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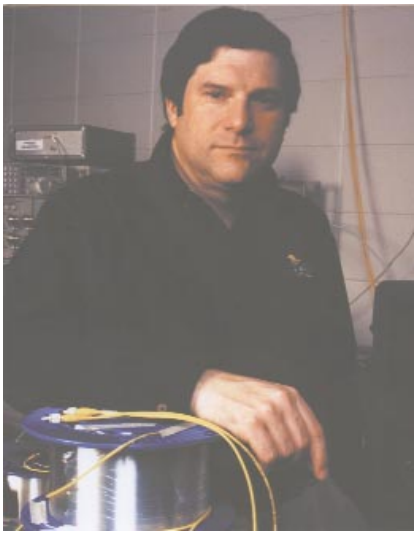
Director's Report



Victor Frost, ITTC Acting Director.

This year, without a doubt, ITTC established the groundwork for its future growth. After several meetings last fall, the faculty and staff agreed to pursue several large, ambitious projects. We coordinated our efforts and pinpointed those opportunities that fit the Center's vision. In turn, our faculty went after—and won the competition for—several significant research grants. The new projects are major initiatives with the Defense Advanced Research Projects Agency (DARPA), the National Aeronautics and Space Administration (NASA), the Department of Energy (DOE), and the National Science Foundation (NSF). As you'll discover in this annual report, these projects are excellent matches for our vision to become a world-class, university-based research center in the area of information and telecommunication technologies.

Among this year's new and challenging projects are large, multi-investigator, multi-year efforts in the areas of information retrieval and intelligent systems. Our faculty have targeted and increased their research activity in these areas, and this year they laid the foundation for the Center's future growth.

Gary Minden and co-principal investigator (co-PI) Joe Evans, and Costas Tsatsoulis and co-PI Doug Niehaus received DARPA contracts. Gary and Joe's Active Networking project seeks to improve and manipulate Internet capabilities. Costas and Doug's Autonomous Negotiating Teams (ANTs) will examine computers' capability to negotiate with each other to execute the best results in the available time.

Chris Allen continues to attract support for his work with radar systems. His new NASA award demonstrates an interesting synergy between lightwave transmission research and laser radar research applied to an application in a space-born operation. His work offers a strong example of the Center's ability to look at a problem from many angles.

We are also pleased with the significant, yet diversified, support that continues in the lightwave area. We maintain a strong collaborative spirit with NEC of America and NORTEL of Canada—manufacturers of telephone switches and optical transmission systems. Our Sprint support continues strong and steady, with significant contributions over the past 12 years. NEC and Sprint also have stepped forward as supporters of ITTC's new Industrial Affiliates Program.

Shortly after the 1998-99 fiscal year closed, we were pleased to learn that Gary and his co-investigators had received an important NSF award. Several factors helped land the Ambient Computational Environments (ACEs) contract: the faculty's coordinated effort, matching funds, solid facilities, and a review team that clearly saw the quality of our faculty and the ITTC labs. The reviewers met investigators noted for their work in each of the project's major thrust areas. They saw firsthand that we were not a group of "we're gonnas," but rather a group of researchers who had already accomplished significant work. ACEs speaks well of the Center's collaborative spirit and of the faculty's ability to put that spirit to work.

Our new directions clearly have their foundations in older and solid research efforts. ACEs grew out of the Rapidly Deployable Radio Network (RDRN) with DARPA, Susan Gauch's work with data discovery and information retrieval, and other interdisciplinary ITTC research. The Active Networking project and ANTS also combine roots in our previous efforts with a view to the future. Our new DOE award was a direct result of Joe Evans' work on the MAGIC and AAI national high-performance testbed networks. All of our new efforts are linked to a history of continuing hard work and to our growing and recognized level of expertise.

Here at the Center, we certainly are savoring the short-term gratification that comes from this year's newly funded proposals. Long term, however, we are especially pleased that Information Telecommunication has been identified both by KU and by the State of Kansas as a high priority area for research investment. Our future looks bright indeed!

Victor Frost
Daniel F. Servey Distinguished Professor of EECS

IT AND ITTC

Research centers and institutions are undisputedly the most important factor in incubating high-tech industries. A side effect of the technical capability and scientific research activities of these institutions is the training and education of the skilled labor that will be critical to the expansion and reinforcement of regional high-tech industries. (Ross C. Devel, Miliken Institute.)

KU's Information and Telecommunication Technology Center (ITTC) represents the leading advanced information and telecommunication technology (IT) research, development, and commercialization within the entire Midwest region. It is the second largest center on campus in terms of research expenditures, with FY1999 expenditures of approximately $6.5 million. The Center is strategically positioned to achieve a tenfold growth increase over the next decade.

KU's Center for Research has recognized ITTC—one of the largest university-based R&D programs in the Big 12 conference and in the country—for its

- Successful track record in attracting research funding
- Internationally recognized academic and research programs in IT
- Proven history of working with the leaders of the telecommunications industry
- Excellent record of successfully developing and commercializing IT technologies
- World-renowned faculty
- Unique facilities secured by substantial internal and industry-based investments
- Interdisciplinary campus

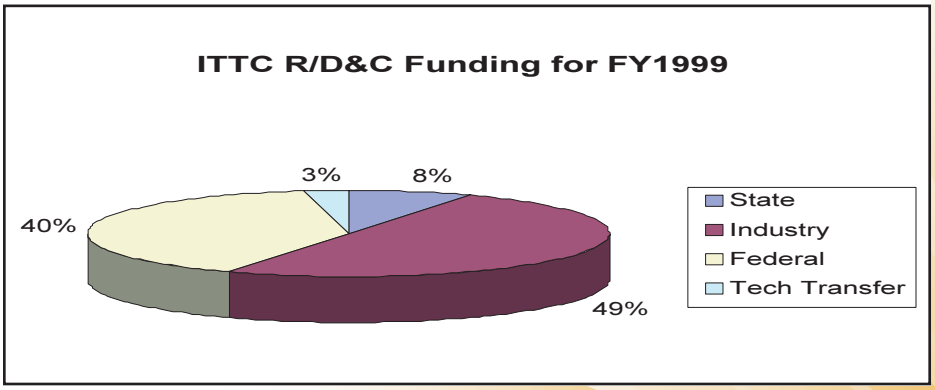
Why IT?

Information technology (IT)—the electronic exchange of information—has become an engine of economic growth. In fact, IT is so important at this point that the University, KU's Center for Research, Inc. (CRINC), and ITTC all believe that KU and its researchers must make a major move toward increasing KU's and Kansas' market share in the many fields that this strategic technology affects. As IT affects everything, it is an essential component in every aspect of education, business, and daily life. So the importance of IT development places ITTC at the forefront of economic growth considerations for Kansas, the Midwest, the nation, and the world.

Recognizing the importance of Information Technology and ITTC's role in that diverse and exciting field, the University of Kansas is envisioning the establishment of a major regional IT center in Lawrence, built around the core competencies of ITTC.

ITTC Funding and Facilities

During FY1999, ITTC participated in seven multi-year, multi-disciplinary, multi-million-dollar sponsored research projects. Research, Development, and Commercialization (R/D&C) awards for the fiscal year totaled more than $7.8 million, of which 40 per cent represented federal



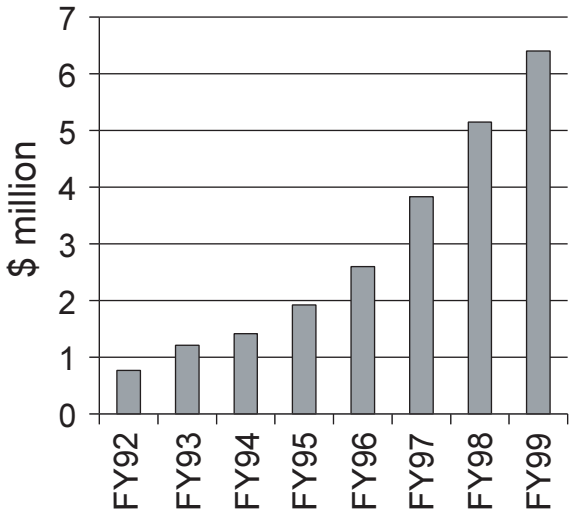
grants, 8 per cent represented state-based funding (KTEC), 49 per cent represented industry-based collaborative sponsored research, and 3 percent represented technology transfer, commercialization revenue, and other income sources.

ITTC continues to partner successfully with local industry and with nationally recognized academic institutions and governmental agencies in the development of advanced IT technologies. Of the 43 project awards in FY1999, 25 represented new projects, while 18 represented sustaining projects. Throughout the fiscal year, ITTC managed 55 active projects and assisted 14 companies.

MAMTC (Mid-America Manufacturing Technology Center)—affiliated with ITTC and sponsored through KTEC—provided critical assistance to an estimated 100 companies throughout the year.

ITTC R&D Core Expenditures

~ $15 million over last 3 years
(averaging 36% annual growth)



Outreach Highlights

Throughout the year, ITTC hosted several events—from site-review teams to guests from state and national companies. In April, ITTC welcomed three reviewers for its biennial KTEC site review, and the Center received excellent marks. In May, ITTC hosted about 100 people for part of the spring meeting of the Kansas Telecommunication Industry Association (KTIA). Owners and employees of companies that offer telephone services in Kansas toured ITTC's facilities, and heard researchers' thoughts on the ongoing changes in telecommunication technologies.

ITTC's Ambient Computational Environments (ACE) proposal to the NSF moved to the final selection round; and on May 14, three reviewers visited the Center. They came to further critique ITTC's proposed project, which was among eight finalists. During the reviews, an NSF commentator noted that the proposed research "takes a novel cut across subdisciplines in computer science, artificial intelligence, language, and systems researchers." The project represents more than $1 million over three years and brings together ITTC's notable research in computer networking and artificial intelligence. As this annual report was being written at the close of fiscal year 1999, NSF announced it would fund the project. A brief description of the project and its goals appears on page 41.

The diversity and importance of the research presented at ITTC's Second Annual Technology Review Day on May 17 prompted a *Kansas City Star* reporter to call ITTC "the best kept secret in Kansas." About 60 people joined ITTC faculty, students, and staff to learn more about ITTC's research efforts and to tour the Center's five laboratories.

In conjunction with Technology Review Day, ITTC held its Annual Advisory Board Meeting on May 18. ITTC's Board consists of about 40 leaders within the telecommunications industry, who meet yearly for strategic planning. A list of FY99 Advisory Board members appears on page 35.

ITTC at a Glance

Faculty	26
Staff	15
Students	125

Laboratories:

- Intelligent Systems and Information Management
- Lightwave Communication Systems
- Networking and Distributed Systems
- Radar Systems and Remote Sensing
- Wireless Communications and Digital Signal Processing

The Future

IT advances enhance not only business opportunities, efficiency, and effectiveness, but also the quality of life for all citizens. Furthermore, IT can vastly improve the economic condition of Kansas through the education of its students and collaborations with local industry and the government.

ITTC renews its goals to

- Make strides in the area of telecommunication and information technologies through basic and applied research and development
- Satisfy the need for IT professionals by training undergraduate and graduate students in IT
- Provide a point of focus for expertise in all IT-related research
- Develop high-impact commercial IT technologies
- Transfer critical technologies to industry
- Help companies use appropriate IT technologies to their benefit
- Serve as a state resource for applications of IT to improve Kansans' quality of life
- Diversify ITTC's funding base for IT research and development
- Position ITTC on a strategic growth trajectory to reach its funding goal of $60 million within 10 years.

New technologies evolve from various opportunities:

- *Industry or federally sponsored research programs*
- *Collaboration with industry*
- *Innovation from KU faculty, staff, and students*

ITTC INDUSTRY AFFILIATES PROGRAM

In the rapidly changing world of information technology (IT), theory and hardware can quickly become obsolete. IT industries need to keep current, and this need has generated fertile interactions between industry and the academic community. ITTC has a successful record of understanding and being responsive to industry needs and has worked closely with industry on many joint research and development projects.

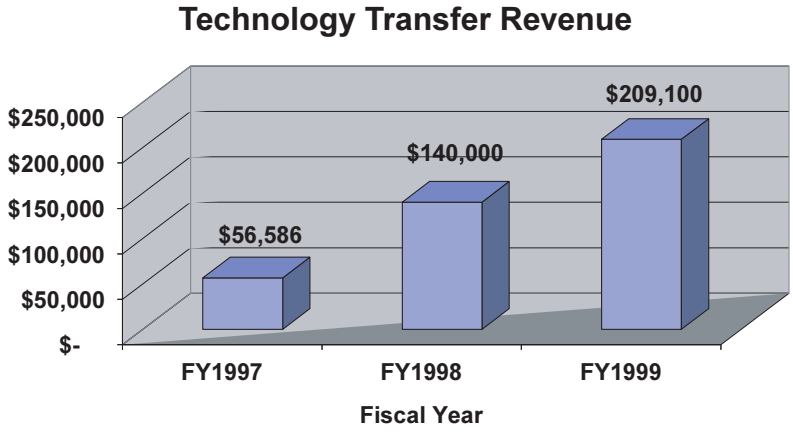
To further this collaborative interaction, ITTC launched its Industry Affiliates Program during this fiscal year. This program will develop a practical and functional relationship between ITTC and the industrial community. The program offers many benefits, including annual workshops, periodic seminars, special courses, and an open dialogue about research areas of mutual interest. Affiliates also gain access to research results and to faculty, staff, and students.

Other benefits include periodic exchanges between faculty and their business counterparts, improved contact with students for recruitment and internships, enhanced participation in joint proposal and project activities, and increased communications between the Center and its affiliates.

ITTC plans to continue to expand the program during FY2000 and to include international affiliates.

TECHNOLOGY TRANSFER

Intellectual property development, technology transfer, and commercialization are key Center objectives, and these objectives are well aligned with the KTEC mission, "to support technology advancement, technology transfer, and commercialization." ITTC also is committed to increasing its emphasis on technology transfer in the next decade. By taking a leadership role in this technical area, ITTC will improve the impact of IT on the local and state economy and support the Center's long-range objective to increase its current funding level tenfold over the next 10 years.



In support of its long-term tech transfer needs, ITTC added four critical staff members during the fiscal year. Mark S. Wdowik was brought on board during the second quarter to manage and direct the Center's IP portfolio, technology transfer, commercialization, and applied technology activities. Judith Galas was added during the third quarter to improve and manage ITTC's public relations, marketing, and community outreach. Finally, two full-time staff members, Enlian Chong and Sash Guha, were added to the Applied Technology Group to provide advanced software development skills for external business assistance and in-house development needs.

Technology Transfer Objectives:

- *Develop solid intellectual property (IP) foundation*
- *Provide IP expertise and support to faculty, staff, and students*
- *Transition high impact technologies to industry*
- *Community outreach*

Technology transfer inherently involves applied technology development, as well as the mining of technological advances from the Center's extensive research portfolio. Technology development involves close collaboration and investment by ITTC and the business community alike. Such projects may take the form of joint collaborative development or internally funded technology development projects. Through such projects during FY1999, ITTC licensed two advanced technologies: one to a local Kansas start-up and another to an international broadcasting and entertainment conglomerate. As is consistent with ITTC's mission, most technology licenses are awarded to Kansas entities when suitable. During FY1999, ITTC's royalty and licensing fee receipts increased approximately 50 percent over the prior year to $209,100.

With typical innovation-to-commercialization cycles of 10 years, ITTC believes its current technology portfolio will continue to produce strong returns on investment (ROI) over the next decade. Augmenting this portfolio, new advances are being made through current projects in key areas such as networking hardware and data routing protocols, high-speed wireless data hardware, intelligent information retrieval and analysis, video processing, advanced radar imaging, and agent-based applications. Such technology development is expected to produce significant returns to the Center over the next decade and beyond. This activity also improves the Center's ability to attract external government and industry funding in its core competency areas.

