THE ITTC VISION...

To be a world-class university center dedicated to advancing information and telecommunication technologies.

...and Mission

To provide an excellent interdisciplinary research environment that capitalizes on partnerships with industry and government entities to develop technologies and advance knowledge in information and telecommunications areas:

- intelligent systems and information management,
- lightwave communication systems,
- networking and distributed systems, and
- wireless communications and digital signal processing.

To apply the Center's expertise and resources to best

- enhance the education and training of students,
- aid in the continued development of faculty and staff, and
- support Kansas companies and national industries through the transfer of technological innovation.

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ITTC Annual Report for FY98 (1 July 1997 - 30 June 1998).
Published February 1999.

DIRECTOR'S STATEMENT: FISCAL YEAR = PHYSICAL CHANGES

During Fiscal Year 1998 we put into place a plan that will insure future information and telecommunication technology research and related economic development activities at the University of Kansas.

A rare combination of opportunity and inspiration in 1997 led to the reorganization of the Center, but this was only the first of many changes that will spell success for ITTC as we near the turn of the century. The Center continues to be dedicated to providing an interdisciplinary research environment, to attracting and graduating outstanding students, and to developing and transferring technological innovation to the private sector. Each of the Center's laboratories—Lightwave Communication Systems, Wireless Communications and Digital Signal Processing, Networking and Distributed Systems, and Intelligent Systems and Information Management—continues to prosper.

The growth of our activities during the past 12 months has led to a lengthy list of accomplishments:

First, a domino effect at the University moved Jim Roberts, Chair of the Department of Electrical Engineering and Computer Science, to Associate Vice Chancellor for Research and Public Policy. Dr. K. Sam Shanmugan, original Director of ITTC, was asked to serve as Interim Department Chair of EECS; and in turn, I became Acting Director for ITTC. Change is often good, and these changes promote supportive faculty into positions of higher authority where they can continue to advocate our mission.

In administrative and operational issues, for the first time our Center generated about $140,000 in income from royalties and license fees. We also created an industry advisory board, which met twice and participated in developing a vision and mission for the Center as well as providing input on research directions.

In Center "outcomes," Profusion, an Internet metasearch tool developed with assistance from the Center, received national recognition by *PC Magazine* as the "Editor's Choice" for best metasearch engine. Several other technologies developed at the Center have made great strides toward commercialization as well, including Driver's Alert System, a technology that assists over the road, long-distance drivers in staying alert; and a Remote Therapist Support System, that connects remote therapists with a database of patient records.

Looking to the future, an important event for the Center was the installation of dedicated fiber between our University laboratories and the Sprint research facilities in Overland Park. This connection sets the stage for impressive

information technology research in the future. In other research areas, we have expanded the number of full-time staff who are dedicated to specific efforts, and who will initiate new research as we begin refilling the commercialization pipeline.

As we begin FY 1999, we are encouraged by the new projects which will soon be under way. New partnerships with industry and the Federal Government will fuel development and future technology transfer activities in information technology and telecommunications. New partnerships through our Industry Affiliates Program will help support students and Center activities that are of a general interest to the industry.

Information and telecommunication technology is recognized as a nationally critical technology area, and a strategic technology for the State of Kansas. Not only does the Information and Telecommunication Technology Center play an important role in the growth of these technologies, but also we are training the students who will lead the industry through technical innovation in the future.

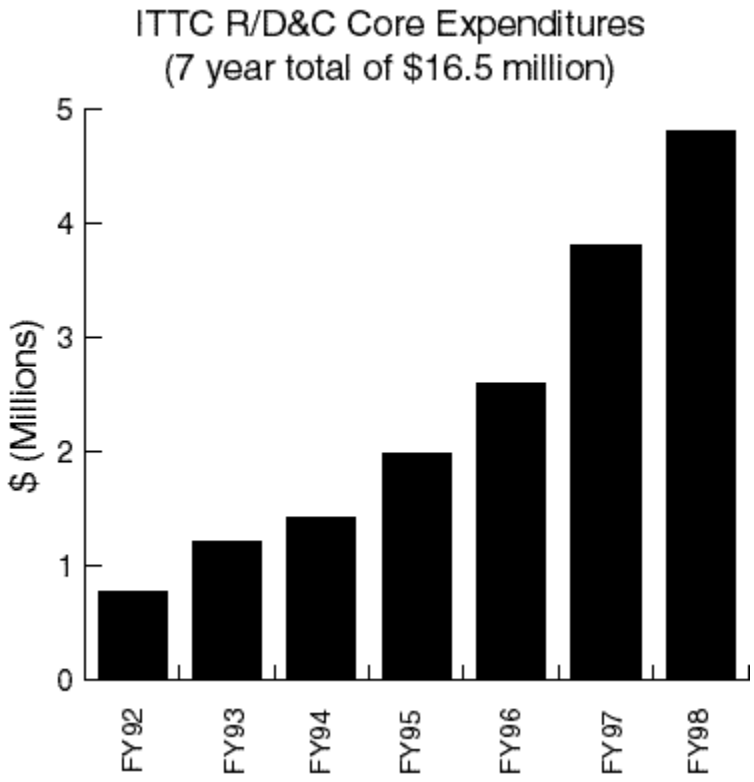
Victor S. Frost
Acting Director, ITTC
Dan F. Servey Distinguished Professor of Electrical Engineering
and Computer Science

INTRODUCTION AND OVERVIEW

The University of Kansas Information and Telecommunication Technology Center (ITTC) was formed in autumn of 1996 by the merger of the Telecommunications and Information Sciences Laboratory (TISL) and the Center for Excellence in Computer Aided Systems Engineering (CECASE). Each Center had already been a separate, established, integral part of the University for many years, with a history of dedicated teaching, research, and service.

During Fiscal Year 1998, ITTC has made great strides in developing as an organization with a strong team in information and telecommunication technology (IT). This technology area has been identified as one of seven critical to the nation. It has also been emphasized as having high opportunity and capacity within Kansas. Information and telecommunication technologies are changing the way the world functions and have fueled economic growth in the United States during the past decade. A quarter of real economic growth in the U.S. from 1993 to 1998 came from IT and Internet-related technologies. Over 7.4 million people work in the IT field, earning on average $46,000 annually—64% more than the private sector average.

The market segments related to our technology base are substantial and are experiencing strong growth, which is mirrored in our own recent growth. The Center's research funding base (Federal and industry) is very strong and is growing rapidly. ITTC continues to serve Kansas companies of all sizes, from the small spin-off companies to major industry sponsors such as Sprint Corporation. ITTC continues its strong support for technology transfer, industry enhancement, and commercialization. ITTC has positioned itself to be a true "center of excellence" and is now the second largest research unit on KU's Lawrence campus.



