during FY2005 and their responsibilities.

Peggy Williams, Program Assistant. Acts as assistant to the director of ITTC; coordinates and manages recruitment activities; manages and tracks ITTC accounts; prepares and files immigration and visa documents for staff; organizes workshops, conferences, symposia, and other presentations. **Note:** Williams left ITTC in September 2005 to work with KU's Higuchi Biosciences Center. The new program assistant in her place at ITTC is **Pamela Heimerich**.

Michelle Ward, Public Relations and Marketing Coordinator. Manages publicity with local news media and state and industry contacts; composes and publishes ITTC's newsletters; writes press releases and the text for *Annual Report*; creates other publicity materials for the Center.

Kelly Mason, Program Assistant. Manages and coordinates budgets, purchasing, and student appointments for PRISM and other grants; assists with proposals and reports; provides support for RSL faculty and staff.

Robin Hinman, Research Administration Specialist. Manages payroll, accounts payable, and purchasing; tracks finances on all Center projects and performs budget projections.

Nancy Hanson, Program Assistant. Acts as assistant to ITTC executive director; assists with KTEC-related functions; tracks and maintains records for Center proposals and awards; calculates annual income and expenditures; manages publication of *Annual Report*; designs and executes layout for *Annual Report* and other publications; coordinates events involving Industry Advisory Board.

Annie Francis, Office Specialist. Manages new-student check-ins and appointments; maintains student information database; maintains Nichols space-assignment database; provides word processing for faculty and staff; coordinates workshops, conferences, and event hospitality; arranges travel for faculty and staff.

Michelle Crick, Student Office Assistant. Maintains ITTC office supplies stock; assists facilities coordinator with courier/mail/express shipment services, key maintenance, conference room scheduling; performs word processing, copying, filing, database processing to assist faculty and other staff; runs errands on and off campus; assists with *Annual Report* preparation. **Note:** Crick left ITTC in November 2005 to work at Hall Center for the Humanities.

Paula Conlin, Nichols Hall Facilities Coordinator. In charge of building maintenance requests, key maintenance, telephone administration, conference room scheduling, courier/mail services/express shipments, and other facility matters.

On the Cover

The photo used for our cover design was taken by Megan E. Gannon, Graphics Coordinator, University of Kansas Center for Research, Inc. (KUCR).

Adam Hock, Senior Network Systems Administrator for ITTC's Bioinformatics and Computational Life-Sciences Lab (BCLSL), is shown at the master keyboard for the Lab's computer cluster, new in FY2005. The cluster contains 384 processors and a 25-terabyte storage capacity and is used in compute-intensive research for discovery and advances in medical and biological sciences. (Graphic changes were applied to the photo, via Adobe Photoshop and QuarkXPress.)



Colors used in this report are those officially designated in KU's new *Graphic Identity Standards*, issued in September 2005, as appropriate for use in and with the new KU "signature" and the logos assigned by the University for departmental use. The Pantone colors are Blue 293, Crimson 186, Yellow 116, and Gray 430.

ITTC's *Annual Report Fiscal Year 2005* covers the period July 1, 2004, through June 30, 2005.

Published online only, March 2006.

Text by Michelle Ward and
ITTC Executive Staff.

Design, layout, and editing by Nancy Hanson.

Interior photos by
Michelle Ward and Annie Francis
unless otherwise indicated.

ITTC also acknowledges
photo contributions by Megan E. Gannon, and
Wally Emerson Photography.



Thanks to Paula Conlin, Annie Francis, and
Pam Heimerich

for their invaluable proofreading
assistance,

and to Michelle Crick for compiling the
faculty publications lists into one.



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