Such opportunities also are supported by KTEC and KU's Center for Research, Inc. (CRINC), a not-for-profit foundation that manages the University's sponsored research and technology transfer agreements. ITTC's technology transfer process typically concludes with a formal technology license or assignment agreement. These agreements may include sponsored research support, significant cost sharing, royalty and other compensatory payments, and noncash positions of equity and/or debt. The technology transfer activities at ITTC seek a "win-win" solution for all affiliated parties.

Technology Transfer Achievements for FY1999:

New Technologies Developed	*13*
Technologies Commercialized in KS	*8*
Technologies Commercialized (Other)	*2*
Patents / Copyrights Filed or Issued	*9*
Companies Assisted	*14*
Technology Transfer Revenue	*$209,100*

FY99 Tech Transfer Highlights

In FY1999, ITTC greatly increased its intellectual property (IP) portfolio, providing key technologies for future licensing and assignment. One patent issued during the year, two additional patents were filed, and four other technologies are currently at the patent application development stage. During the year, 13 new technologies were created and 10 were transferred to commercial entities via licensing or assignment.

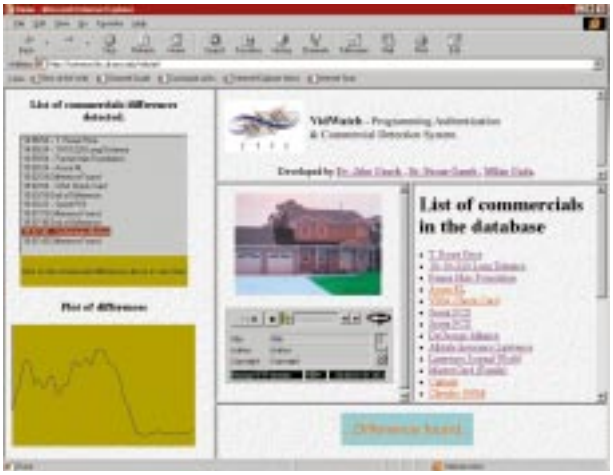
Here are some highlights of the Center's achievements this year:

- **DiscoverME, LLC**: ITTC successfully transferred an innovative client/server software technology to a Kansas start-up company. Developed in a collaborative, shared risk/shared reward relationship, ITTC's World Wide Web (WWW) personality-based candidate assessment and recruitment system was designed to create an entire Web-based database and user interface for on-line recruiting services. This system, based on meaningful, enduring personality characteristics, is an effective method of using motivation, expertise, knowledge, and personal goals to segregate prospective employees. Use of this service is intended to reduce the level of placement mismatches, attrition, and dissatisfaction of employees. Since the time of technology transfer, the company has successfully completed a private placement offering and has fully launched its service.

DiscoverME's software teamwork included (front row, left to right) CEO Carol Rudder; ITTC's Enlian Chong, the project's software engineer; and Rajashree Patil, a master's student who worked closely with the project's development. In the back row, left to right, are DiscoverME President and COO Brian Johnson; Tim Johnson, ITTC's Executive Director for Operations and Applied Technology; and Doug Herbers, an undergraduate who helped with testing and compatibility.
Photo by Aaron Paden, KU University Relations.

- **ProFusion, LLC**: The ProFusion™ meta-search technology developed by Susan Gauch at ITTC, was fully licensed to ProFusion, LLC in FY1997. The technology continues to receive numerous awards and accolades, including *PC Professionell* Editors' Choice Award (August 1998), *PC Magazine* Editors' Choice Award (December 1997), recommendation of ProFusion's core technology by German subcontractor on Berlin-Brandenburg BB-OPAC project (January 1997), and Scout Report Award (December 1996). Fully launched about two years ago, the ProFusion™ website's traffic is increasing at a steady rate.

- **VidWatch**: Developed by John Gauch at ITTC, this critical video processing and analysis system is currently under exclusive evaluation by a major international broadcasting and entertainment company. VidWatch processes two or more input video streams in real time to detect video signal differences, including programming variations, signal distortions, "dead airtime," and other anomalies. The system is currently under evaluation for the application of automated advertising commercial detection and programming verification.



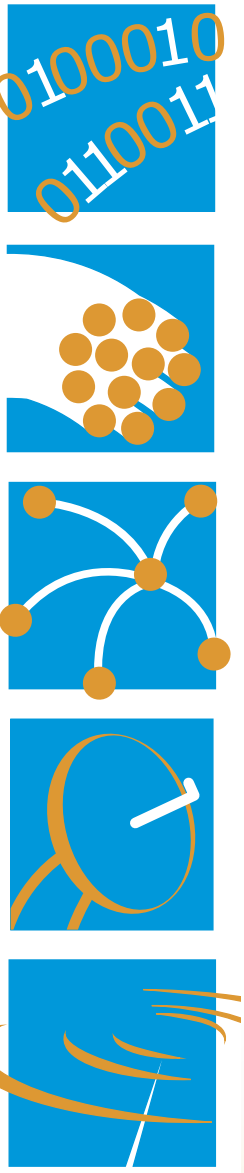
VidWatch's Real-Time Commercial Detection Reports are Viewable via the Web.

Patent
Swept-Step Radar System and Detection Method Using Same
Provisional Patent
Real-Time Feature-Based Video Stream Distortion Analysis System
Patent Pending
Method and Apparatus for Controlling an Optical Signal
ATM Reference Traffic System
Real-Time Feature-Based Video Stream Distortion Analysis System
Processing and Delivery of Audio-Video Information (2)
Three-Dimensional Display Apparatus
Patent Application Preparation
Multiwavelength All-Optical Clock Recovery System
WDM Lightwave Network Simulation Tool
First Order Polarization-Mode Dispersion (PMD) Adaptive Compensation System
High Resolution Optical Spectrum Analyzer for Optical System Link Quality Monitoring
Registered Copyright
MEM-1, Lucid Common, DECStation
MEM-1, Golden Common, PC
MEM-1, Allegro Common, IBM RS6000
MEM-1, Sun Common, LISP
MEM-1, MacIntosh Common, LISP
Remote Pump Controller

Registered Copyright (continued)
Remote Pump Monitoring
Voice Band HF Channel Config. Editor for Windows
Voice Band HF Channel Simulator
Voice Band HF Channel Simulation Designer for Windows
KTRAC
RTSS, Admin Tool
RTSS, Patient Care
RTSS, Training Tool
Web-Based Personality Assessment and Recruitment System
VidWatch System
Data Extraction from RDD-100 DVF Run
Rapid Prototyping Tool, RDD-100
Information Provider Guide
Operational Concept Doc for KICIN
Initial Requirements for KICIN
Dynamic Enterprise Modeling
VISION
ProFusion Meta-Search Engine
ASIS
ARKTOS
TopoView
Helios
PHOENIX

LABS OVERVIEW

As one of five KTEC Centers of Excellence, ITTC has a full breadth of knowledge, experience, innovation, and facilities to perform critical research and development of cutting-edge technologies in the fastest growing employment sector in the state of Kansas—IT, or information technologies. With more than $6.5 million in annual research and development expenditures and expertise in all critical IT areas, ITTC has enjoyed an average annual growth rate of 36 percent during the past six years.

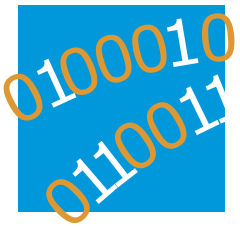


The information infrastructure comprises bitways, services, and applications. "Bitways" refers to the avenues of data transfer, whether in the form of digital or analog signals. "Services" represents the generic information sources transported over bitways, such as voice, video, and data. Finally, "applications" refers to the higher-level uses and manipulation of such services. While some research centers focus on narrow technology niches, ITTC envisioned the need for a systems-centric IT approach, with the capability to closely collaborate with the government and corporations of all sizes in the rapidly growing IT arena. ITTC focuses not only on today's solutions to complex IT problems, but also on the technological needs of tomorrow. Supported by current Kansas leaders, Industry Advisory Board, governmental funding agencies, and local and international corporate partners, ITTC represents an all-in-one IT "solution." It stands poised to become the next major IT center for the Midwestern region. Strategic plans include a new, state-of-the-art IT building and infrastructure to enable the Center to carry forth its long-term mission and to meet the demands of the new millennium.

ITTC comprises five major research laboratories: Intelligent Systems and Information Management Lab (ISIML), Lightwave Communication Systems Lab (LCSL), Networking and Distributed Systems Lab (NDSL), Wireless Communications and Digital Signal Processing Lab (WDSPL), and the Radar Systems and Remote Sensing Lab (RSL). Supported by many governmental agencies such as NSF, NRL, NASA, DARPA, NIH, and the Tri-Services, as well as corporate entities such as Sprint, Nortel Networks, Ciena, Lucent Technologies, ProFusion, L.L.C., and DiscoverME, L.L.C., ITTC has made significant technological contributions to the rapidly growing IT field.

ITTC is well-staffed with over 25 affiliated faculty and post-doctoral members, 15 staff members, and 125 graduate and undergraduate students. The Center is located in Nichols Hall on KU's west campus. The current facility occupies approximately 20,000 square feet of well-capitalized laboratory, office, and community-access space. ITTC houses an extensive array of state-of-the-art computer, telecommunications, measurement, and other analytical equipment, and it maintains a direct 2.4 Gbps fiber link to the Sprint campus in Kansas City, Mo.

INTELLIGENT SYSTEMS & INFORMATION MANAGEMENT LAB



Mission: **To perform leading-edge research and to develop critical, enabling technologies in advanced network-based applications, information retrieval, and intelligent data processing.**

Description: ISIML studies theoretical and applied technology in the areas of artificial intelligence, intelligent agents, and agent-based applications. It also investigates information retrieval from distributed and heterogeneous sources and data mining. ISIML's researchers develop advanced methodologies for automated characterization of data sources, dynamic routing, soft- or auto-bots, information fusion and enhanced visualization, image and video processing, knowledge-based systems, and development tools.

Facilities:
- AI Development Tools
- CATV Link
- CORBA
- Data Mining Tools
- KU Image Analysis Program (KUIM)
- KU Information Retrieval (KUIR)
- KU Real Time (KURT)
- NT PCs and Linux Workstations
- Proportional Time/Real-Time Network Testbed
- Robotics Assembly Shop
- Video Recording/Transmission Systems
- 2.4 Gbps Fiber Terminal

Current Sponsors: National Science Foundation (NSF), Defense Advanced Research Projects Agency (DARPA), National Institutes of Health (NIH), Naval Research Laboratory (NRL), Sprint, Turner Broadcasting Systems

Lab Director: Costas Tsatsoulis (EECS)

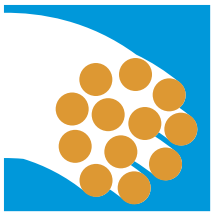
Affiliated Faculty: Arvin Agah (EECS), John Gauch (EECS), Susan Gauch (EECS), Jerzy Grzymala-Busse (EECS), Douglas Niehaus (EECS), Kim Roddis (Civil Engineering)

Staff Personnel: Leen-Kiat Soh

♦ Agents ♦ Artificial intelligence ♦ Compression ♦ CORBA ♦ Data mining ♦ Distributed data ♦ Fusion ♦ Intelligent systems ♦ Machine learning ♦ Multiagent systems ♦ Human-Machine interaction ♦ Image analyses ♦ Information retrieval ♦ Intelligent agents ♦ Internet ♦ KURT ♦ Metasearch engine ♦ Query routing ♦ Robotics ♦ Segmentation ♦ Video indexing ♦ Video libraries ♦ Video processing

LIGHTWAVE COMMUNICATION SYSTEMS LAB

Mission: **To increase the capacity utilization of long-distance lightwave communication networks; to train the next generation of engineers in the field of lightwave systems; to conduct research and publish results that contribute to the knowledge base in the lightwave arena; to provide value to local industry relating to the application of lightwave technologies; and to establish and maintain a core competency in lightwave systems techniques.**



Description: LCSL explores lightwave technologies, specifically in the areas of photonic devices—including components and fiber, and network flexibility and protocols of existing optical networks. Such research and development is performed in conjunction with government agencies and industry partners to optimize performance, cost, and reliability of such networks and related technologies. Experts within LCSL investigate lightwave systems and networks, wavelength division multiplexing (WDM) and dense wavelength division multiplexing (DWDM), network performance improvements, reduction or elimination of deleterious transmission effects such as polarization mode dispersion (PMD), new fiber technologies, and advanced photonic devices.

Facilities:

- Ciena Multiwave 1600 16-λ WDM system
- Direct fiber link to Sprint facility in Kansas City
- Erbium-doped fiber amplifiers
- Fiber-optic polarization analyzer
- Fiber-optic recirculating loop
- Hundreds of kilometers of assorted optical fiber
- Lucent FT-2000 8-λ WDM system
- Optical clock recovery system
- Optical spectrum analyzer
- Soliton generator
- Tunable lasers
- 12-Gb/s BERT
- 50-GHz sampling oscilloscope
- 100-fs pulsed laser source

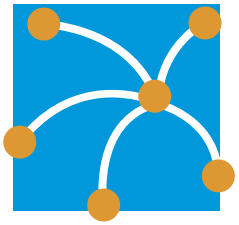
Current Sponsors: Sprint, National Science Foundation (NSF), Lucent Technologies, Ciena, Nippon Electric Company (NEC), Nortel Networks, KTEC

Lab Co-Directors: Kenneth Demarest (EECS) and Christopher Allen (EECS)

Affiliated Faculty: Joseph Evans (EECS), Victor Frost (EECS), Rongqing Hui (EECS), Gary Minden (EECS), Karen Nordheden (Chemical and Petroleum Engineering)

♦ All-optical networks ♦ ATM ♦ Bandwidth optimization ♦ Dense wavelength division multiplexing (DWDM) ♦ Fabry-Perot interferometer ♦ Optical amplifiers ♦ Optical clock recovery ♦ Optical fiber ♦ Optical modulators ♦ Optical network simulations ♦ Optical repeaters ♦ Polarization mode dispersion ♦ Solitons ♦ Synchronous optical network (SONET) ♦ Wavelength division multiplexing (WDM)

NETWORKING & DISTRIBUTED SYSTEMS LAB



Mission: To research and develop innovative, high-performance networks and systems.

Description: NDSL engages in analytical research, advanced simulations, and testbed measurements of large-scale networks and network technologies. It emphasizes networking issues, performance, testing, modeling and enhancements, network control and signaling, and integration of advanced lightwave and wireless communication technologies. Such efforts have had critical impact on the telecommunications industry, networking community, and information service providers (ISPs). NDSL has produced world-recognized achievements in distributed performance measurement and modeling, network control and management systems, self-configuring networks, optimal data transfer protocols, architectures, reliability, robustness, ubiquitous systems, improved distributed networking routing, management tools, and cost models.