Note: RD&C = Research, Development, and Commercialization.

Technology Focus

With resources in faculty, staff, and students at the University of Kansas, the Center is developing new technologies for the telecommunication and information sciences industry. The Center receives broad support from industry, Federal, and State programs; and its research projects often result in investment-grade technologies. ITTC is organized into four technical areas, which allows the Center to take advantage of opportunities for funding in its affiliated faculty's areas of interest:

- Intelligent Systems and Information Management
  This group focuses on the use of advanced, intelligent methodologies as applied to solving problems in information identification, retrieval, analysis, and fusion. Dr. Costas Tsatsoulis coordinates the efforts of faculty and students in this area.

- Lightwave Communication Systems
  This group explores new lightwave technologies in order to increase the capacity and reliability of commercial lightwave communication networks. Drs. Ken Demarest and Chris Allen lead the faculty and student efforts in this area.

- Networking and Distributed Systems
  This group develops innovative networking and system technologies, and seeks to understand their behavior and to improve performance. Dr. Joe Evans leads the faculty and students in this area.

- Wireless Communications and Digital Signal Processing
  This group investigates software radio signal processing algorithms, adaptive beamforming, spread spectrum, and code division multiple access communications. Faculty and student efforts in this area are lead by Dr. Glenn Prescott.

(See Research Laboratories section for further information on research in these technical areas.)

Affiliated Labs

In addition to the four technical areas named above, ITTC is affiliated with two other KU research laboratories: DesignLab, and the Radar Systems and Remote Sensing Laboratory (RSL). Faculty associated with both DesignLab and RSL work with ITTC when faculty interests overlap.

Organization

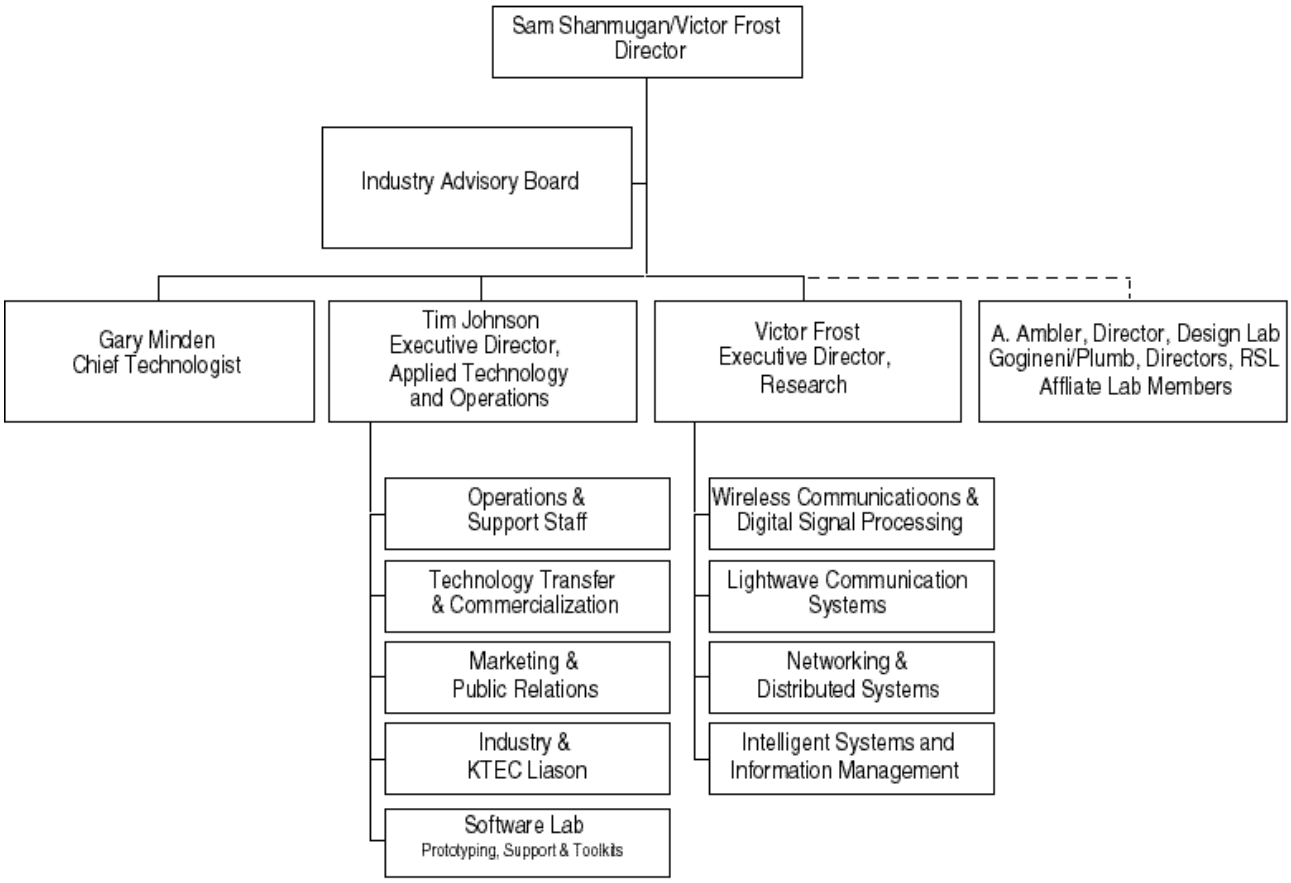
ITTC was built upon the related efforts and strengths of the University faculty, staff, and students and continually seeks opportunities to leverage the Center's expertise with industry and Federal agencies.

ITTC is composed of approximately fourteen staff, twenty-three faculty, and over one hundred students. (See Affiliated Faculty and Staff sections.)

ITTC has a new Advisory Board for FY98. Members are leaders from nationally-known information and telecommunications companies. (See Advisory Board listing on page 49.)

As stated in the Director's column (page 3), during FY1998 Dr. James Roberts, Chair of the Electrical Engineering and Computer Science Department, became Associate Vice Chancellor for Research and Public Policy. Dr. K. Sam Shanmugan, original Director of ITTC, became Interim Department Chair of EECS, and Dr. Victor Frost became Acting Director for ITTC. These changes have had no adverse effect on ITTC, as they promoted supportive faculty into positions of higher authority where they continue to advocate our mission.

ITTC R/D&C Organization



FY1998 Accomplishments

ITTC had an exceptional year in attracting funding awards of over $5 million dollars. Likewise, FY1998 has been the Center's most successful year in terms of licensing revenue from the transfer of ITTC-developed technologies, generating $140,000. The success of ITTC in developing industry-driven technologies is also reflected in the continued strong financial support from Kansas Industry. ITTC continues to work with Kansas companies on technologies and activities that have potential for significant and sustainable economic benefit to Kansas.