Facilities:

- Direct access to SprintLink, Internet2, CAIRN
- Direct fiber link to Sprint facility in Kansas City
- Extensive high-speed networking infrastructure
- FORE ATM switches and concentrators
- High speed WANs
- Linux PC array and Sun workstation testbeds
- Miscellaneous routers, switches, and network interfaces
- Network system software and configuration server
- Several carrier-class Cisco IP routers
- Sprint testbed connections at 40 & 2.4 Gbps
- 2.4 Gbps SONET fiber terminal

Current Sponsors: Sprint, Defense Advanced Research Projects Agency (DARPA), National Science Foundation (NSF), Adaptive Broadband

Laboratory Director: Joseph Evans (EECS)

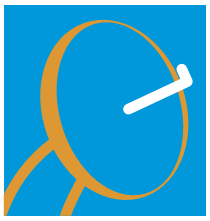
Affiliated Faculty: Tyrone Duncan (Mathematics), Victor Frost (EECS), Gary Minden (EECS), Douglas Niehaus (EECS), Bozenna Pasik-Duncan (Mathematics), David W. Petr (EECS)

Staff Personnel: Jason Keimig

♦ AAI ♦ ABR ♦ Active networking ♦ ATM ♦ BONeS ♦ CAC ♦ CBR ♦ Cell loss ♦ DiffServ
♦ Distributed services ♦ Gigabit testbed ♦ High speed wireless ♦ LAN ♦ Local loop ♦ MAGIC
♦ NetSpec ♦ Network benchmarking ♦ Network protocols ♦ Packet loss ♦ Packets ♦ Paths ♦ QoS
♦ Reliability ♦ Routers ♦ Scalability ♦ Signaling ♦ Simulation ♦ Software switches ♦ SPW Switches
♦ TCP/IP ♦ Testbeds ♦ Trunking ♦ VBR ♦ VCs ♦ VoIP ♦ WAN ♦ Wireless broadband

RADAR SYSTEMS & REMOTE SENSING LAB

Mission: **To educate engineers and future leaders in the area of radar, microwaves, communications and remote sensing techniques for the 21st century; to explore new ways to use electromagnetic waves in remote sensing of land—surface and subsurface—sea, polar ice, and the atmosphere; to produce new remote sensing sensors (primarily radar); and to develop new methods for solving electromagnetic problems.**



Description: RSL develops, evaluates, and applies new radar systems and other related sensing technologies for remote sensing of land, sea, ice, and atmosphere. A broad range of laboratory activities is involved, including sensor development, data collection, data analysis and modeling, and data dissemination. Remote sensing areas where RSL has made significant contributions throughout the years include remote sensing of the ocean, atmosphere, sea ice, polar ice sheets, vegetation, soil moisture, subsurface, and snow.

Facilities:
- Antenna measurement range
- Field-programmable logic
- High-speed oscilloscope
- Variety of high-end workstations and personal computers
- 20-GHz frequency synthesizer
- 22-GHz spectrum analyzer
- 40-GHz network analyzer

Current Sponsors: National Aeronautics and Space Administration (NASA), U.S. Army, U.S. Air Force, Jet Propulsion Lab (JPL), University of Copenhagen, and California Institute of Technology

Lab Director: Christopher Allen (EECS)

Affiliated Faculty: Kenneth Demarest (EECS), Prasad Gogineni (EECS), Richard K. Moore (Emeritus, EECS), Glenn Prescott (EECS), Jim Stiles (EECS)

Staff Personnel: Torry Akins

♦ Ground-penetrating radar ♦ Ice-sounding radar ♦ Laser radar ♦ Oceanographic radar
♦ Radar data analysis ♦ RF and microwave engineering ♦ Scanning radiometer systems
♦ Synthetic-aperture radar (SAR)

WIRELESS COMMUNICATIONS & DIGITAL SIGNAL PROCESSING LAB

Mission: **To advance the state of the art in wireless communications architectures, protocols, hardware, and methodologies through the application of critical digital signal processing technologies.**

Description: WDSPL serves as ITTC's focal point for leading edge research in wireless communications and digital signal processing applications in communications and radar. Well integrated with the other laboratories within ITTC, WDSPL performs design, implementation, testing, measurement and commercialization of wireless systems and components. Innovative digital communication system design bridges the gap between the simulation world and real-life applications. WDSPL performs both basic and applied research in these areas in collaboration with the government and international industrial leaders. The lab has been successful in demonstrating intelligent wireless communication systems for the government and commercial applications. It is currently engaged in employing digital signal processing technology to the problem of radio and synthetic aperture radar signal processing through the use of rapid prototyping techniques.

Facilities:

- APTIX FPGA prototype facility
- Circuit board fabrication facility
- DSP rapid prototyping facility
- Eagleware RF design
- EESof
- High-speed digital T/R rooftop antenna
- MATLAB / Simulink
- Power meters
- Protel PCB Layout
- Signal processing workstation
- Synopsys FPGA design tools
- 2 GHz digital sampling scope
- 20 GHz synthesizer
- 22 GHz spectrum analyzer
- 25 Mbps wireless communications system
- 40 GHz, 6 GHz network analyzers

Current Sponsors: Defense Advanced Research Projects Agency (DARPA), National Science Foundation (NSF), U.S. Air Force Research Laboratories (USAF), Sprint, and Air Force Office of Scientific Research (AFOSR)

Laboratory Director: Glenn Prescott (EECS)

Affiliated Faculty: Swapan Chakrabarti (EECS), Joseph Evans (EECS), Victor Frost (EECS), Gary Minden (EECS), Douglas Niehaus (EECS), James Roberts (EECS), Sam Shanmugan (EECS), James Stiles (EECS)

Staff Personnel: Dan DePardo, Artur Leung

♦ Amplifiers ♦ Antenna design ♦ ATM ♦ Broadband ♦ CDMA ♦ Cellular ♦ DC ♦ Digital radios ♦ Digital signal processing ♦ Downconverters ♦ Error correction algorithms ♦ FPGA ♦ GaAs ♦ GHz ♦ Hand-held ♦ HBTs ♦ High-speed bridge ♦ High-speed datacomm ♦ Intelligent algorithms ♦ LNAs ♦ MHz ♦ Microwave ♦ Millimeter wave ♦ Mixers ♦ MMICs ♦ Mobile ♦ NII-band ♦ Nodes ♦ Oscillators ♦ PCBs ♦ PHEMTs ♦ QAM ♦ QPSK ♦ Radar ♦ Radios ♦ RDRN ♦ Reed-Solomon ♦ Remote management and control ♦ RF ♦ Spread spectrum ♦ Steerable beams ♦ Telemetry ♦ Upconverters ♦ Wireless technologies

EXECUTIVE STAFF

Executive Staff, left to right: Gary Minden, Chief Technologist; Mark Wdowik, Director for Applied Technology; Victor Frost, Acting Director/Executive Director for Research; Tim Johnson, Executive Director for Operations and Applied Technology.

Victor Frost

Acting Director; Dan F. Servey Distinguished Professor of Electrical Engineering and Computer Science

Victor S. Frost has performed advanced research for many corporations, including Sprint, NCR, BNR, NEC, Telesat Canada, AT&T, McDonnell Douglas, DEC, and COMDISCO Systems. He has published over 45 journal articles, and has served as a guest editor for the *IEEE Communications Magazine* and *IEEE Journal on Selected Areas in Communications*. He is an associate editor for the *IEEE Communications Letters* and the *ACM Transactions on Simulation and Modeling of Computer Systems*. His current research interests are in the areas of integrated communication networks, high-speed networks, communication systems analysis, and simulation and have included projects such as MAGIC and AAI high-speed, wide-area testbeds.

He received his B.S., M.S., and Ph.D. degrees from KU in 1977, 1978, and 1982, respectively. In 1982 he joined KU's Electrical Engineering and Computer Science Department. From 1987 to 1996, he directed the Telecommunications and Information Sciences Laboratory (TISL) at KU and became ITTC's acting director in January 1998.

He is a member of Eta Kappa Nu and Tau Beta Pi and a fellow of the IEEE. He has served on State of Kansas NSF EPSCoR and DoD DEPSCoR committees, as well as the Kansas Inc. Telecommunications Task Force. He is a member of the Board of Trustees for KU's Center for Research, Inc., and the Self Fellowship program.

During the 1999-00 academic year, he is on sabbatical at Sprint Corp. He will return to ITTC as its director in summer 2000.

Tim Johnson

Executive Director for Operations and Applied Technology

Tim Johnson has over 14 years of experience in the management and design of engineering and software projects and has conducted, presented, and supervised research in communications and digital signal processing. His engineering

career includes work with Kansas Power and Light Co. in Topeka, Kan., and work as a senior associate division engineer with Computer Sciences Corp. in Falls Church, Va., where he researched the performance of defense satellite communication systems.

He received a B.S.E.E. from Memphis State University in 1982 and a M.S.E.E. in 1985; he pursued doctoral studies in electrical engineering at Kansas State University. While at K-State, he was an electrical engineering instructor and performed research funded by Motorola, Inc., Government Electronics Group. From 1989 to 1990, he was an assistant professor of electrical engineering at the University of Wyoming (UW) in Laramie, Wyo. At UW, he conducted signal-processing research.

In August 1991, he joined KU's Center for Excellence in Computer-Aided Systems Engineering (CECASE), becoming its associate director in December 1993 and its executive director in August 1996. He's a former vice president of Lawrence Applied Research Corp. (LARC) in Lawrence and has served on corporate boards of directors. He serves on the Kansas Innovation Center's (KIC) Operations committee, Silicon Prairie's Information Technology committee, and KTEC's Telecommunications committee. He is an IEEE member.

Gary J. Minden **Chief Technologist and Professor**

Gary Minden received his B.S.E.E. degree in 1973 and his Ph.D. in 1982, both from KU. He joined the Electrical Engineering and Computer Science Department in 1981.

From 1971 through 1978 he was a research engineer at KU's Center for Research, Inc., where he focused on image processing systems, multi-processor computer systems, and general systems theory. From 1978 to 1980 he was vice president of CHILD, Inc., where he was a co-designer of the LIGHT-50 computer graphic terminal. From 1983 to 1989, he led the implementation of a new computer engineering degree program within the Electrical and Computer Engineering Department.

In 1991, he completed a sabbatical at Digital's renowned System Research Center, researching gigabit local area networks. He is a principal investigator on the MAGIC gigabit testbed and the Rapidly Deployable Radio Network (RDRN) projects at ITTC. From June 1994 through June 1996, he was on leave at the Defense Advanced Research Projects Agency (DARPA) Information Technology Office. He served as a program manager in the area of high performance networking systems. While at DARPA, he formulated and initiated a new research program in Active Networking.

His research interests are in the area of large-scale distributed systems, which encompasses high performance networks, computing systems, and distributed software systems. He is a member of IEEE and the Association of Computing Machinery.

Mark S. Wdowik **Director for Applied Technology**

Mark Wdowik has more than 15 years of industry experience in managing multi-million dollar, technology-based companies and in establishing business relationships and cooperative ties. His work has included mergers and acquisitions, financing strategies, contract negotiations, government contracts, intellectual property (IP) development, assessment, portfolio management, licensing and assignment contracts, IP marketing, and technology transfer, marketing, and economic development. He received his bachelor's and master's degrees in electrical engineering from the University of Illinois, Champaign, Ill., in 1982 and 1983, respectively.

In 1983, he joined Texas Instruments Inc. in Dallas, where he was responsible for the design of integrated circuits. He concluded his time at TI as manager of advanced materials and process development.

In 1991, he joined Bandgap Technology Corp. in Broomfield, Colo., where he managed advanced materials and optoelectronics product lines. He became president of the company in 1993. From 1994 to 1998, he owned and managed Critical Dimension Inc., in Fort Collins, Colo. The company offered technical and business consulting services to Fortune 500 companies and to the government in areas such as technology and market assessment, software development, government contracts, manufacturing optimization, strategic planning, intellectual property development, assessment and portfolio management, and M&A.

In December 1998, he joined ITTC where he oversees and directs all technology transfer, intellectual property management, and state-affiliated economic development activities for the Center.

He is a member of Eta Kappa Nu and Pi Mu Epsilon.

TECHNICAL STAFF

Torry Akins — Research Engineer

Torry Akins received his B.S. and M.S. degrees in electrical engineering from KU in 1996 and 1998, respectively. Since 1996, he has been with KU's Radar Systems and Remote Sensing Lab (RSL), working on the Greenland Depth Sounder Project, first as a student and then as a research engineer. In that time, he has developed an improved data acquisition system for the Greenland depth sounder and improved the data processing tools. In 1995, while finishing his bachelor's degree, he worked in the Government Program Division of Allied Signal. In fall 1999, he left to join the Radar Science and Engineering section of the Jet Propulsion Laboratory.

Enlian Chong — Software Engineer

In 1996, Enlian Chong joined ITTC as a graduate research assistant. He received his bachelor's and master's degrees in computer science from KU in 1996 and 1999, respectively. His thesis focuses on the rapid development of database client/server applications. His areas of expertise include client/server system engineering, relational data modeling, rapid GUI development, object-oriented design, and World Wide Web application deployment. He currently focuses on applied technology projects involving the use of SQL, relational database management systems (RDBMS), the Internet architecture, and the latest Java technology.

Daniel DePardo — RF Electronics Engineer

Dan DePardo studied at the U.S. Army Intelligence Center and graduated from the Aerial Surveillance Sensors School, while co-attending the University of Arizona. During his tours of duty, he was responsible for support of various airborne surveillance systems and also provided technical support for the Army's Electronic Proving Ground. After his discharge, he worked for a variety of defense electronics organizations.

At ITTC he supports the Center's Wireless Communications and Digital Signal Processing Lab. His areas of expertise include SAW technologies, photolithography, hybrid circuitry design, environmental testing techniques, Mil-spec soldering and assembly, surface mount technologies, RFI (radio frequency interference) and EMI (electro-magnetic interference) suppression, analog/digital systems, and three-dimensional display technologies.

Judith Galas — Public Relations and Marketing Manager

Judith Galas has been a journalist for more than 20 years. As a reporter and editor she worked for Knight-Ridder Financial News and covered the commodity and futures markets from bureaus in Kansas City, New York, and London. She has worked as a promotional writer at KU and has worked closely with such KU-related agencies as K*STAR/EPSCoR, University Relations, and KU's alumni and endowment offices.

She has taught journalism at the University of Missouri-Kansas City and teaches technical and business writing seminars to area businesses. She received her master's degree in journalism from KU and her bachelor's degree in English from Temple University.

Sash Guha

Software Development Manager

With more than a decade of experience in the IT industry, Sash Guha joined the Center in December 1998. Before coming to ITTC, she was a principal in a multi-billion-dollar systems management company and managed the technical architecture of major multi-million-dollar projects involving hundreds of people. Her ITTC responsibilities include managing the Center's industry-based software projects and ITTC's intranet requirements. Sash has a master's degree in computer science from KU and a bachelor's degree in engineering from the Jadavpur University in India.

Michael Hulet

Systems Administrator

Mike Hulet joined ITTC as a computer systems administrator in July 1998. He holds a B.S. degree in electrical and electronic engineering from North Dakota State University and a M.S. degree in systems management from the University of Southern California. He most recently was employed as an electronics engineer for the Naval Warfare Assessment Division in Riverside, Calif.

Roelof Jonkman

Senior Network Engineer

Roel Jonkman earned his bachelor's degree in computer engineering from the Hogeschool Enschede in the Netherlands. While pursuing a master's degree in computer engineering at KU, he researched network performance analysis and developed a tool called NetSpec. His work in this area led to his joining ITTC as its systems and network "wizard." Roel is chiefly responsible for setting goals and planning the future of the Center's computing infrastructure. His personal computing interests include computer security, firewalls, the science and psychology of hacking, intrusion detection, and network performance.

Jason Keimig

Research Engineer

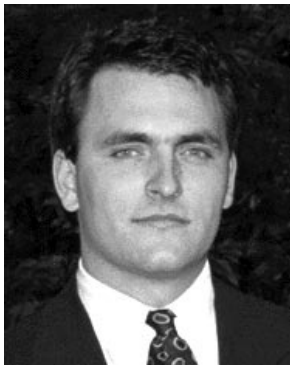
Jason Keimig received his B.S. and M.S. degrees in electrical engineering from KU in 1995 and 1998, respectively. From 1995 to 1996, he was involved in an ISP startup that has become a successful network provider throughout much of the Midwest. In 1997, he joined the Sprint Corp., where he was involved in integrating Sprint's ATM and IP networks into one common infrastructure. Since the middle of 1998, he has been a staff researcher at KU and works on advanced IP/ATM/QoS networking research topics, designing new low-cost networking technologies. He is actively involved in carrier-scale deployment issues.

Ed Komp — Research Engineer

Ed Komp 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. The start-up company he co-founded was eventually purchased by Cadence Design Systems where Komp continued to specialize in graphical simulation tools. He joined ITTC in September 1998. He 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.

Artur Leung — Research Engineer

Artur Leung joined ITTC in May 1997 as a graduate research assistant. In 1996, he received his bachelor's degree in electrical engineering at KU with highest distinction and his master's degree in electrical engineering, also from KU, in 1998. His master's research focused on the design and implementation of a UHF wireless channel simulator that can be used to evaluate the performance of wireless communication systems. As a staff research engineer, he works on the Rapidly Deployable Radio Network (RDRN) project, as well as applied research projects.



Craig Sparks — Senior Wireless Project Engineer

Craig Sparks received his B.S.E.E. from KU in 1994 and his M.S.E.E. from KU two years later. His graduate work included designing and building wireless radios in the Rapidly Deployable Radio Networks (RDRN) project. His areas of expertise include radio frequency (RF) and wireless digital communications system design. Before coming to ITTC in 1997, he worked in the Wireless Local Area Network (WLAN) industry as an RF design engineer. At ITTC, he was responsible for the design of a second phase of the RDRN project in addition to overseeing the engineering efforts for all of ITTC's wireless communication projects. Craig left ITTC shortly after close of FY99 to pursue his own interests.

SUPPORT STAFF

Peggy and Nancy in back; Wendy in front.
Photo by Doug Hesse.

Nancy Hanson — Office Manager and Operations Secretary

Nancy Hanson joined CECASE in January 1993 after several years as a secretary for another KU Center for Research, Inc., laboratory. At ITTC she coordinates office procedures and handles purchasing records. She also manages ITTC publications, including work with layout, graphics and copy editing for the *Annual Report*. She has a B.A. degree in Spanish from Washburn University, in Topeka, and has studied art and design at KU.

Peggy Williams — Research Secretary

Peggy Williams joined ITTC in March 1997 and is the office's key resource person for personnel- and research-related documentation, office supplies, travel arrangements, and hospitality. She has held positions with the NSF EPSCoR program; Merck & Co., Inc.; CRINC administrative offices; and KU.

Wendy Prescott — Student Secretarial Assistant

Wendy Prescott joined ITTC in December 1996 as a student assistant, after three years in that role at CECASE. Her duties include assisting administrative staff in various clerical and data processing tasks. She has five years of prior experience in administrative assistant duties at office supply stores. She is a KU student and plans to complete her bachelor's degree in geography in December 1999.

Donnis Graham — RSL Office Manager

Donnis Graham has been with the Radar Systems and Remote Sensing Lab (RSL) since 1987. She manages general office tasks, coordinates lab purchasing and payroll, plans travel, organizes conferences, and edits all published articles and technical reports. She also assists faculty with the editing of an international professional newsletter and a conference-related special issue of a geophysics journal.

She has been a technical editor for more than 35 years. Her career has included coordinating marketing for the subsidiary of a large corporation, managing the office and teaching religious school for a small synagogue, and editing positions including ones at a research division of Yale University and at The Johns Hopkins University Press. She received a bachelor's degree in social work from KU after completing more than 90 hours toward a bachelor's degree in English.

Donnis Graham.
Photo by Doug Hesse.

POSTDOCTORAL RESEARCH STAFF

Deb Chatterjee

Deb Chatterjee completed is Ph.D. in February 1998 while working in KU's Radar Systems and Remote Sensing Lab (RSL). From March 1998 to August 1999, he was a post-doctoral research engineer with RSL and researched advanced algorithms for correction of wind speeds for space-borne satellite measurements. While at KU, he was a full- and part-time lecturer at the EECS Department and authored or co-authored more than 30 publications.

Xinhua Gan

Xinhua Gan received his Ph.D. in electrical engineering in 1995 from Xian Electrical Science and Technology University (Xidan University), Xian, China. From October 1997 to July 1999, he worked as a post-doctoral research associate at RSL, where he designed and developed an innovative swept stepped-FM ground-penetrating radar (GPR) for mine detection. He is now a post-doctoral research associate at the University of Houston.

Kumar Peddanarappagari

Kumar ("Vijay") Peddanarappagari has a B.S. in electronics and communication engineering from Osmania University, India. He completed his master's and Ph.D. degrees in electrical engineering at the University of Virginia, Charlottesville. From October 1997 through December 1998, he was an ITTC research engineer. He assisted students with their thesis topics and coordinated work in ITTC's lightwave laboratory. He is now in Dallas working in industry.

Leen-Kiat Soh

After receiving his Ph.D. degree with honors from KU in 1998, Leen-Kiat Soh joined ITTC as a research scientist. He works with Costas Tsatsoulis in the Intelligent Systems and Information Management Lab. His research interests include data mining, image processing, computer vision, machine learning, expert systems, digital libraries, and classification methodologies. He hopes to teach at the university level and to continue to research advanced technologies.

Oscar Waddell

Oscar Waddell was with ITTC from June 1998 through July 1999. In October 1999, he completed his doctorate at Indiana University. He has researched commercially distributed Chez Scheme compiler and runtime systems, including source-to-source optimization, register allocation, code generation, runtime support, execution profiling, and programming environments. He has developed tools for interactively examining both static and dynamic program properties and for visualizing the process and results of transformations.

Benyuan Zhu

Benyan Zhu received his bachelor's and master's degrees in physics from East China Normal University in Shanghai and his Ph.D. in opto-electronics from Bath University in Bath, England. He joined ITTC in 1998, where he researched advanced topics in high-speed optical fiber communication systems. He has authored or co-authored more than 20 technical papers in leading international journals and conferences. Ben left ITTC shortly after the close of FY99 to work with Bell Labs, Lucent Technologies, in Holmdel, N.J.

AFFILIATED FACULTY

Arvin Agah

Research Interests:

- *Human interactions with intelligent systems*
- *Distributed autonomous systems (robots and agents)*

Arvin Agah has been a member of the Electrical Engineering and Computer Science faculty since 1997. His areas of research are distributed robotics, multi-agent technologies, human-robot interaction, intelligent user interfaces, and enhanced multimedia. From October 1995 through August 1997, he was a visiting researcher at the Bio-Robotics Division of Mechanical Engineering Laboratory, Ministry of International Trade and Industry, in Tsukuba, Japan. He received his B.A. in Computer Science with highest honors from the University of Texas at Austin in 1986; M.S. in Computer Science from Purdue University, West Lafayette, Ind., in 1988; M.S. in Biomedical Engineering from the University of Southern California, Los Angeles, in 1993; and Ph.D. in Computer Science from the University of Southern California in 1994. He was a member of the research staff at IBM's Los Angeles Scientific Center, Santa Monica, Calif., in 1989; and at Xerox's Webster Research Center, Rochester, N.Y., in 1988. He has also worked as a technical consultant in the areas of graphical user interfaces and database design for entertainment law firms and management companies in Century City and Beverly Hills, Calif. He is a member of ACM, AIAA, and IEEE.

Chris Allen

Research Interests:

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

Chris Allen received his B.S., M.S., and Ph.D. degrees in Electrical Engineering from KU in 1980, 1982, and 1984, respectively. From 1984 to 1990, he was with Sandia National Laboratories in Albuquerque, N.M., working in exploratory radar systems and development of high-speed digital systems. From 1990 to 1994, he was with the Allied Signal Kansas City Division, Kansas City, Mo., where he worked in the areas of high-speed digital design, radar systems analysis, and multi-chip module development. Since August 1994, he has been a faculty member in KU's Electrical Engineering and Computer Science Department. His research interests include high-speed digital circuits, microwave remote sensing, radar systems, and photonics/lightwave technologies. He has served as a technical reviewer for various IEEE journals and *Remote Sensing of the Environment, Geophysics—The Journal of the Society of Exploration Geophysicists*, and *Journal of Glaciology*. He currently is the director of the Radar Systems and Remote Sensing Lab (RSL) and co-director of the Lightwave Communication Systems Lab. He also serves on the SAE AE-8D task group on standards development for fiber optic cable and test methods for aerospace applications. He is a member of Phi Kappa Phi, Tau Beta Pi, Eta Kappa Nu, and the International Union of Radio Science (URSI).

Michael J. Ashley

Michael Ashley earned his M.S. and Ph.D. degrees in Computer Science at Indiana University in 1992 and 1996, respectively. His B.A. in Computer Science (with honors) came from Oberlin College in 1990. From 1994 to 1995, while at Indiana University, he worked as a research assistant. He joined KU's Electrical Engineering and Computer Science Department in 1995 and taught programming languages. He left KU in June 1999 and returned to Indiana, where he now works in industry.

Research Interests:

- *Programming language design and implementation*

Swapan Chakrabarti

Swapan Chakrabarti joined KU's Electrical and Computer Engineering Department in 1986 as an assistant professor. In fall 1992, he was promoted to associate professor in the department now called Electrical Engineering and Computer Science.

In 1992, he received the Ned N. Fleming Teaching Award for outstanding classroom teaching at KU. He was awarded honorary membership in the Golden Key National Honor Society, in 1996. He has taught graduate and undergraduate level courses in topics such as digital logic design, microcomputer applications, computer architecture, digital signal processing, neural networks and fuzzy logic. He has published 10 journal papers and 31 conference papers. He has received one patent; a second patent application is pending. His research interests include hardware and software development for True 3-D display systems, applications of neural networks, and fuzzy logic for signal processing.

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

Kenneth Demarest

Research Interests:

- Lightwave communication systems
- Microwave engineering
- Electromagnetic theory
- Antennas

Kenneth Demarest received a B.S. in electrical engineering from John Brown University, Siloam Springs, Ark., in 1974, and a M.S. and Ph.D. in electrical engineering from Ohio State University (OSU), Columbus, in 1976 and 1980, respectively.

From 1974 to 1979, he was a graduate research associate with the ElectroScience Laboratory at OSU. From 1979 to 1984, he was an assistant professor in the electrical engineering department of Lafayette College, Easton, Penn. Since 1984, he has been with KU's Electrical Engineering and Computer Science Department, most recently as a professor.

His research interests are in the areas of fiber optic communications and electromagnetics. His work in electromagnetics has centered on the development of computational techniques for determining the electromagnetic scattering of moderate-to-large objects. These techniques have been variations of the Method of Moments and the Finite-Difference Time-Domain technique.

His work in fiber optic communications has centered on high speed, wavelength division, multiplexed fiber optic systems. This work has involved both experimental measurements and the development of numerical modeling methods for high-capacity fiber links. His work also has involved the development of all-optical switching and clock recovery techniques.

He is the author of a number of papers, book chapters, and the book *Engineering Electromagnetics*, published by Prentice Hall in 1998. He is a member of Eta Kappa Nu, the Institute of Electrical and Electronics Engineers (IEEE) and the International Union of Radio Science (URSI) Commission B.

Tyrone Duncan

Research Interests:

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

Tyrone Duncan received his bachelor's degree from Rensselaer Polytechnic Institute and his M.S. and Ph.D. in electrical engineering from Stanford University. He has been a faculty member at the University of Michigan and the State University of New York-Stony Brook before coming to KU in 1979. He has held visiting positions at the University of California--Berkeley, Harvard University, and the University of Bonn. He is the author or co-author of more than 125 papers in the areas of stochastic optimal control, adaptive control, filtering and communication, as well as related topics in probability. He is a member of the editorial boards of *SIAM Journal on Control and Optimization* and *IEEE Transactions on Automatic Control*.

Joseph B. Evans

Joseph Evans received the B.S.E.E. from Lafayette College in 1983, and his M.S.E., M.A., and Ph.D. from Princeton University in 1984, 1986, and 1989, respectively.

In 1989, he joined KU's faculty in the Department of Electrical Engineering & Computer Science, where he is now a professor. While at KU, he has been involved in a variety of networking projects, ranging from the MAGIC gigabit networking testbed, the ACTS ATM Internet, and the Rapidly Deployable Radio Network project. He has also collaborated with KU's School of Education to deliver K-12 educational resources over the Internet. He spent the 1996-1997 academic year on sabbatical at Cambridge University and at Olivetti & Oracle Research Laboratory in Cambridge, England, working in the area of mobile computing and communications systems. He participated in the Air Force Summer Research Program at Hanscom AFB in 1991.

Prior to joining KU, he held a post-doctoral position in AT&T Bell Laboratories' Network Systems Research Department in Holmdel, N.J., where he was involved in the design of a high-performance integrated network. He was also a part-time employee of Bell Labs and worked in the field of speech processing algorithms for packet networks.

His current research interests include high-speed (gigabit) networks, special-purpose computer architecture, adaptive signal processing, digital speech processing, and VLSI implementations.

Research Interests:

- High-performance networks
- Mobile networking and wireless systems
- Digital signal/speech processing
- System implementations

(For Victor S. Frost, see Executive Staff, page 15.)

John M. Gauch

John Gauch received his honors B.Sc. and M.Sc. degrees in computer science from Queen's University in Ontario in 1981 and 1982 respectively, and his Ph.D. in computer science from the University of North Carolina-Chapel Hill in 1989. From 1989 to 1993 he was an assistant professor in the College of Computer Science at Northeastern University in Boston. In 1993 he joined KU's Department of Electrical Engineering and Computer Science.

He conducts research in a variety of imaging applications—specifically multimedia systems, such as digital video processing, creation and navigation of video libraries; digital image processing, such as image segmentation, image enhancement; and computer vision, including depth from stereo and motion tracking. He has more than 50 publications in these areas, including one book and two patents pending.

Research Interests:

- Multimedia systems (digital video processing, creation and navigation of video libraries)
- Digital image processing (segmentation, enhancement)
- Computer vision (stereo, motion tracking)

Susan Gauch

Research Interests:

- Multimedia databases
- Intelligent search agents
- Information discovery on the World Wide Web
- Corpus linguistics

Susan Gauch's primary research field is intelligent information agents. She received her Ph.D. from the University of North Carolina-Chapel Hill in 1990, where she developed an expert search assistant for an online full-text database.

While a senior research scientist with the Biological Knowledge Laboratory at Boston's Northeastern University, she explored the storage, retrieval, and user interface technologies necessary to present and navigate databases of technical literature. Since joining KU in 1993, her research has encompassed intelligent agents for information discovery and fusion from the World Wide Web (ProFusion), content-based searching of digital video libraries, and a NSF-sponsored project on the application of corpus linguistics to the field of information retrieval. Her work has been presented at numerous conferences and appears in major journals. Two projects (VISION and ProFusion) have resulted in software licenses from KU to industry. She is treasurer for the ACM Special Interest Group on Information Retrieval and is a reviewer for the NSF and several archival journals.

Siuprasad Gogineni

Research Interests:

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

Prasad Gogineni received his Ph.D. from KU in 1984. From 1984 to 1986, he was a visiting assistant professor and research engineer at KU. In November 1986, he joined KU's Electrical Engineering and Computer Science Department as an assistant professor. As a world-renowned researcher, he spent the 1992-93 academic year on sabbatical at the Byrd Polar Research Center at Ohio State University, and another year as the manager of NASA's Polar Research Program Headquarters in Washington, D.C. He is the former director of the Radar Systems and Remote Sensing Lab (RSL), and has been involved in all aspects of radars to the remote sensing of sea ice, ocean, and land.

He has authored or co-authored 50 archival journals and more than 100 technical reports and conference presentations. He developed several radar systems currently being used for backscatter measurements and has participated in field experiments in the Arctic and on towers in the open ocean.