The first quarter of FY1998 also saw the first convening of ITTC's reconstituted Advisory Board. This occurred in conjunction with the Center's first annual Technology Review Day. The second day was set aside for the Advisory Board meeting, where ITTC solicited feedback on establishing its future research efforts, stating its vision and mission, and improving its service to sponsors and clients in industry.

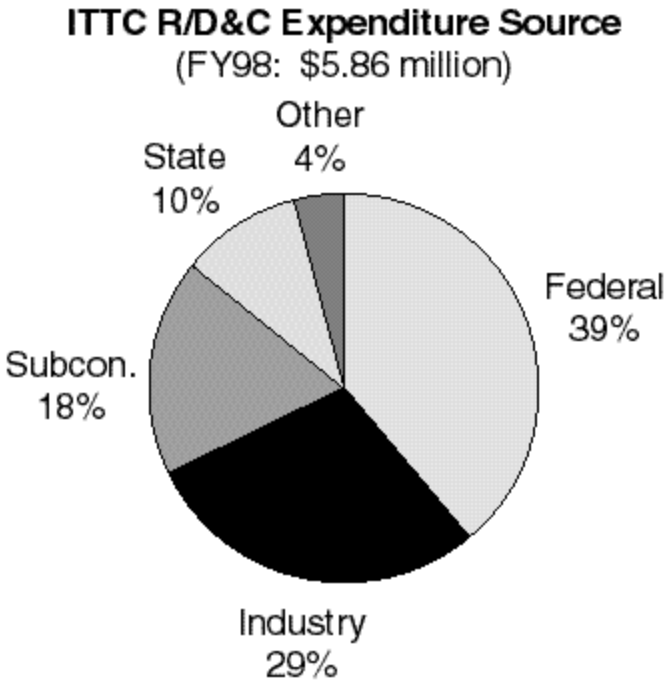
FY1998 Indicators

	Goal	Actual
R/D&C Industry Awards	$ 1,500,000	$ 1,842,561
R/D&C Federal Awards	$ 3,000,000	$ 2,688,623
R/D&C State Awards	$ 620,000	$ 689,000
Total R/D&C Awards	$ 5,120,000	$ 5,220,184
Technologies Commercialized-KS	4	1
License Fees/Royalties	$ 55,000	$ 140,000

(Where R/D&C is Research, Development, and Commercialization)

In addition to the strong industry activity this year, the research core of ITTC is very strong and continues to grow. ITTC has been very successful in partnering with local industry and other nationally recognized universities and agencies to obtain funds for key cutting-edge research projects in our core technology areas. ITTC has met the objective of obtaining $4.5 million in FY1998 leveraged R&D/C funds, with over a third of those funds from industry (primarily Kansas companies). During FY1998 ITTC received 26 project awards from Federal and industry sources totaling $4.53 million. Of the 26 awards 11 were "new project" proposal awards and 15 were for continuation of existing projects.

In total for FY1998 ITTC has had 54 active projects and helped 14 Kansas companies; MAMTC (Mid-America Manufacturing Technology Center, whose funding by Kansas Technology Enterprise Corporation—KTEC—is channeled through ITTC) has had 24 technical assistance projects and assisted an estimated 70 companies.



Future Directions

Information technologies can enhance Kansas residents' quality of life with improvements in living conditions and high-wage jobs and can vitalize the economy for all citizens as the Information Age enters the new millennium.

Our goals include

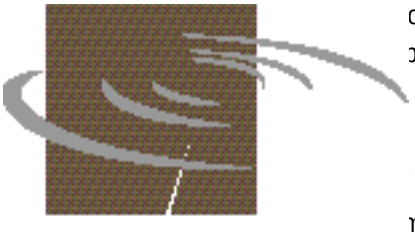
- Advancing the state of the art in telecommunications and information technologies by conducting basic and applied research,
- Satisfying the need for telecommunications and information technology professionals by training undergraduate and graduate students in IT,
- Providing a point of focus for expertise in all IT-related research,
- Developing commercial-grade IT technologies,
- Transferring technologies developed to industry,
- Helping companies use appropriate IT technologies to their benefit,
- Serving as a State resource for applications of IT to improve the quality of life for Kansans,
- Establishing an Industrial Affiliates Program,
- Diversifying ITTC's funding base for IT research and development, and
- Growing from a $6 million to a $10 million world-class IT center.

Currently over 100 students are actively working within ITTC enhancing their education while providing a valuable resource to ITTC and the State. Within this environment, ITTC excels in attracting funding, conducting leading-edge research, and developing and transferring useful technologies. However, IT clearly presents distinct opportunities for continued significant growth. ITTC is expanding its influence by developing and delivering Information and Telecommunication technologies for the benefit the State of Kansas, the Midwest region, and the Nation.

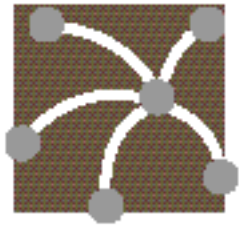
RESEARCH LABORATORIES

Overview

ITTC is structured to focus on information and communication technologies. The productivity of information workers is significantly enhanced by advances in communications, computer, and information technology. Focusing on advancing the state of the art in telecommunications and information sciences will speed the evolution

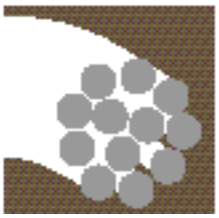


ormation-based economy and society. The information infrastructure is composed of
bitways, services, and applications. Bitways carry information in the form of analog or digital
signals. Generic services—e.g., voice, data and video—are supported by bitways, while
applications are constructed using communications services. Research in ITTC has been
span all aspects of the information infrastructure.



ment of future bitways for the information infrastructure is occurring in ITTC's Wireless and
l Processing and Lightwave Communication Laboratories. Fundamental research in the
t of all-digital radios and advanced wireless systems is supported by the Department of
D) Advanced Research Projects Agency (ARPA), the US Air Force, and others, to develop
tems that take advantage of the Center's expertise in networks, digital radios, propagation,
ling, and antennas. The Lightwave Communication Laboratory is using support from Sprint,
and Lucent Technologies to focus research in lightwave communications systems. The
hese investigations is to identify and investigate the issues necessary to integrate high-
onic and lightwave devices to support leading-edge communications services. The
on how to migrate from the existing network to a system that dynamically uses lightwave
provide optimal information transport for a variety of services. Research is addressing how
the capability offered by optical communications with techniques such as wavelength-
tiplexing (WDM), solitons, and coherent modulation. These methods offer viable
to utilizing the 25,000 billion bits /sec capacity of a single fiber.

king and Distributed Systems Laboratory is conducting several multi-year projects to develop
s to control and manage communications networks, including signaling and test facilities.
forts are also directed toward evaluating the performance of high-speed, wide-area
ing theoretical analysis, measurements, and simulation. A hardware infrastructure to
arch in advanced high-speed networking exists within ITTC. Using these facilities, the
olved in three national scale networking testbeds. The Multidimensional Applications and
network Consortium (MAGIC), will continue to investigate issues associated with distributed
nd communications over wide-area, high-speed networks. The ACTS ATM Internetwork is a



testbed connecting eight DoD sites by terrestrial fiber and the other sites via a 622 Mb/s satellite link. The satellite earth station is connected to MAGIC and is located at Sprint in Overland Park, Kansas. The SPrint Applied Research parTners Advanced Network (SPARTAN) is an ATM testbed between research institutions including Digital, SRI, Xerox, and the Sprint Advanced Technology Laboratory in the San Francisco Bay area.