He is an IEEE Fellow and member of URSI Commission F and the Electromagnetics Academy. He has received numerous awards in lifetime achievement, including the KU Miller Award for Engineering Research (1991), the Taylor and Francis Best Letter Award (1991), a best-of-session award from the Third International Airborne Remote Sensing Conference (1997), and the NASA Terra award (1998). In 1999, he was awarded U.S. Patent No. 5867117 for a swept-step radar system and its detection method.

Jerzy W. Grzymala-Busse

Research Interests:

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

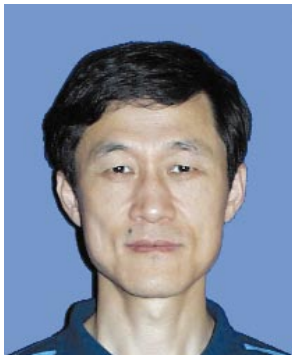
Jerzy Grzymala-Busse has been with KU's Electrical Engineering and Computer Science Department since 1981. He has taught courses in expert systems, knowledge acquisition, artificial intelligence, concurrency models, Petri nets, data structures, computer architecture and networking, computer organization, theory of computing, switching theory, automata theory, computability, discrete structures, and probabilistic analysis. His research interests include knowledge discovery, data mining, machine learning, expert systems, reasoning under uncertainty, and rough set theory.

He received his M.S. in electrical engineering from the Technical University of Poznan, Poland, in 1964; his M.S. in mathematics from the University of Wroclaw, Poland, in 1967; and his Ph.D. in engineering from the Technical University of Poznan in 1969. In 1972, he received a Doctor Habilitatus in Engineering from the Technical University of Warsaw, Poland.

He first came to KU in 1977 as a visiting professor and became a KU professor of Computer Science in 1980. In 1974 he was a visiting professor at the Stefan Banach International Mathematical Center in Warsaw; an associate professor at the Technical University of Poznan from 1973 to 1980; and an assistant professor at the Technical University of Poznan from 1970 to 1973.

He has published three books and over 100 articles in the above areas. He has served as a session chair and in steering committees, advisory committees, and program committees of various international and national scientific and technical conferences. He is a member of the Association for Computing Machinery, American Association for Artificial Intelligence, Upsilon Pi Epsilon, and International Rough Set Society, where he also serves on the advisory board.

Rongqing Hui



Research Interests:

- Fiber-optic communication systems
- Photonic devices

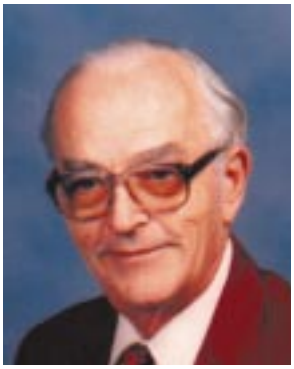
Rongqing Hui received his B.Sc. in microwave communications in 1982 and his M.Sc. in lightwave technology in 1988, both from Beijing University of Posts and Telecommunications. He received his Ph.D. in electronics engineering from Politecnico di Torino, Torino, Italy, in 1993. In 1997, he joined KU's Department of Electrical Engineering and Computer Science. His research interests include fiber-optic communication systems and photonic devices.

From 1982 to 1985, he taught in the Physics Department of Anhui University, Hefei, China; and from 1985 to 1989, he was with the Optical Communications Laboratory of Beijing University of Posts and Telecommunications. There he worked in the field of coherent optical fiber communication systems and components. From 1989 to 1990, he held a Research Fellowship from Foundazione Ugo Bordoni, Rome, Italy, in the area of nonlinear effects and optical injection locking of semiconductor lasers. From 1990 to 1993, he was with the Department of Electronics, Politecnico di Torino; during this period, he held a fellowship from the Italian Telecommunication Research Center (known as CSELT). From 1993 to 1994, he was a Postdoctoral Research Fellow at Canada's University of Ottawa, where he concentrated on optical network architecture.

In 1994, he joined Bell-Northern Research (now part of Nortel Networks), in Ottawa, as a member of the scientific staff. He has authored or co-authored more than 40 technical papers in leading engineering journals, as well as numerous international conference publications. He has been an active technical reviewer for various IEEE, IEE, and OSA journals.

(For Gary J. Minden, see Executive Staff, pages 15-16.)

Richard K. Moore



Research Interests:

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

Richard Moore received his B.S.E.E. at Washington University, St. Louis, Mo., and his Ph.D. at Cornell University, Ithaca, N.Y. From 1951 to 1955, he was research engineer at Sandia Corp. In 1955 he became professor and chairman of the Electrical Engineering Department at the University of New Mexico. In 1962, he came to KU as Black and Veatch Professor of Electrical and Computer Engineering. He directed the Remote Sensing Laboratory from 1964 to 1974, and from 1984 to 1993. At KU, he researched radar systems, radar backscatter, and applications of aircraft and space radar to monitoring the Earth and planets. He retired in 1994.

He is past chairman of Commission F (Wave Propagation and Remote Sensing) of USNC of URSI (International Union of Radio Scientists) and past international chairman of Commission F of URSI. He is an AAAS fellow, an IEEE Life Fellow, and a member of the National Academy of Engineering. His lifetime achievement awards include the IEEE Geoscience and Remote Sensing Society Distinguished Achievement Award (1982), the IEEE Centennial Award (1984), KU's Irvin Youngberg Award in the Applied Sciences—a research achievement award (1989), and the Australia Prize for Remote Sensing (1995). He has published widely.

Douglas Niehaus

Research Interests:

- High-performance networks
- Network performance evaluation tools
- Real-time systems
- Operating systems

Douglas Niehaus has been in KU's Electrical Engineering and Computer Science Department since 1993. His research interests include real-time and distributed systems, operating systems, ATM networks, performance measurement, and programming environments. His current projects include network performance evaluation and characterization, WWW server software design and application to research and educational user groups, high performance distributed systems using ATM networks, and advanced debugging tools.

He received his B.S. in computer science in 1980 from Northwestern University, his M.S. in computer, information, and control engineering from the University of Michigan in 1981 and his Ph.D. in computer science from the University of Massachusetts at Amherst in 1993. He was a senior software engineer porting UNIX to new platforms at Convergent Technologies in 1986 and 1987, and a member of the technical staff performing system, network, and development environment tool programming at Bell Laboratories and AT&T Information Systems from 1981 to 1986.

Karen J. Nordheden

Research Interests:

- Plasma processing of semiconductors
- Fabrication of III-nitride- and III-V-based semiconductor devices

Karen Nordheden is with the Department of Chemical and Petroleum Engineering. She earned her B.S. in physics from Michigan State University in 1980, and her M.S. and Ph.D. in electrical engineering from the University of Illinois in 1984 and 1988, respectively.

She has six years of industrial semiconductor device fabrication experience. Prior to joining the faculty at KU, she was a senior process engineer at Martin-Marietta's fabrication facility in Syracuse, N.Y. Her duties there included processing of HEMT, HBT, and MMIC process lots, as well as being in charge of the development and maintenance of all plasma chemistry processes.

She has taught courses in Semiconductor Device Fabrication, Electrical Devices and Properties of Materials, Control Systems, Fortran, and Advanced Engineering Mathematics. Her current research interests include the development of plasma etch processes for semiconductor device improvement, and the fabrication of III-V based devices.

She is a member of the advisory board to KU's Engineering Diversity Program, a senior member of IEEE, a member of the American Vacuum Society, the American Physical Society, the Electrochemical Society, Phi Kappa Phi, Eta Kappa Nu, and Tau Beta Pi. She was awarded the Harry Talley Excellence in Teaching Award from the local chapter of Eta Kappa Nu in 1997, the H. Bernerd Fink Award for Excellence in Teaching at the KU in 1998, and the Henry E. Gould Award for Outstanding Undergraduate Engineering Teaching in 1999. She has published over 15 technical articles on semiconductor processing and devices.

Bozenna Pasik-Duncan

Research Interests:

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

Bozenna Pasik-Duncan received her master's degree from Warsaw University in 1970, and her Ph.D. and Habilitation degrees in mathematics from the Warsaw School of Economics in 1978 and 1986, respectively. She was a staff member of the Mathematics Department of Warsaw School of Economics from 1970 until 1983. In 1984 she joined KU's faculty as a professor in the Department of Mathematics, where her research focuses on stochastic processes and stochastic adaptive control of continuous-time linear and nonlinear systems with and without delays. She has held several visiting appointments in Poland, Hungary, the Czech Republic, France, and Italy.

She has been actively involved in the IEEE Control Systems Society and is the chair of the standing committees on Assistance of Engineers at Risk and Women in Control. She is an associate editor at large of *IEEE Transactions on Automatic Control*. She recently received the Kemper Fellowship for Teaching Excellence and Advising in Public Outreach. She has established a partnership between the Lawrence Elementary Schools and KU Math Department and is planning a Children's Math Laboratory in conjunction with the KU Stochastic Control Group Program. She is a member of the KU Mathematics Education Committee and KU Women in Science and Engineering Club. She has written more than 100 technical articles and three books.

David W. Petr

Research Interests:

- *High-speed, wide-area networks*
- *Network traffic and congestion management*
- *Traffic integration for networks*
- *Performance analysis and simulation*

David Petr received his B.S.E.E. degree in 1976 from Southern Methodist University, his M.S.E.E. in 1978 from Stanford, and his Ph.D. in 1990 from KU. He joined KU's Electrical Engineering and Computer Science Department in 1990. His current research interests focus on the design and analysis of network resource management and congestion control mechanisms, voice transport over Asynchronous Transfer Mode (ATM) networks, and pricing for multiservice networks.

From 1977 to 1986 he worked at AT&T Bell Laboratories in the areas of digital PBXs, digital transmission systems, packet communication networks and protocols, and speech coding. He was awarded three patents related to this work and was an internal Bell Laboratories candidate for the Eta Kappa Nu Outstanding Young Electrical Engineer Award in 1984. While pursuing his doctoral degree, he received the 1987 IEEE Frank A. Cowan Scholarship for graduate studies in communications.

He is a senior member of the IEEE and a member of Eta Kappa Nu, Tau Beta Pi, Sigma Xi, and the American Society for Engineering Education (ASEE).

Glenn E. Prescott

Research Interests:

- *Spread spectrum systems*
- *Military tactical communication radios and systems*
- *Software radio systems*
- *Application of FPGAs to DSP*
- *Design and implementation of wireless communication systems*

Glenn Prescott received his B.S.E.E. degree with highest honors from the Georgia Institute of Technology in 1974, his M.S.E.E. from the University of Missouri in 1976, and his Ph.D. from the Georgia Institute of Technology in 1984.

In 1989 he joined KU's Electrical Engineering and Computer Science Department, where he teaches and conducts research in the areas of digital signal processing, information theory and digital communications. He directs ITTC's Wireless Communications and Digital Signal Processing Laboratory.

He also performs research with the Radar Systems and Remote Sensing Laboratory in the area of land mine detection using ground-penetrating radar. His primary research areas are military communication systems, low probability of intercept/interference waveform design, spread spectrum modulation techniques, and radio modem design.

He is a senior member of the IEEE and has served as a publication reviewer for the IEEE Communications Society and the National Science Foundation. He is also vice president of Lawrence Applied Research Corp., which is involved in defense-related consulting activities.

James Roberts

James Roberts received his B.S. from KU in 1966, his M.S. from the Massachusetts Institute of Technology, Cambridge, Mass., in 1968, and his Ph.D. from Santa Clara University, Santa Clara, Calif., in 1979—all in electrical engineering.

His career began in 1966 with RCA on Boston's Route 128 Electronics Beltway working on the Apollo mission to the moon. In 1969, he joined ESL—a start-up company in California's Silicon Valley—and was promoted through the ranks to laboratory manager. Following TRW's acquisition of ESL, he relocated to Colorado in 1983 and managed TRW Denver Operations.

He was an adjunct lecturer in the Electrical Engineering and Computer Science Department at Santa Clara University from 1978 to 1983. From 1990 to 1997, he served as chairman of KU's Electrical Engineering and Computer Science Department. He is currently an EECS professor, associate vice chancellor for research and public service at KU, and vice president of the KU Center for Research, Inc. He teaches and conducts funded research in wireless communications and information theory and publishes in IEEE journals and conference proceedings.

He serves on the board of directors of Kantronics, Inc., the KU Center for Research, Inc., and the Silicon Prairie Technology Association.

Research Interests:

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

W. M. Kim Roddis

Kim Roddis joined KU's faculty in 1988 in its Department of Civil Engineering. She is actively engaged in research applying advanced technologies to civil engineering problems. Her research interests and experience include applications of artificial intelligence to civil and structural engineering; design of computer-aided tools for civil engineering; nondestructive testing and evaluation of structures; and fatigue and fracture in steel bridges.

She teaches undergraduate and graduate courses in structural steel design, as well as undergraduate structural analysis and a graduate course in knowledge-based expert systems. She is a registered professional engineer in the states of Massachusetts and Kansas.

Prior to joining KU, she was a Hertz Fellow at the Massachusetts Institute of Technology (MIT), where she obtained her Ph.D. in 1988. Her master's and bachelor's degrees are also from MIT, in 1977 and 1987, respectively. She has structural design experience in the areas of heavy industrial buildings (Stone & Webster Engineering Corp., Boston), general commercial/residential/medical structures (Souza and True Consulting Engineers in Watertown, Mass.), and bridge inspection/repair/rehabilitation (A. G. Lichtenstein Engineers in Framingham, Mass.)

Research Interests:

- *Design, fabrication, and construction engineering processes;*
- *Applications of artificial intelligence to civil and structural engineering;*
- *Design of computer-aided tools for civil engineering;*
- *Fatigue and fracture in steel bridges;*
- *Behavior of structural steel joints;*
- *Frame stability;*
- *Nondestructive testing & evaluation of structures.*

K. Sam Shanmugan

Research Interests:

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

Sam Shanmugan received his B.E. degree from Madras University, India in 1964; his M.E. from the Indian Institute of Science, Bangalore, India in 1966; and his Ph.D. from Oklahoma State University (OSU), Stillwater, in 1970—all in electrical engineering.

From 1970 to 1973 he was a Postdoctoral Fellow at OSU and at KU's Center for Research, Inc., where he researched pattern recognition, image processing, and modeling and analysis of communication systems. From 1973 to 1978, as a faculty member with the Department of Electrical Engineering at Wichita State University, Wichita, Kan., he lectured and researched systems theory, communication systems, and image processing. From 1978 to 1980, as a visiting scientist at Bell Laboratories, Holmdel, N.J., he researched advanced modeling and analysis of satellite communication systems. He joined KU's faculty in 1980. He was the director of ITTC in 1997 and director of KU's Telecommunications Laboratory from 1982 to 1987.

He has published numerous articles and three books: *Digital and Analog Communication Systems* (1979), *Random Signals: Detection Estimation and Data Analysis* (1988), and *Simulation of Communication Systems* (1992).

He is an IEEE Fellow and an editor of the *IEEE Transactions on Communications*. He received the Outstanding Young Engineering Faculty Award in 1979 from the Society of Automotive Engineers, KU's Higuchi Award for Outstanding Research, and three awards for outstanding teaching—the Henry E. Gould Award, the AMOCO Foundation Award, and the Burlington Northern Award.

James M. Stiles

Research Interests:

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

James Stiles received his B.S. degree in Electrical Engineering from the University of Missouri, Columbia, Mo., in 1983; his M.S. in Electrical Engineering from Southern Methodist University, Dallas, in 1987; and his Ph.D. in Electrical Engineering from the University of Michigan, Ann Arbor, Mich., in 1996.

From 1983 to 1990, he was a microwave systems design engineer for Texas Instruments; and from 1990 to 1996, he was employed as a graduate research assistant in the Radiation Laboratory at the University of Michigan. He joined KU's Department of Electrical Engineering and Computer Science in 1996 and is a member of ITTC's Radar Systems and Remote Sensing Laboratory (RSL). His research interests include radar remote sensing of vegetation, propagation and scattering in random media, ground-penetrating radar and landmine detection, and radar signal processing.

Costas Tsatsoulis

Research Interests:

- *Multi-agent systems*
- *Data mining*
- *Case-based reasoning*
- *Knowledge-based systems*
- *Intelligent image analysis*

Costas Tsatsoulis joined KU's Department of Electrical Engineering and Computer Science in 1988. He directs ITTC's Intelligent Systems and Information Management Lab and conducts research in multiagent systems, artificial intelligence, data mining, case-based reasoning, and intelligent image analysis. He teaches computer system software, artificial intelligence, knowledge-based systems, image processing and computer vision, case-based reasoning and distributed AI, introduction to database systems, and structured programming. In 1995, he was a visiting scientist at the Artificial Intelligence Center of the Lockheed-Martin Corp.

He received his B.S., M.S. and Ph.D. degrees in Electrical Engineering from Purdue University in 1983, 1984, and 1987 respectively, and a B.A. in German from Purdue University in 1987.

He recently co-edited *Analysis of SAR Data of the Polar Oceans*, published by Springer-Verlag. He is an associate editor for *IEEE Intelligent Systems* and was the guest editor of a special issue on "Applications of Artificial Intelligence in Systems Engineering" of the *International Journal of Concurrent Engineering: Research and Applications*.

He has received the Big-12 Faculty Fellowship, the AT&T Engineering Education Excellence Award from the State of Kansas, and KU's Miller Award for Research Excellence.

He is a senior member of the IEEE and a member of AAAI, ACM, the IEEE Computer Society, Eta Kappa Nu, and Sigma Xi.

Victor L. Wallace

Research Interests:

- *Interactive graphics, virtual reality, and human interface design*
- *Distributed and real-time systems (scheduling and load distribution policies)*
- *Computer network performance modeling*
- *ATM traffic analysis models, operating systems theory, queuing theory*

Victor Wallace had spent almost 30 years in business, research, and academics before coming to KU in 1976 as the chairman of the Computer Science Department—a position he held until 1983. In 1993, he became a faculty member in the Department of Electrical Engineering and Computer Science and its graduate director.

With a bachelor's in electrical engineering from the Polytechnic Institute of Brooklyn, he joined the technical staff of Bell Telephone Laboratories in 1955. The following year, he joined IBM as a programmer. In 1957 he went to the University of Michigan, first as an instructor and then as an associate research scientist. He earned his Ph.D. there in 1969. Following a year as an academic visitor at the University of London, he joined the faculty at the University of North Carolina and stayed there until coming to KU.

At KU, his teaching focuses on computer operating systems, graphics, programming language, and data structures.

He is a senior life member of IEEE and of ACM, ACM/SIGGRAPH, ACM/SIGOPS, ACM/SIGCHI, the Institute for Operations Research and Management Science (INFORMS), and the honorary societies Eta Kappa Nu, Sigma Xi, Tau Beta Pi, and Upsilon Pi Epsilon.

INTRODUCING NEW AFFILIATED FACULTY

Perry Alexander

Perry Alexander received all of his Electrical and Computer Engineering degrees from KU: Ph.D. in 1992, master's in 1988, and bachelor's in 1986. In 1992 he joined the Department of Electrical and Computer Engineering and Computer Science at the University of Cincinnati (UC). While at UC, he founded and directed the Knowledge-Based Software Engineering Laboratory. In fall 1999, he joined KU's Electrical Engineering and Computer Science Department and is an associate professor and researcher in the areas of systems level design, formal specification, formal verification, formal synthesis, and component reuse. He is a member of IEEE where he is vice-chair of the Engineering of Computer-Based Systems Technical Committee, ACM, AAAI, and Sigma Xi.

Jerry James

Jerry James completed his Ph.D. at the University of California-Santa Barbara in 1999 before joining KU in its Electrical Engineering and Computer Science Department. He received a B.S. degree in computer science in 1992 and a M.S. degree in 1993, both from Brigham Young University. He is a member of Phi Eta Sigma, Golden Key, and Phi Kappa Phi national honor societies. His research focuses on the consistency of shared data and objects in distributed systems, especially in the presence of failures.

H. Scott Hinton

Scott Hinton, KU's Deane E. Ackers distinguished professor, became the new chairman of KU's Electrical Engineering and Computer Science Department in August 1999. Prior to joining KU, he was with the University of Colorado in Boulder, where he was Hudson Moore, Jr., Professor of Electrical Engineering. He previously held the title of BNR/NSERC Professor of Photonic Systems at McGill University, in Montreal, Canada. Before entering academia, he was employed for 12 years by AT&T Bell Laboratories. There he managed the development and advancement of free-space photonic switching systems. He holds an M.S.E.E. degree from Purdue University and a B.S.E.E. from Brigham Young University. He is a fellow of both the Optical Society of America and of IEEE. His research interests include photonic switching systems, free-space optical interconnects, optical backplanes, and technology-enhanced learning environments.

Stephen P. Lohmeier

Stephen Lohmeier earned his B.S. in electrical engineering from Kansas State University in 1989, and his M.S. and Ph.D. degrees in electrical engineering from the University of Massachusetts, Amherst, in 1992 and 1996, respectively.

While at the U of M, he designed, built, and used millimeter-wave, polarimetric radars to solve various problems in remote sensing. From 1996 to 1999, he was with Dynetics, Inc., in Huntsville, Ala., where he researched surveillance and the tracking of radar problems related to air and missile defense. His current research includes remote sensing of clouds and rain, polarimetric radar, and bistatic radar.

He has served as a technical reviewer for *IEEE Transactions on Geoscience and Remote Sensing*. He is a member of Tau Beta Pi, Eta Kappa Nu, and the IEEE.

Industry Advisory Board

The ITTC Industry Advisory Board for Fiscal Year 1999 included the following:

Phil Anderson, Kantronics, Lawrence, Kansas
Bob Boaldin, Elkhart Telephone Co., Inc., Elkhart, Kansas
Darren S. Braun, PMC-Sierra, San Jose, California
Chris Brown, TRW, Inc., Redondo Beach, California
Gerard J. Canavan, Globalstar, San Jose, California
Steve Chaddick, Ciena Corporation, Linthicum Heights, Maryland
Simon Crosby, CPlane, Inc., Los Altos, California
Jim Dahmen, Columbus Telephone Co., Inc., Columbus, Kansas
Marc Epard, Netopia, Inc., Lawrence, Kansas
Andrew J. Ernstein, Lucent Technologies InterNetworking Systems, Overland Park, Kansas
Charles Holt, Midwest Research Institute, Kansas City, Missouri
Andy Hopper, AT&T Laboratories, Cambridge, England.
James Isaacs, ITT Aerospace Optical Div., TAC, Ft. Wayne, Indiana
Gordon Johnston, NASA Headquarters, Washington, D.C.
Ali S. Kazeroonian, Active Research, Inc., Foster City, California
John R. LaLonde, GE Medical Systems, New Berlin, Wisconsin
Leland Langston, Texas Instruments Corporate Research, Dallas.
Tom Lyon, Nokia, Sunnyvale, California
Jake Maczuga, Kansas Innovation Corp., Lawrence, Kansas
Mike Mallory, Allied Signal FM&T, Kansas City, Missouri
Gary A. Mastin, Lockheed Martin Mgmt. & Data Systems, Reconnaissance Systems, Litchfield Park, Arizona
Rodler F. Morris, Center for Army Lessons Learned, Ft. Leavenworth, Kansas
David Nicol, Illuminet, Overland Park, Kansas
Susan Norris, Sprint PCS, Overland Park, Kansas
Maurice O'Sullivan, Nortel Broadband Networks, Ottawa, Ontario, Canada
Joe Ozorkiewicz, Netopia, Inc., Lawrence, Kansas
Robert Parker, USC-IC, Arlington, Virginia
David M. Purvis, AlliedSignal, Inc., Olathe, Kansas
Brian Ruf, RUF Corp., Olathe, Kansas
Robert Sansom, FORE Systems, Inc., Warrendale, Pennsylvania
Daniel Sershen, Sprint Corporation,Overland Park, Kansas
David Smith, Public Networks Group, NEC, Irving, Texas
Michael F. Sobek, Information Control Systems, Inc. (ICSI), Overland Park, Kansas

ITTC's Industry Advisory Board met on May 18 to help the Center with its strategic planning. Thirteen corporations were represented. Pictured, left to right from bottom row up, are Robert Zerwekh, KU Center for Research, Inc.; Jake Maczuga, Kansas Innovation Corp.; Mike Wojcicki, KTEC; Gordon Johnston, NASA Headquarters; Maurice O'Sullivan, Nortel Broadband Networks; Daniel Sershen, Sprint Corp.; Loudon Blair, Ciena; Brian Ruf, Ruf Corp.; Gary Mastin, Lockheed-Martin; Phil Anderson, Kantronics; Susan Norris, Sprint PCS; and David Nichol, Illuminet. John Voeller, Black & Veatch, is not pictured. Photo by Doug Hesse.

Arun Sobti, Third Generation Cellular Systems Development, Motorola, Schaumburg, Illinois
Jerry White, Black & Veatch, Overland Park, Kansas
Gregory G. Williams, SBC Technology Resources, Inc., Austin, Texas
Mike Wojcicki , Kansas Technology Enterprise Corp. (KTEC), Topeka, Kansas
Ken Young, Telcordia Technologies, Morristown, New Jersey
Bob Zerwekh, KU Engineering Management, Overland Park, Kansas

ALL-OPTICAL CLOCK RECOVERY FOR MULTIWAVELENGTH, FIBER-OPTIC COMMUNICATIONS

Sponsor: Sprint Corp.

Faculty Investigators: Kenneth Demarest, Chris Allen, Ron Hui

Student Investigator: Chris Johnson

Staff Investigator: Ben Zhu

Most long-distance fiber-optic networks use wavelength division multiplexing (WDM), where a number of different optical frequencies are used simultaneously on the same fiber. Each optical frequency travels through the fiber more or less independently of the others, thus allowing a single fiber to carry upwards of a hundred times more information than could be carried by a single optical wavelength.

Most of the signal regeneration operations that must be performed along a fiber link to maintain signal integrity are presently performed at the electronics level, rather than at the optical level. This includes signal reshaping and re-timing operations. Optical-to-electrical and electrical-to-optical conversions are cost effective when the number of wavelength channels is small, but very expensive when each fiber is carrying hundreds of individual wavelength channels. To get around this problem, devices that can perform key signal regeneration operations directly in the optical domain will be required.

In the Lightwave Lab, we have developed an all-optical device that is capable of performing one of these regeneration operations-clock recovery-directly in the optical domain. In addition, this device is capable of extracting clocks of multiple WDM frequencies simultaneously. This device uses an optical phenomenon called Brillouin amplification to extract the clock information that is embedded in the optical data signals, producing multiple clock waveforms at each optical frequency.

The WDM compatibility of this clock recovery device makes it attractive for future optical networks. By using a single device to recover the clocks of a number of optical inputs, this technology could be integrated into future WDM networks, thereby eliminating the need for costly regenerators for each wavelength.

Patent is pending.

For more information, contact Chris Allen, callen@eecs.ukans.edu, (785) 864-3017, or Ken Demarest, demarest@eecs.ukans.edu, (785) 864-4838.

In ITTC's Lightwave Lab, students test the performance of a fiber-optic communications systems.
Photo courtesy of KU's University Relations.

AUTONOMOUS NEGOTIATING TEAMS (ANTS): A CASE-BASED REFLECTIVE NEGOTIATION MODEL

Sponsor: Department of Defense Advanced Research Projects Agency (DARPA)

Faculty Investigators: Costas Tsatsoulis and Douglas Niehaus

Student Investigators: Dugganapally Arun Gautam, William Dinkel, Huseyin Sevay, James Williams, Nick Evaggelopoulos

Staff Investigator: Leen-Kiat Soh

Life is filled with negotiations, for people never get everything they want, when they want it. So too in the military scenarios of DARPA's most recently funded project on Autonomous Negotiating Teams (ANTs).

In these problem-based scripts, every military entity—brigade, soldier, rifle, radio, aircraft—is part of a computer network that negotiates resources, assesses capabilities, makes plans, and takes action. These autonomous negotiating teams also bid for open tasks and bid to supply operations.

Investigators Costas Tsatsoulis and Douglas Niehaus are applying a case-based, reflective negotiation (CRN) problem-solving approach to their ANTs project. They will integrate case-based reasoning (CBR) and utility theory and apply them to virtual reality scenarios.

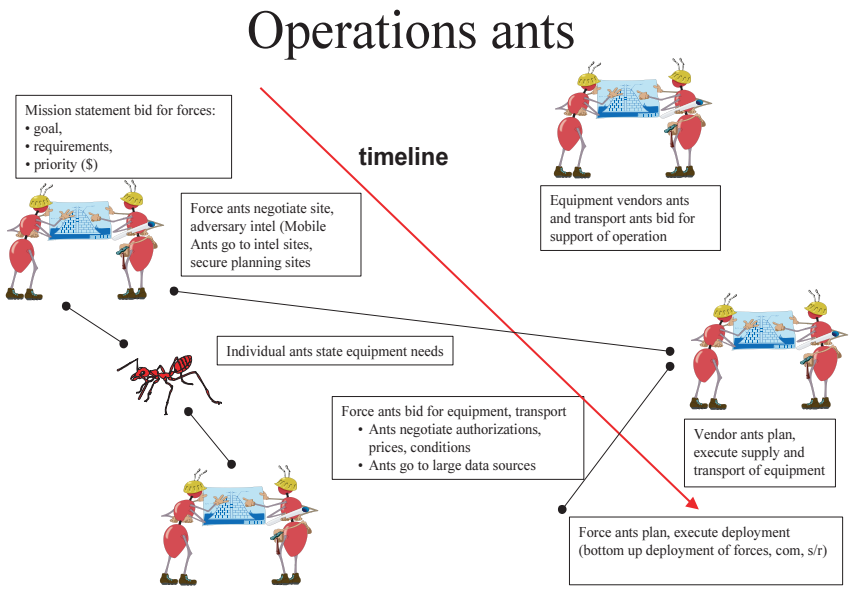
For example, perhaps U.S. planes are flying toward an enemy missile that is set to release a warhead in a matter of minutes. Each of the planes is technically capable of destroying the missile, but some are nearer to the target than others. Some have more fuel. So negotiations begin among the planes' computers to evaluate which of the aircraft can provide a good enough-soon enough solution.

Using problem-solving computations created by the investigators, these ANTs will reason about their own probabilities of success, their utilities and priorities, as well as about those of other ANTs with whom they are negotiating. They will evaluate negotiation policies in light of their shared goal to destroy the missile in time.

"We view the retrieval of a negotiation strategy as a decision problem," says Costas Tsatsoulis, "and integrate CBR with utility theory allowing the CRN system to handle problems where information is uncertain, incomplete or missing."

This problem-solving research may one day be applied to non-military situations. In a manufacturing setting, equipment—through computers—may negotiate for its own parts from suppliers. Computers supporting emergency response teams may negotiate for supplies, vehicles, and medical personnel.

For more information, contact Costas Tsatsoulis, tsatsoul@eecs.ukans.edu, (785) 864-7749.



DEVELOPMENT OF A HYBRID RF/LASER RADAR

Sponsors: National Aeronautics and Space Administration (NASA), Center for Research, Inc., and ITTC

Co-principal investigators: Chris Allen and Prasad Gogineni

Student investigators: Kenny Chong, Yanki Cobanoglu, Ryan Eakin

In July 2001, NASA will launch ICESat. This satellite will provide data on ice sheet thickness in Greenland and Antarctica using the Geoscience Laser Altimeter System (GLAS). This system works like a radar, but uses a laser to make its altitude measurements. NASA already has a similar system orbiting Mars.