The Center's Intelligent Systems and Information Management Laboratory is involved in research on advanced network-based applications as well as information retrieval, analysis, and fusion. Access and database technologies, developed in conjunction with faculty in the School of Education, allowed kindergarten through twelfth grade school teachers to share material. The data base is located in ITTC facilities, and the access technology is in use by over 100 schools. ITTC researchers have also developed digital video library technology, which improves the usability of such libraries by allowing direct, easy access to vast quantities of information. An advanced information retrieval system for the Internet has also been a result of the research conducted by the Intelligent Systems and Information Management Laboratory.

The synergy of research efforts in ITTC's research laboratories is producing advances in information and communication technologies.

Laboratory Facilities

ITTC employs state-of-the-art facilities to perform the research and development of technologies that will form the next generation of communications systems. These facilities include a high-speed networking lab with a 2.4 Gb/s SONET connection; DSP and digital radio lab; integrated, diverse networking environment; and a leading-edge lightwave research lab. Complementing the hardware facilities, the Center uses some of the best-in-class design and development tools, such as BONeS Designer® and Signal Processing Workstation (SPW).

As much of the work which ITTC does requires the development of new software, ITTC uses CORBA, C++, Java, and Lisp among others, to ensure that we use industry-established solutions to smooth the technology transfer process.

ITTC facilities are categorized into four research areas, described in more detail below. In addition to the research function of the Center, great emphasis is placed on realizing the commercial potential of the technologies and expertise developed. Therefore, many of the software and hardware facilities that are in use in research are also used in the technology transfer function of the Center.

Intelligent Systems and Information Management (ISIM)

Multiagent Development Tools : CORBA, C++, ACCS.
Information Retrieval and Web Tools: KUIR Information Retrieval Library.
Data Mining Tools: SNOB, Cobweb, ID3, C4.5, statistical analysis packages.
Artificial Intelligence Development Tools and Languages: Lisp, CLOS, CLIPS, Prolog, GBB, OPS, MEM-1.
Image Processing and Computer Vision Tools: KUIM Image Processing Library.

Lightwave Communication Systems (LCS)

The Lightwave Laboratory is equipped with modern lightwave equipment: 12Gb/s BERT; optical spectrum analyzer; OTDR; tunable source and filters; modulators; photodetectors; polarization analyzer; etc.

Commercial WDM (multiple wavelengths carrying 2.4 Gb/s per wavelength) systems (complete with 360 km of fiber), have been installed for systems level testing.

Networking and Distributed Systems (NDS)

Extensive high-speed networking infrastructure: connected to high-speed wide area networks; MAGIC backbone connection at 2.4 Gb/s; AAI testbeds for coast-to-coast experimentation; wide variety of switches and network interfaces.

Hardware and software design experience: developed 622 Mb/s ATM switch hardware, network testing and measurement tools, network simulation and modeling tools, early web applications and servers; integrated wireless, mobile systems with fixed networks.

Software tools: BONeS Designer®, SPW.

Wireless Communications and Digital Signal Processing (WDSP)

To enable the rapid development of leading-edge technologies, the Wireless Communications and DSP Lab uses high-speed oscilloscopes, arbitrary function generators, Sun workstations, logic analyzers, network analyzers, spectrum analyzers, field programmable circuit cards (APTIX), a DSP rapid prototyping system, a variety of DSP platforms and evaluation boards, and an IS-95 CDMA facility.

Intelligent Systems and Information Management (ISIM) Laboratory

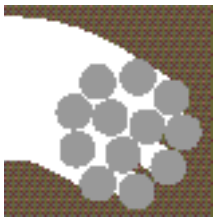
The Intelligent Systems and Information Management Laboratory (ISIML) studies theoretical and application issues of artificial intelligence, intelligent agents, information retrieval from distributed and heterogeneous sources, and data mining. Most of our applications are related to information retrieval, presentation, and management.

Researchers in the ISIML work on theoretical and practical issues of the automatic characterization of the contents of information sources, intelligent query routing, softbots, information fusion and visualization, video indexing, discovery of knowledge in very large databases, learning of user profiles, collaborative patterns of information-seeking agents, and anticipation of the user's information needs in a dynamic, distributed-data environment.

Principal areas of concentration are artificial intelligence, information retrieval, intelligent agents, data mining, digital and video libraries, knowledge-based systems, information presentation, and image processing and computer vision. The resources available to this Lab include multiagent development tools (CORBA, C++, ACCS), information retrieval and Web tools (KUIR Information Retrieval Library), data mining tools (SNOB, Cobweb, ID3, C4.5, statistical analysis packages), artificial intelligence development tools and languages (Lisp, CLOS, CLIPS, Prolog, GBB, OPS, MEM-1), and image processing and computer vision tools (KUIM Image Processing Library).

In 1997 the ISIML started participating in a large DARPA project in agent-based information dissemination, spun off a small company to market Web search tools, and licensed a content-based video-indexing and retrieval tool to industry. Future work includes a new NSF program to investigate cooperative agents for conceptual search of the Web, a new NRL program to analyze satellite images, and increased interactions with industry—including Sprint and Lucent, where some of the ISIML students spent summer internships.

Lightwave Communication Systems (LCS) Laboratory



The mission of the Lightwave Communication Systems Laboratory (LCSL) is to explore new lightwave technologies and determine their impact on future optical communication networks.

These lightwave technologies are examined from two points of view. The first is the photonic properties of lightwave technologies, including issues such as performance, cost, and reliability. The second is the impact of these technologies on network flexibility and protocols of existing optical networks. By merging these two points of view, the LCSL evaluates these new technologies for total network performance, including both the hardware and networking aspects of these systems.

The LCSL boasts a state-of-the-art measurement facility that is capable of examining device and network characteristics of optical components and networks. It also contains an analytical modeling facility, capable of performing numerical component and network performance studies. Technologies that are currently under investigation by the LCSL include wavelength division mutiplexing (WDM); high-speed, time-domain multiplexing (TDM); photonic switching; rate-independent all-optical clock recovery; PMD compensation; and link quality monitoring.

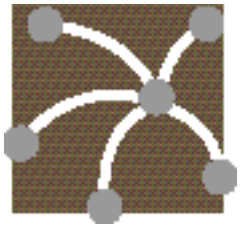
The principal areas of concentration are lightwave systems, wavelength division multiplexing (WDM), performance prediction of lightwave systems, solitons, and polarization-mode dispersion (PMD).

The LCSL is equipped with modern lightwave equipment: 12Gb/s BERT, optical spectrum analyzer, OTDR, tunable sources and filters, modulators, photodetectors, polarization analyzer, etc. In addition, two commercial WDM systems (complete with 360 km of fiber) have been installed for systems-level testing.

Recent accomplishments include fiber-link simulation software capable of modeling all major fiber non-linearities and polarization characteristics and demonstration of a robust all-optical bit-rate independent clock recovery system.

Near-term future activities will focus on increasing the capacity utilization of long-distance lightwave communications networks through a variety of schemes, and evaluating the impact of these approaches on network robustness. We envision longer-term activities to focus on all optical network architectures and related issues. Given the rapid rate of development in this flourishing field, the future, while uncertain, will definitely be exciting.

Networking and Distributed Systems (NDS) Laboratory



The Networking & Distributed Systems Laboratory (NDSL) performs research on innovative high-performance networks and systems with a particular emphasis on the areas of performance measurement, modeling, and improvement; network control and signaling; and integration of lightwave and wireless technologies into systems. The NDSL engages in experimental studies, enabled by its unique interconnection to several wide-area testbeds, as well as analytical and simulation work on the behavior of networks and systems, focusing on performance and scalability issues. Work on the control of networks includes the development of active networks, off-board signaling platforms, and other innovative control and signaling architectures. With the support of other ITTC laboratories, NDSL develops strategies and implementations for the integration of both lightwave and wireless technologies into system-level solutions. In the course of NDSL investigations, both hardware and software implementations are developed, designed, and tested in prototype networks.

The principal areas of concentration are distributed performance measurement and modeling (tools, analysis techniques, simulation models, and accurate performance prediction), network control and management systems (self-configuring networks, signaling systems, and protocols), integration of wireless networks (architectures and protocols, reliability and robustness, and ubiquitous and ad-hoc systems), high-capacity network systems (study, implementation, and integration of multiple network types at multiple levels; and integration of optical networking systems), and distributed network services (active networking, routing, quality of service, and management and control functions).

The resources available to the NDSL include (1) extensive, high-speed networking infrastructure (connected to high-speed, wide-area networks); (2) MAGIC backbone connection at 2.4 Gb/s; (3) AAI testbeds for coast-to-coast experimentation; (4) a wide variety of routers, switches and network interfaces; (5) hardware and software design experience, with significant locally developed systems such as 622 Mb/s ATM switch hardware, network testing and measurement tools, network simulation and modeling tools, and early Web applications and servers; (6) working experience with numerous systems such as integrated wireless mobile systems with fixed networks; and (7) working experience with numerous tools such as BONeS Designer® and SPW.

Recent activities have included demonstrations of active networking techniques for wired/wireless internetworking as part of the the DARPA MAGIC-II program. Other accomplishments include the public release of enhanced versions of the NetSpec performance testing tool, which was originally developed for use on the AAI testbed. NetSpec was also integrated into the MAGIC-II distributed systems environment for prediction of high performance network paths for terrain data retrieval from storage. The performance of TCP/IP over ATM networks, including the NASA ACTS satellite as well as fiber components, was experimentally measured and compared to simulation models. Protocols for quality-of-service support in rapidly mobile wireless networks have been studied and development begun. Network control issues, including architectures for off-board control of network elements, have been extensively studied and prototypes developed. Models for the pricing of network services were also studied.

Continuing work includes the DARPA-funded MAGIC-II program, which involves the integration of wireless systems into the MAGIC gigabit testbed environment using active networks techniques. Other continuing efforts include the integration of optical systems into flexible network architectures, development of quality-of-service control techniques in mobile networks, and experimentation and measurement with flexible network element control entities called switchlets. New work includes an experimental study of quality-of-service techniques in IP and ATM networks, the integration of broadband wireless local loop technologies into traditional carrier networks, and studies of signaling and control in new voice trunking networks based on AAL2.

Wireless Communications and Digital Signal Processing (WDSP) Laboratory

The mission of the Wireless Communications and DSP Laboratory is to advance fundamental knowledge in the area of wireless radio through investigation and ıentation of digital communication systems using state-of-the-art radio-requency (RF) and DSP technology.

ireless and DSP Lab is established to serve as a focal point for collaborative ch on wireless communications and the innovative application of signal processing technology to wireless radio and radar. The emphasis of this Laboratory is on the actual implementation, testing, and measurement of wireless communication systems and components. The goal of the Laboratory is to become a center of excellence in the design and implementation of radio and high-speed digital communications systems in order to serve as a resource to support researchers who are investigating fundamental issues in communications and information theory. The Lab's objective is to develop and maintain an expertise in RF and high-speed digital design, and the application of advanced DSP technology to the implementation of wireless radio systems.

The principal areas of concentration are software radio systems, radio system implementation (analog and digital), RF system design, communication and radar applications of DSP, smart antennas, communication system simulation and analysis, spread spectrum systems (commercial and military), wireless CDMA, and FPGA applications for DSP.

The resources available to this Lab include an array of state-of-the-art RF test equipment, including high-speed oscilloscopes, arbitrary waveform generators, computer workstations, logic analyzers, network analyzers, and spectrum analyzers. We also have the hardware and software necessary to design special purpose digital hardware, such as Field Programmable Circuit Cards, a DSP Rapid Prototyping System, and a variety of DSP platforms and evaluation boards. Numerous software development tools are also available, including PC board development systems, simulation and mathematical computation software, and RF development software systems.

Since the Laboratory was founded in early 1997, we have completed implementation and testing of both a 1.2 GHz software radio receiver system and a digital beamforming transmitter system in support of the DARPA funded Rapidly Deployable Radio Network (RDRN) Program. We have also completed design and implementation of high-speed digital radio signal processing algorithms on field-programmable gate arrays. Future work includes a new DARPA-funded program investigating adaptive computing systems. This program will require us to investigate and implement real-time DSP processors using field-programmable hardware. We also are currently developing an RF channel simulator for indoor wireless communication systems.