With this most recent NASA award, Chris Allen and Prasad Gogineni, from the Radar Systems and Remote Sensing Lab (RSL), seek to develop a new class of laser radar with distinct improvements compared to the GLAS system. Their system uses off-the-shelf, advanced fiber optic components and combines radio frequency (RF) pulse compression with digital signal processing to achieve elevation measurements with range accuracies comparable to the GLAS altimeter but at a rate ten times faster. In addition, the peak power of the laser used in their system is orders of magnitude less than those used in GLAS resulting in a significant increase in laser reliability.

"The early stages of the project already are showing good results," says Allen, who is RSL's director. He believes the project will offer many improvements over GLAS, such as reduced size, less power consumption, and sensor flexibility—which translate to greater efficiency and costs savings. This project represents the first of many that combine fiber optic technology with radar remote sensing systems.

For more information, contact Chris Allen, callen@eecs.ukans.edu, (785) 864-3017.

IceSat photo compliments of NASA.

ENHANCING OF NETWORK-AWARE APPLICATIONS AND BOTTLENECK ELIMINATION (ENABLE)

Sponsor: Department of Energy (DOE)

Co-principal investigators: Joe Evans and Victor Frost (KU), and Brian Tierney (LBNL)

Student investigators: Anupama Sundaresan, Priyanka Parameswaran, Jiang Yao

Next generation Internet (NGI) applications will push the limits of available network bandwidth. Scientists at the Department of Energy and elsewhere will face possible limits and lapses in their Internet capabilities at the very time when their collaborative work is reaching unprecedented levels.

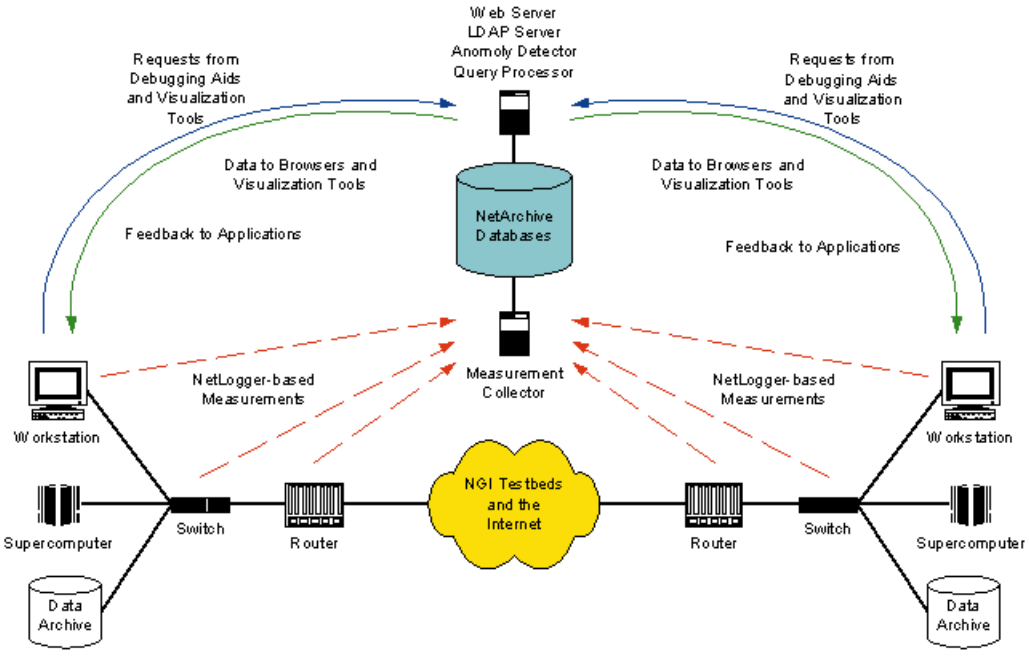
The Internet network needs two critical services to guarantee maximum efficiency in the use of network resources. First, it needs a system to monitor the performance of each the system's components. This system would enable detailed performance analysis of the complete end-to-end system.

Second, it needs a system to monitor current network characteristics and to provide this information to network-aware applications that can effectively adapt to current network conditions.

Both needs require a similar set of services—adaptive monitoring, infrastructure, a monitor data publishing mechanism, and monitor data analysis tools. Through this project, investigators will develop a grid service to provide these capabilities. They will also address the overall goal: to provide manageability, reliability, and adaptability for high-performance applications running over wide-area networks.

This project is a collaborative effort between researchers at KU and at Lawrence Berkeley National Laboratory (LBNL) in California and is an outgrowth of the MAGIC testbed effort of the late '90s. The project demonstrates a history of continuity of work in this area and KU's recognized expertise.

For more information, contact Joe Evans, evans@ittc.ukans.edu, (785) 864-4830.



This drawing of ENABLE's architecture and operating environment shows the key role the tools NetArchive and NetLogger will play in analyzing the performance of a wide-area distributed system. NetLogger will log the system's performance data. NetArchive, developed at KU, will help researchers understand complex application and network interactions.

INNOVATIVE ACTIVE NETWORKING SERVICES

Sponsor: Department of Defense Advanced Research Projects Agency (DARPA)

Faculty investigators: Gary Minden, Joe Evans, W. Perry Alexander

Student investigators: Amit B. Kulkarni, Isfahan Deendar, Chetan Khanna, Tsz Shun Lam, Ravi Chamarty, Vishal Zinjuvadia, Suresh Krishnaswamy, Yoganandhini Janarthanan, Justin Marz, Steve Ganje

Staff investigator: Roel J.T. Jonkman

Gary Minden and Joe Evans are focusing on the new concept of active networking. Their research is driven by the fact that today's routers—the units that interconnect the networks—have remained fairly standard. But what's standard may not always deliver the best service.

Message addressing in networks is uniform, so that email addresses can be read and sent anywhere. All messages, or packets, sent along the Internet also use uniform formats, or protocols. In effect, everyone agrees to the same operating procedures. Finally companies design, build, and sell routers that can handle this uniform format or protocol. In a worldwide Internet system, where users and equipment suppliers must all agree to the same protocols and routers, change could mean a loss of connection.

So, it takes a long time and lots of agreement to introduce new capabilities or services into the Internet network. But improvements to this fairly uniform and slow-to-change system can be made through active networking. In active networking, the routers' decision-making behavior is changed rather than the router itself, so services can be improved without rebuilding the networks components. Instead of a huge networking community agreeing to implement a change in the routing protocols, a network operator can take the initiative to implement a new routing procedure.

Gary Minden, professor of EECS and ITTC's Chief Technologist, is co-principal investigator on ITTC's DARPA-sponsored Innovative Active Networking Services project.

"We envision packets that carry their own routing instructions," said Minden, "that interact with the routers as the packets move through the network. So active networking is about how to work with routers to allow easy insertion of new routing methods, how to write the instructions that packets might carry, and how to make all of this robust and secure."

This project will use active networking to develop faster, more efficient, and more flexible computer networks for DoD's Defense Advanced Research Projects Agency (DARPA). The DARPA contract meshes with Minden's professional interests. From 1994-96 he was on leave from KU to work with DARPA's Information Technology Office. While a program manager in the area of high-performance networking systems, he conceived and started the Active Networking research program. Since the late 1960s, DARPA has funded the development of key ideas to improve networks and is responsible for a number of technology breakthroughs in this area.

For more information, contact Gary Minden, gminden@ittc.ukans.edu, (785) 864-4834, or Joe Evans, evans@ittc.ukans.edu, (785) 864-4830.

AMBIENT COMPUTATIONAL ENVIRONMENTS (ACE)

Sponsor: National Science Foundation (NSF)

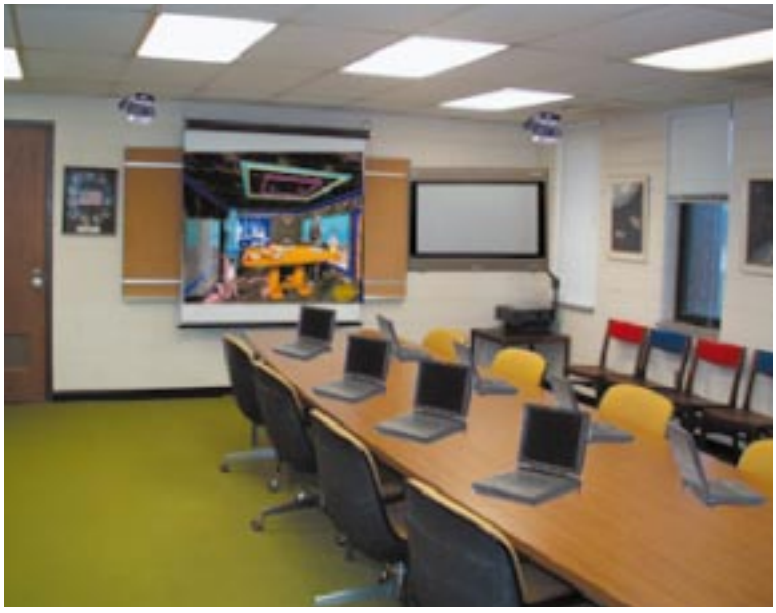
Principal Investigator: Gary Minden

Others on the ACE Team: Arvin Agah, robotic systems; Allen Ambler, programming languages and systems; Frank Brown, artificial intelligence systems; Joe Evans, networking and computing systems; John Gauch, video information systems; Susan Gauch, information retrieval; Jerzy Grzymala-Busse, learning systems; James Miller, graphics; Doug Niehaus, distributed systems and real-time; Thomas Schreiber, human information retrieval; Shari Speer, psycholinguistics; Costas Tsatsoulis, expert systems, agent systems and case-based reasoning; and Perry Alexander and Jerry James, new faculty, who joined the team in August 1999

Just after the close of FY99, Gary Minden and the ACE team learned that the National Science Foundation had decided to fund their Ambient Computation Environments (ACEs) project. So much of the work that went into securing this important award occurred in the 1998-99 year, that it seems appropriate to briefly note in this annual report the people involved and the possibilities this research will create.

In the spring of 1999, ITTC learned that the ACEs proposal was among eight NSF had chosen to consider for funding. On May 14, three NSF reviewers visited ITTC to discuss this far-sighted research project, which draws on the Center's notable and collaborative research efforts. Victor Frost, then the Center's acting director, observed that ACEs moves people toward the day when their interactions with home and office computers will become more seamless and efficient.

Primarily a grant for equipment, ACEs is not focused on multi-media or collaborative environments—though it will use both disciplines. Rather it will look at how computer resources can be embedded into any given environment and be made available from almost anywhere in the world.



This artist's rendering of the Gemini Room in Nichols Hall shows what will be possible when the ACEs ideas become part of our business lives. Imagine yourself entering this room, which is outfitted with a HDTV panel display, remote cameras, microphones, and tables arranged with laptops. As you enter the room, you tell it, "I'm here," and the main computer identifies you by your voice print. Because you have scheduled the room for the meeting, the equipment responds to your room-set-up commands. You request that your presentation load on the projector and that a room in another building come up on the HDTV screen. You assign one camera to view the room you are in, while another points toward the speaker podium. Your colleagues enter the room and sit down at one of the many laptops. Through their thumbprints, they identify themselves to these laptops and request that the files in their office computers pop up on the screen. This is a meeting room of the not-too-distant future, an ambient computational environment.

For more information, contact Gary Minden, gminden@ittc.ukans.edu, (785) 864-4834.

ITTC Projects Active during FY99

Establishment of a Lightwave Laboratory for Applications Focused Research
National Science Foundation, NSF-EPSCoR
Kenneth R. Demarest, with C. Allen, J. Evans, V. Frost, K. Nordheden

Functional Programming Environment for Design and Implementation of High Performance Radio and Synthetic Aperture
Defense Advanced Research Project Agency (DARPA)
Gary Minden, with M. Ashley, J. Evans, D. Niehaus, G. Prescott

High-Resolution Radar Characterization of Ice in the Search for Extra-Terrestrial Life
National Aeronautics & Space Administration (NASA)
Sivaprasad Gogineni, with R. Plumb

Short Experiment to Measure Ocean Radar Backscatter and Relate it to Slopes
Naval Research Laboratory (NRL)
Richard K. Moore, with S. Gogineni, G. Prescott

Swept Stepped-FM Vehicular Mounted Ground Penetrating Radar for Anti-Tank Mine Detection
U.S. Army
Richard G. Plumb, with G. Prescott, J. Stiles

Wireless Extension to the ACT ATM Internetwork
Sprint Corp.
Joseph B. Evans, with V. Frost, G. Prescott

AAL2 Call/Connection Control Signaling
Sprint Corp.
Joseph B. Evans, with V. Frost, D. Petr

ACTS ATM Internetwork
DARPA/Sprint Communications Co. L.P.
Victor S. Frost, with J. Evans, G. Minden, D. Niehaus, D. Petr

ATM Reference Traffic System
Sprint Corp.
Douglas Niehaus, with J. Evans, V. Frost

Battlefield and Data Dissemination System, Intelligent Information Dissemination Server (IIDS) Project
Lockheed Martin Missiles & Space
Constantinos P. Tsatsoulis

Bi-directional Optical Recirculating Loop for Multi Channel WDM Applications
Nortel Networks
Rongqing Hui

Broadband Wireless Local Loop
Kansas Technology Enterprise Corporation (KTEC)
Joseph B. Evans, with V. Frost

Broadband Wireless Local Loop
Sprint Corp.
Joseph B. Evans, with V. Frost, G. Prescott, J. Roberts, K. S. Shanmugan

CDMA Capacity Assessment for Personal Wireless Communications
Sprint Corp.
James A. Roberts, with V. Frost, G. Prescott, K. S. Shanmugan

Conclusion: Ground Penetrating Radar
Kansas Electric Utilities Research Program
Richard G. Plumb (through August 1998)/Deb Chatterjee

Cooperative Agents for Conceptual Search and Browsing of World Wide Web Resources
NSF
Susan E. Gauch

Determination of the Impact of Advanced Traffic Controls on the Performance of Edge/Core ATM Network Architectures
Sprint Corp.
Victor S. Frost, with J. Evans, D. Niehaus, D. Petr

Development of a Hybrid RF/Laser Radar
NASA
Christopher T. Allen, with S. Gogineni

Development of Data Acquisition System for Europa Radar Test Bed
NASA
Sivaprasad Gogineni

Development of Radar System for Accumulation Measurements
NASA
Sivaprasad Gogineni

Development of Scanning Laser Ophthalmoscope for Low Vision Rehabilitation
Department of Veterans Affairs Medical Center
John M. Gauch

Enhancement of the KU PNNI Performance Evaluations Tools-NP&D
Sprint Corp.
Douglas Niehaus, with J. Evans, V. Frost

Enhancement of the KU PNNI Performance Evaluations Tools -TP&I
Sprint Corp.
Douglas Niehaus, with J. Evans, V. Frost

Establishment of a Lightwave Laboratory for Applications Focused Research
KTEC
Victor S. Frost, with C. Allen, K. Demarest, J. Evans, K. Nordheden

Exploiting Open Control of ATM Networks
Sprint Corp.
Joseph B. Evans

Feasibility Study of Compact Soliton Source Using Dual-Mode Highly Gain-coupled DFB Laser Diodes
Nortel Networks
Rongqing Hui

High Resolution Optical Spectrum Analyzer for Optical System Link Quality Monitoring
Nortel Networks
Rongqing Hui

High Speed WDM Sub-Carrier Multiplexed Optical Fiber Communication Systems
Sprint Corp.
Rongqing Hui, with C. Allen, K. Demarest

Integrated Evaluation of Network, System, and Application Software Architecture and Performance Issues in ATM Networks
Sprint Corp.
Douglas Niehaus, with C. Tsatsoulis