TECHNOLOGY TRANSFER

ITTC continues to emphasize its technology transfer activities. The Center's staff help transfer the technologies developed within ITTC from the University to the commercial sector. During FY1998, ITTC has licensed one technology and generated approximately $140,000 in licensing revenue to the University. Most ITTC licenses are awarded to Kansas entities, and it remains a goal to keep technology within the State. Most projects involve cooperative development and investment by both ITTC and a business.

Last year's (FY1997) extraordinary success in transferring and licensing technologies to Kansas companies has led to FY1998's being a year in which we were busy reloading the pipeline with new opportunities. As most of our projects are long-term efforts, it is not surprising that FY1998 was a year of new projects which point to a promising future.

New technologies come from various opportunities:

- industry or federally sponsored research agreements,
- direct company assistance,
- research and ideas with commercial potential from KU faculty, staff, and students.

These opportunities are supported by KU's Center for Research, Incorporated (CRINC), a foundation that manages the University's sponsored research and license agreements. ITTC-developed technologies frequently produce a license agreement with a company. These agreements often include sponsored research support, cost sharing, royalty arrangements, or sometimes equity positions. Each technology is managed to find the best "win-win" solutions for those involved.

FY98 Highlights

ITTC held its first technology review day consisting of presentations and a tour of ITTC. Members of the local and statewide information technology and telecommunications industries, in addition to the new advisory board members, were invited to attend the technology review day presented by the members of the ITTC Executive Committee, ITTC lab directors, and ITTC-affiliated faculty.

ITTC completed an extensive redesign of its Web pages [http://www.ittc.ukans.edu]. The revision provides detailed information for both users inside the University and outside for our readers, covering how technology transfer works at ITTC. Helpful and useful Web pages introduce the Center to the rest of the world.

Phoenix: Phoenix is an Internet/intranet product that allows users to have concurrent secure access to a database. It will help solve management problems in tracking intellectual property (IP). Phoenix has been jointly developed by ITTC, KU, KIC, and HBC. It has the potential to compete in the national marketplace of databases for IP management, and an initial version will be ready for testing during FY1999.

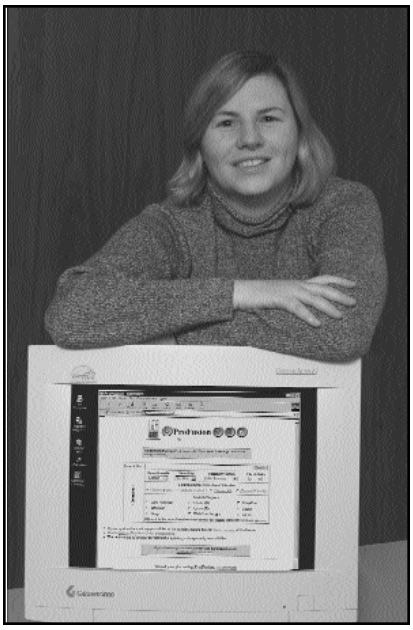
ProFilter (Personalized Information Discovery and Visualization): ProFilter will allow users to automatically create a personal (or company-wide) collection of useful information collected from the Web. The personal agent collects a subset of Web pages defined by the pages' location and content. Intelligent filtering of results, to remove irrelevant documents, has been implemented. This technology will be licensed to a Kansas company in FY1999.

VISION: This project was successfully licensed in FY1997. Further technology development has occurred with the licensing company funding the new development projects in ITTC.

ProFusion: *PC Magazine* Editors' Choice for Web Metasearch Engine

ProFusion, a product developed at ITTC, has won *PC Magazine's* December 1997 Editor's Choice Award for "Best Advanced Meta-Search Engine." Profusion, first released for public use in 1995, is the work of Dr. Susan Gauch, Assistant Professor, Department of Electrical Engineering and Computer Science (EECS), and research assistants Tapash Majumder, Yizhong Fan, and Guijun Wang. The product underwent various upgrades before being licensed to a resulting Kansas start-up company, ProFusion, LLC.

ProFusion is an intelligent Internet metasearch agent that sends user queries to multiple underlying search engines in parallel and merges the results. According to PC Magazine, "With an intelligent search strategy, helpful hints for targeting queries, and an invaluable personalized search service, Profusion offers the best metasearching around. …(it) easily handles simple queries, and a host of options and customizations let you find even the most evasive Internet information."



Dr. Susan Gauch, creator of award-winning Internet metasearch agent, ProFusion

The program supports nine search engines, allows an individual to manually pick the search engines (up to and including all nine), or allows the program to automatically pick the best three search engines. In addition, ProFusion's personalized search service allows an individual to register regular queries, lets ProFusion run them periodically, and sends notification with new results.

ProFusion eliminates duplicates and creates a single list of URLs, ranked in descending order of match, to the searched word(s) or phrase(s). ProFusion incorporates intelligent features for automatically selecting the best search engines for each query, automatically evaluating the quality of results provided by search engines, and sophisticated post-processing to produce high quality results. Queries can also be registered for automatic topic tracking.

What distinguishes ProFusion from other metasearch engines is its use of query categorization to identify the best sources for individual queries, its use of adaptive agents to continuously update its knowledge of the quality and speed of the underlying search engines, and its ability to allow users to track topics of interest over time. These features allow ProFusion to provide very high-quality search results.

ProFusion is only one example of ITTC's excellence in basic research, technology development and transfer of viable telecommunication and information technology through the support of the Kansas Technology Enterprise Corporation (KTEC).

EXECUTIVE STAFF

K. Sam Shanmugan
Director, 1997

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

From 1970 to 1973 Dr. Shanmugan was as a Postdoctoral Fellow at Oklahoma State University, Stillwater, and the University of Kansas Center for Research, Inc., Lawrence, Kansas, where he worked on problems in pattern recognition, image processing and modeling, and analysis of communications systems. From 1973 to 1978, he was with the Department of Electrical Engineering at Wichita State University, Wichita, Kansas, where he taught and conducted research in systems theory, communication systems, and image processing. From 1978 to 1980 he was a Visiting Scientist at Bell Laboratories, Holmdel, NJ, where he worked on problems in the modeling and analysis of satellite communication systems. Dr. Shanmugan joined the faculty of the University of Kansas in 1980, where he is currently the Southwestern Bell Distinguished Professor of Electrical and Computer Engineering and also Acting Chairman of the Department. He served as Director of ITTC from autumn of 1996 until January 1, 1998, when he accepted the EECS Department Acting Chairmanship. His current interests are in the areas of wireless communications and computer-aided modeling and analysis of communication systems. Dr. Shanmugan has published a number of articles in the above areas and is the author of three books: Digital and Analog Communication Systems (Wiley, 1979), Random Signals: Detection Estimation and Data Analysis (Wiley, 1988), and Simulation of Communication Systems (Plenum Press, 1992).