Intergovernmental Personnel Act (IPA Agreement)
NASA
Sivaprasad Gogineni

Investigation of FPGA Rapid Prototyping of Military Software Radio Systems
Rome Laboratory
Glenn E. Prescott, with J. Evans, K. S. Shanmugan

Kansas Participation in Sea Winds Instrument Activities
Oregon State University
Richard K. Moore

KEURP-Link: Phase III
Kansas Electric Utilities Research Program
Susan E. Gauch

KEURP-Net: Phase II Summer Work
Kansas Electric Utilities Research Program
Douglas Niehaus, with S. Gauch

Lightwave Communication Systems Research
Sprint Corp.
Kenneth R. Demarest, with C. Allen, J. Evans, V. Frost, R. Hui, G. Minden

Magic-II: A Large-Scale Internetwork Supporting High Speed Distributed Storage, Processing and Applications
Department of Defense (DoD)
Victor S. Frost, with J. Evans, D. Niehaus

Measurement of Thickness of the Greenland Ice Sheet and High-Resolution Mapping of Internal Layers
NASA
Sivaprasad Gogineni, with J. Stiles

Miniature Ground Penetrating Radar Probe for Planetary Stratigraphy and Subsurface Water-Ice Detection
California Institute of Technology
Sivaprasad Gogineni, with R. Plumb

Moving Target Indication Using Sparse-Aperture, Multi-Channel SAR
Research & Development Labs (Culver City, Calif.)
James Stiles

Multi-Dimensional Signal Processing Algorithms for Sparse Radar Arrays
Air Force Office of Scientific Research
James Stiles, with J. Gauch

Multidisciplinary Research in Mine Detection and Neutralization Systems
U.S. Army
James Stiles, with S. Gogineni

Object Motion Analysis for Biomedical Applications
Whitaker Foundation
John M. Gauch

Performance Tuning Study and Tools for Computer Systems Connected to the DREN
U.S. Navy
Joseph B. Evans, with V. Frost, G. Minden

Pricing of Services in ATM Networks
Sprint Corp.
David W. Petr

Project to Port ARKTOS to a Pentium II/NT Processor
Ice Services Environment Canada
Constantinos P. Tsatsoulis

Quality of Service Translations
Sprint Corp.
Joseph B. Evans, with G. Minden

Radar Interferometry for Improved Cross-Track Resolution Measurements of the Thickness of the Greenland Ice Sheet
NASA
Sivaprasad Gogineni

Rapidly Deployable Radio Network (RDRN)-Phase II
DARPA
K. Sam Shanmugan, with J. Evans, V. Frost, G. Minden, D. Petr, R. Plumb, G. Prescott, J. Roberts

Seismic-Reflection and Ground Penetrating Radar for Environmental Site Characterization
Department of Energy (DoE)
Donald W. Steeples, with R. Plumb

System Support and Performance Evaluation of Conventional and Real-Time ORBs
Sprint Corp.
Douglas Niehaus

Tracking Internal Layers of the Greenland Ice Sheet Using Airborne Radio Echo Sounder Images
NASA
John M. Gauch

Traffic Management and Controls for ATM Networks
Sprint Corp.
David W. Petr, with V. Frost, D. Niehaus

Voice Transport Over ATM
Sprint Corp.
David W. Petr

Wireless ATM Adaptive Voice/Data Networks
U.S. Air Force
Joseph B. Evans, with V. Frost, J. Gauch

Wireless Network Systems Research
Adaptive Broadband Ltd.
Joseph B. Evans

ITTC-Affiliated Publications, FY99

BOOKS AND BOOK CHAPTERS

To Appear

Duncan-Mortensen-Zakai Equation,
T.E. Duncan; accepted for *Encyclopedia of Mathematics*; Kluwer Academic Publishing Co.

Intelligent Agents in Telecommunication Networks,
C. Tsatsoulis, L.K. Soh; *Computational Intelligence in Telecommunications Networks*; ed. W. Pedrycz, A.V. Vasilakos; CRC Press (1999).

Transform-Based Low Probability of Intercept Communications,
T. Farrell, G. Prescott; accepted for *Wavelet and Subband Transforms in Communications and Multimedia*; Kluwer Academic Publishing Co. (1999).

The VISION Digital Video Library Project,
S. Gauch, J.M. Gauch, K.M. Pua; accepted for *The Encyclopedia of Library and Information Science*.

The VISION Digital Video Library Project,
S. Gauch, J.M. Gauch, K.M. Pua; accepted for *The Encyclopedia of Microcomputer Technology*.

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T.E. Duncan; *Wiley Encyclopedia of Electrical and Electronics Engineering*, Vol. 7; ed. J.G. Webster; J. Wiley & Sons (1999), pp. 480-493.

Group Behavior of Robots,
G.A. Bekey, A. Agah; *Handbook of Industrial Robotics*, Second Edition; ed. Shimon Y. Nof ; John Wiley & Sons, Inc. (1999), pp. 439-445.

Solvable Infinite Time Horizon Stochastic Control Problems in Non Compact Symmetric Spaces, Stochastic Analysis, Control, Optimization and Applications,
T.E. Duncan, W. McEneaney, G.G. Yin, Q. Zhang (eds.); Birkhauser (1999), pp. 373-390.

Some Approaches to Ergodic and Adaptive Control of Stochastic Semilinear Systems,
T.E. Duncan; *Control of Distributed Parameter and Stochastic Systems*; eds. S. Chen, X. Li, J. Yong, X.Y. Zhou; Kluwer (1999), pp. 199-206.

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B. Pasik-Duncan; *Encyclopedia of Electrical and Electronics Engineering*; John Wiley & Sons, Vol. 20 (1999), pp. 543-555.

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Evolutionary Communication in Distributed Multi-Agent Systems,
A. Agah, G.A. Bekey; *Robotics and Manufacturing Systems, Recent Results in Research, Development, and Applications*, Vol. 7; eds. M. Jamshidi, F. Pierrot, M. Kamel; TSI Press (1998), pp. 9-14 .

Identification for Linear Stochastic Distributed Parameter Systems with Boundary/Point Control, Stochastic Analysis, Control, Optimization and Applications,
B. Pasik-Duncan, W. McEneaney, G.G. Yin, Q. Zhang (eds.); Birkhauser (1998).

Knowledge-Based Assistants in Collaborative Engineering,
W.M. Kim Roddis; *Artificial Intelligence in Structural Engineering: Lecture Notes in Artificial Intelligence 1454*; ed. Ian Smith; Springer (1998), pp. 320-334.

LERS—A Knowledge Discovery System,
J.W. Grzymala-Busse; *Rough Sets in Knowledge Discovery 2: Applications, Case Studies and Software Systems*; eds. L. Polkowski, A. Skowron; Physica-Verlag (1998), pp. 562-565.

On the Best Search Method in the LEM1 and LEM2 Algorithms,
J.W. Grzymala-Busse, P. Werbrouc; *Incomplete Information: Rough Set Analysis*; ed. E. Orlowska; Physica-Verlag (1998), pp. 75-91.

On the Lower Boundaries in Learning Rules From Examples,
C.C. Chan, J.W. Grzymala-Busse; *Incomplete Information: Rough Set Analysis*, ed. E. Orlowska; Physica-Verlag (1998), pp. 58-74.

JOURNAL ARTICLES

To Appear

An FDTD/MoM Hybrid Technique for Modeling Complex Antennas in the Presence of Heterogeneous Grounds,
Z. Huang, K. Demarest, R. Plumb; accepted for *IEEE Transactions on Geoscience and Remote Sensing*.

A Note on Sampling and Parameter Estimation in Linear Stochastic System,
T.E. Duncan, P. Mandl, B. Pasik-Duncan; accepted for *IEEE Transactions on Automatic Control*.

An Overview of the Rapidly Deployable Radio Network System,
K. S. Shanmugan, J.B Evans, et. al; accepted for *Journal on Selected Areas in Communications* (March 1999).

Real Time Video Indexing and Classification,
J.M. Gauch, S. Gauch, S. Bouix, X. Zhu; accepted for *Information Processing & Management*.

Real Time Video Scene Detection and Classification,
J.M. Gauch, S. Gauch, S. Bouix, X. Zhu; accepted for *Information Processing & Management*.

Separating Touching Objects in Remote Sensing Imagery,
L.K. Soh, C. Tsatsoulis; accepted for *IEEE Transactions on Image Processing* (1999).

The Spring System: Integrated Support for Complex Real-Time Systems,
J. Stankovic, K. Ramamritham, D. Niehaus, M. Humphrey; accepted for *Real-Time Systems Journal*.

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T.E. Duncan, Y.Z. Hu, B. Pasik-Duncan; accepted for *SIAM Journal of Control Optimization*.

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L.K. Soh, C. Tsatsoulis; accepted for *International Journal of Remote Sensing: Special Issue on Remote Sensing of the Polar Regions* (1999).

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Adaptive Control of Stochastic Manufacturing Systems with Hidden Markovian Demands and Small Noise,
T.E. Duncan, B. Pasik-Duncan, Q. Zhang; *IEEE Transactions on Automatic Control*, Vol. 44 (1999), pp. 427-430.

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H. Garis, F. Gers, M. Korkin, A. Agah, N.E. Nawa; *Artificial Life and Robotics Journal* (1999).

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R. Hui, K. Demarest, C. Allen; *IEEE Journal of Lightwave Technology*, Vol. 17, No. 6 (1999), pp.1018-1026.

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A. Agah, K. Tanie; *International Journal of Intelligent Automation and Soft Computing* (1999).

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D. Haverkamp, C. Tsatsoulis; *IEEE Trans. on Geoscience and Remote Sensing: Special Issue on Data Fusion*, Vol. 37, No. 3 (1999), pp. 1278-1291.

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Model For Etch Depth Dependence on GaAs Via Hole Diameter,
B. Abraham-Shrauner, K.J. Nordheden, Y.S. Lee; *Journal of Vacuum Science Technology*, Vol. B17, No. 3 (1999) p. 961.

Multimedia Human-Computer Interaction for Presence and Exploration in a Telemuseum,
A. Agah, K. Tanie; *Presence Journal*, Vol. 8, No. 1 (February 1999), pp. 104-111.

Multiwavelength All-Optical Clock Recovery,
C. Johnson, K. Demarest, C. Allen, R. Hui, K. Peddanarappagari, B. Zhu; *IEEE Photonics Technology Letters*, Vol. 11, No. 7 (June 1999), pp. 895-897.

Performance Evaluation of TCP Extensions on ATM over High Bandwidth Delay Product Networks,
C.P. Charalambous, V.S. Frost, J. Evans; *IEEE Communications Magazine*, Vol. 37, No. 7 (July 1999), pp. 57-63.

Performance of TCP Extensions On Noisy High BDP Networks,
C.P. Charalambous, V.S. Frost, J. Evans; *IEEE Letters on Communications*, Vol. 3, No.10, pp. 294-299.

A Rapidly Deployable Radio Network,
S. Shanmugan, J. Evans, G. Minden, G. Prescott; *Journal of Selected Applications in Communications* (April 1999).

RIE Initiation Delay in BCl3/SF6/Ar Plasmas Due to Native Oxide Removal in NH4OH/H2O,
K.J. Nordheden; *Electrochemical Solid-State Letters*, Vol. 2, No. 1 (1999), p. 43.

Separation of Noise from Distortion for High-Speed Optical Fiber System Link Budgeting,
R. Hui, M. Vaziri, J. Zhou and M. O'Sullivan; *IEEE Photonics Technology Letters*, Vol. 11, No. 7 (June 1999).

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W. Burleson, J. Ko, D. Niehaus, K. Ramamritham, J. Stankovic, G. Wallace, C. Weems; *IEEE Transactions on VLSI Systems*, Vol. 7, No. 1 (March 1999), pp. 38-48.

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A Practical and Flexible Flow Analysis for Higher-Order Languages,
J.M. Ashley, R.K. Dybvig; *ACM Transactions on Programming Languages and Systems*, Vol. 20, No. 4 (July 1998), pp. 845-868.

Rule Induction System LERS,
J.W. Grzymala-Busse; *Bulletin of International Rough Set Society,* Vol. 2 (1998), pp. 18-20.

The Use of Ground-Penetrating Radar with a Cooperative Target,
C.T Allen, K. Shi, R.G. Plumb; *IEEE Geoscience and Remote Sensing*, Vol. 36, No. 5 (1998), pp. 1821-1825.

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Y. Fan, S. Gauch; accepted for AAAI Symposium on Agents in Cyberspace, Stanford University (March 1999).

An Agent-Based Approach to Anticipatory Information Dissemination,
H. Sevay, C. Tsatsoulis; accepted for IASTED International Conference on Artificial Intelligence and Soft Computing, Honolulu, Hawaii (1999).

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F.M. Brown, A.A. Agah, J.M. Gauch, T. Schreiber, S.R. Speer; accepted for IEEE International Conference on Systems, Man, and Cybernetics, Tokyo (1998).

A Cognitive Robot with Reconfigurable Mind for Ambiguity Resolution (Part 1: The Robot),
F.M. Brown, A.A. Agah, J.M. Gauch, T. Schreiber, S.R. Speer; accepted for IEEE International Conference on Systems, Man, and Cybernetics, Tokyo (1998).

Connection Admission Control for Differentiating Priority Traffic on Public Networks,
C.C. Beard, V.S. Frost; accepted for IEEE MILCOM '99.

Deformable Mesh Algorithm for Strain Imaging with Complex Tissue Deformation,
Y. Zhu, M. F. Insana, P. Chaturvedi, T. J. Hall, L. T. Cook, J. M. Gauch; IEEE Ultrasonics Symposium, Japan.

Efficiency of AAL2 for Voice Transport: Simulation Comparison with AAL1 and AAL5,
D.W. Petr, R.R. Vatte, P. Sampath, Y.Q. Lu; accepted for *Proceedings of the IEEE 1999 International Conference on Communications (ICC'99)*, (June 1999).

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C. Tsatsoulis, J. Holtzman; accepted for Florida Artificial Intelligence Research Symposium FLAIRS'99, Orlando (1999).

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E. Setiawan, S. Chakrabarti; accepted for Conference of Intelligent Engineering Systems through Artificial Neural Networks, St. Louis (Nov. 9-12, 1999).

Identification and Adaptive Control of Some Stochastic Distributed Parameter Systems,
B. Pasik-Duncan; 7th Mediterranean Conference on Control and Automation, Haifa, Israel (June 28-30, 1999).

Intelligent Fusion of Multisource Data for Sea Ice Classification,
C. Tsatsoulis, L.K. Soh, C. Bertoia, K. Partington; accepted for Workshop on Intelligent Techniques for Spatio-Temporal Data Analysis in Environmental Applications, Chania, Greece (1999).

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A.B. Kulkarni, G.J. Minden; IEEE Infocom 1999, New York (March 22-25, 1999).

Adaptive Multiresolution Quantization for Contextual Information Gain in SAR Sea Ice Images,
L.K. Soh, C. Tsatsoulis; IGARSS'99, Hamburg, Germany (1999), pp. 1567-1569.

Ambiguity Resolution in Natural Language Understanding, Active Vision, Memory Retrieval, and Robot Reasoning and Actuation,
F.M. Brown, A. Agah, J.M. Gauch, T. Schreiber, S.R. Speer; *Proceedings of the IEEE International Conference on Systems, Man, and Cybernetics (SMC'99)*, Tokyo (October 1999).

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T.E. Duncan, Y. Chu, M. Matache, B. Pasik-Duncan, P. Zimmer; *Proceedings of the American Control Conference,* San Diego (1999), pp. 4438-4440.

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D. Chatterjee, S.Chakrabarti, K.S. Shanmugan, G.E. Prescott; AP/URSI (B) Conference, Miami (July 1999).

Applications of Some Optimization Techniques to Adaptive, Conformal Array Antennas for Mobile Communication Systems,
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