From 1985 to 1995 Dr. Shanmugan also served in a number of leadership positions in the industry: as President of STA*R Corporation (1985-88), Senior Vice President of Comdisco Systems (1988-93), General Manager of the Alta Group of Cadence Design Systems (1984-85), and Chief Technical Officer of Systems and Networks. During this time he led the development and commercialization of modeling and simulation software for the design of communication systems (BOSS-Block Oriented Systems Simulator) and networks (BONeS-Block Oriented Network Simulator).

Dr. Shanmugan is a Fellow of the IEEE. He was an Editor of the IEEE Transactions on Communications, chaired the first IEEE workshop on Computer-Aided Modeling and Analysis of Communications Systems, and served as the Chairman of the IEEE Communications Society's Subcommittee on Computer-Aided Modeling, Analysis and Design of Communication Systems. He received the Outstanding Young Engineering Faculty Award in 1979 from the Society of Automotive Engineers. Dr. Shanmugan also received the Henry E. Gould, the AMOCO Foundation, and the Burlington Northern Awards for Outstanding Teaching, and the Higuchi Award for Outstanding Research from the University of Kansas.

(See also Dr. Shanmugan's listing in the Affiliated Faculty section.)

Victor S. Frost
Executive Director for Research;
Acting Director, January 1998 - Present

Victor S. Frost is Executive Director for Research at ITTC, and also ITTC's Acting Director since January 1998. Dr. Frost has been involved in research for numerous corporations, including Sprint, NCR, BNR, NEC, Telesat Canada, AT&T, McDonnell Douglas, DEC, and COMDISCO Systems. His research has also been sponsored by government agencies, including, NSF, DARPA, Rome Labs, and NASA. From 1987 to 1996 Dr. Frost was Director of the Telecommunications and Information Sciences Laboratory (TISL). He has published over 38 journal articles. He has served as a Guest Editor for the IEEE Communications Magazine (March 1994 and August 1997) and the IEEE Journal on Selected Areas in Communications (May 1995) and is currently 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, communications system analysis, and simulation. He is currently involved in research on the MAGIC and AAI high-speed, wide-area testbeds.

Dr. Frost received a Presidential Young Investigator Award from the National Science Foundation in 1984, an Air Force Summer Faculty Fellowship, a Ralph R. Teetor Educational Award from the Society of Automotive Engineers, and the Miller Professional Development Awards for Engineering Research and Service in 1986 and 1991, respectively. He is a member of Eta Kappa Nu and Tau Beta Pi and an IEEE Fellow. He served as Chairman of the Kansas City section of the IEEE Communications Society from June 1991 to December 1992. He has also 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 the University of Kansas Center for Research Inc. and the Self Fellowship program.

Dr. Frost received the B.S., M.S., and Ph.D. degrees from the University of Kansas, Lawrence in 1977, 1978, and 1982, respectively. In 1982 he joined the faculty of the University of Kansas, where he is currently the Dan F. Servey Distinguished Professor of Electrical Engineering and Computer Science.

(See also Dr. Frost's listing in the Affiliated Faculty section.)

Tim Johnson
Executive Director for Operations and Applied Technology

Timouthy W. Johnson received the B.S. from Memphis State University in 1982 and the M.S. in 1985 and passed the Ph.D. Preliminary Exam in 1987 while attending Kansas State University—all in electrical engineering.

Mr. Johnson has over fourteen years of experience in the management and design of engineering and software projects. He has conducted, presented, and supervised research in communications and digital signal processing during the last ten years, resulting in four refereed journal publications, over ten presentations, and ten technical articles and reports. In 1982 and 1983 Mr. Johnson was a Senior Associate Division Engineer for Distribution Systems with the Kansas Power and Light Co. in Topeka, Kansas, where his duties included the field supervision of projects. While obtaining his Master's degree (1984 to 1985), Mr. Johnson taught undergraduate electrical engineering lecture courses and was a lab instructor, lab assistant, and academic advisor. In 1986 Mr. Johnson was an Engineer performing defense satellite communication system research for Computer Sciences Corporation in Falls Church, VA. His work emphasized performance estimates for spread spectrum systems. From 1986 to 1989, Mr. Johnson was an instructor of Electrical Engineering at Kansas State University in Manhattan, Kansas, while working towards a Ph.D. He worked for several years on funded research for Motorola, Inc., Government Electronics Group. He conducted research, taught engineering courses, and was an academic advisor. From 1989 to 1990, Mr. Johnson was an Assistant Professor of Electrical Engineering at the University of Wyoming in Laramie, WY. There Mr. Johnson conducted signal processing research, supervised MS graduate students, and taught engineering courses. He was also the faculty advisor for the IEEE student branch that was the Denver Section Student Branch of the Year.

In August 1991, Mr. Johnson joined the Center for Excellence in Computer-Aided Systems Engineering (CECASE) at the University of Kansas, where, until November 1993, he was an Associate Research Engineer who supervised research and commercialization efforts. His duties included supervision and operation of the Rapid Prototyping Facility for DSP and communications. He also provided assistance and consultation to the Kansas business community. Mr. Johnson later became the Associate Director of CECASE from December 1993 to August 1996, and was responsible for management of internal Center operations. He served as the Executive Director of CECASE from September 1996 until formation of the Information and Telecommunication Technology Center (ITTC) in December 1996. In addition, from November 1994 to September 1996, Mr. Johnson was a Vice President of Lawrence Applied Research Corporation (LARC) in Lawrence, KS. LARC performs research, development, and education in communications systems design and performance, communications engineering, information systems engineering, and DSP. In addition, Mr. Johnson is a member of the Board of Directors of Data Discovery, Inc. (DDI) of Overland Park, KS. DDI was founded to automate information discovery.

Mr. Johnson also serves on the Kansas Innovation Center's (KIC) Operations committee, Silicon Prairie's Information Technology committee, and KTEC's Telecommunication committee. Mr. Johnson is an IEEE member whose professional memberships include the Order of the Engineer, IEEE Communications Society, IEEE Signal Processing Society, IEEE Engineering Management Society and the IEEE Computer Society.

Gary J. Minden
Chief Technologist

Gary J. Minden is Chief Technologist for ITTC, and Professor of Electrical and Computer Engineering at KU. He received the B.S.E.E. degree in 1973 and the Ph.D. degree in 1982, both from the University of Kansas.

From 1971 through 1978 Dr. Minden was a Research Engineer at the University of Kansas Center for Research, Inc. During that period he worked on problems in the areas of image processing systems, multi-processor computer systems, and general systems theory. From 1978 to 1980 he was a Vice President of CHILD, Inc., where he was a co-designer of the LIGHT-50 computer graphic terminal. In August of 1981 he joined the University of Kansas Department of Electrical Engineering as an Assistant Professor. During 1983-1989 he lead the implementation of a new Computer Engineering degree program within the Electrical and Computer Engineering Department.

In 1991 Dr. Minden completed a sabbatical at Digital's System Research Center, working on gigabit local area networks. He is a Principal Investigator on the MAGIC gigabit testbed and the Rapidly Deployable Radio Network (RDRN) 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.

Dr. Minden's research interests are in the area of large-scale distributed systems, which encompasses high performance networks, computing systems, and distributed software systems. Dr. Minden is a member of the Institute of Electrical and Electronic Engineers and the Association of Computing Machinery.

(See also Dr. Minden's listing in the Affiliated Faculty section.)

OPERATIONS & APPLIED TECHNOLOGY STAFF

Cathy Ambler, Assistant Director for Technology Transfer

Cathy Ambler worked with ITTC from the time KTEC funded it as CECASE in 1989, through FY98. She assisted Director Julian Holtzman during the Center's start-up years and was later in charge of Technology Transfer for ITTC, assisting the University's engineering faculty and staff in identifying research projects and ideas that might be useful in the commercial or public sector, and working out legalities and contract terms with client companies and University legal staff. A clear conviction of the potential benefits to both University and industy, from cooperative mutual relationships, fueled her lookout for common ground in a "push" of technology out of the university and a "pull in" of technology needs from businesses.

Dr. Ambler has a Ph.D. in American Studies and a Master's in Museum Administration and has been active for many years in historic preservation. It was therefore a a natural progression that she move into her chosen field, by accepting the position of Assistant Director, Cultural Resources Division, with the Kansas Historical Society, Topeka, in August 1998. We miss her here at ITTC and wish her much success.

Juan Cuadra-Sola, Systems/Software Engineer

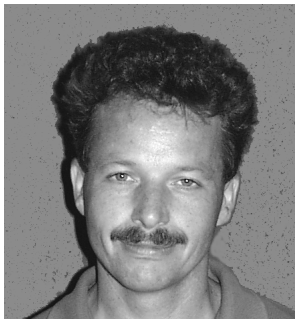
Juan joined the Center as a graduate student, working part time for CECASE as a system/network administrator. He received his BS degree in Computer Engineering from the University of Kansas in 1991, and his Master's degree in Electrical Engineering in May 1994. His Master's research focused on the application of artificial intelligence to automated design. On July 1, 1994, Juan became part of the Center's permanent staff as a system administrator and software engineer, heading the team which maintains and enhances all of the Center's computer and information systems. In July 1998, Juan, retaining his title as Systems/Software Engineer, moved up into software development at ITTC. Juan's main research interests include artificial intelligence, networking, and software engineering.

Janie Rutherford, Public Relations/Marketing Manager

Janie Rutherford joined ITTC in September 1997. She has been involved in promoting technology economic development in the State of Kansas for more than 10 years, as Director of Marketing for the Kansas Technology Enterprise Corporation (KTEC), Topeka (ITTC is a KTEC Center of Excellence). She holds a bachelor of science degree in journalism and mass communications from Kansas State University.

As Public Relations/Marketing Manager for the Center, Janie coordinates the publication of the Center's promotional materials, manages its media relations, and strives to enhance the Center's image with its various publics. She is also involved in identifying research projects or ideas that might have commercial value, and finding the companies to license those technologies developed at the Center.

Daniel DePardo, RF Electronics Engineer

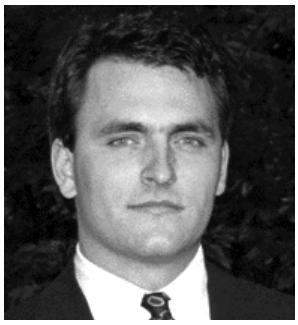


Dan joined the U.S. Army in 1979. He studied at the U.S. Army Intelligence Center, and graduated from the Aerial Surveillance Sensors School, in addition to studying electronic engineering at the University of Arizona. During his tours of duty, he was responsible for support of the various airborne surveillance systems and also provided technical support for the U.S. Army's Electronic Proving Ground, testing a variety of ECM (Electronic Counter Measure) systems. After discharge from the Military, Dan worked with a variety of defense electronics organizations and was deeply involved in the design of subassemblies of many currently operational weapons and detection systems. Dan came to Kansas as an engineering contractor; after the completion of the project, he accepted a position on the University of Kansas Electrical Engineering and Computer Science Department staff. Due to his involvement with the research efforts of the EECS faculty, Dan was invited to join ITTC, where his primary responsibility is to provide technical support for the ITTC Wireless Communications and Digital Signal Processing laboratories. Dan's specific areas of expertise include SAW delay line and filter design, photolithograpy techniques, clean room procedures, hybrid circuitry design, environmental testing techniques, Mil-spec soldering and assembly, surface mount component technology, RFI (radio frequency interference) and EMI (electro-magnetic interference) suppression techniques, and radio frequency and microwave components, circuitry, and systems. His current research interests include the RF electronic hardware section of the DARPA Rapidly Deployable Radio Network (RDRN) and the development of three-dimensional display technologies.

Mohan Kambhammettu, Assistant Research Engineer

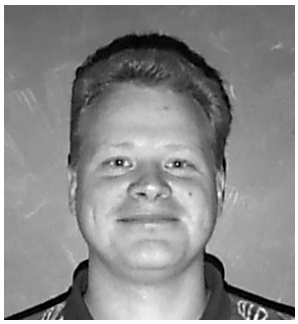
Mohan was a Research Engineer with ITTC from1995 (TISL days) through April 1998. His research interests include Wireless ATM Networks, Rapid Prototyping, Software Radios, and VHDL synthesis. At ITTC his projects included Rapidly Deployable Radio Network (RDRN) funded by the Information Technology Office (ITO) of the Advanced Research Projects Agency (ARPA), and Rapid Prototyping for DSP funded by the Rome Labs. Mohan received his M.S. degree in Electrical Engineering from KU in 1995; his thesis addressed the design and implementation of a real-time algorithm to correct radar signals for Remote Sensing Applications. In 1992 and 1993 Mohan was a software engineer developing application packages on VAX/VMS platform using SQL, DECFORMS, and COBOL at Larsen and Toubro Ltd., one of the top companies in India. He received his B.E. in Electronics and Communications Engineering from Anna University, Madras, India, in 1992. He is missed at ITTC and pursuing his career with Cadence Design Systems, Inc., in Sunnyvale, California.

Craig Sparks, Senior Wireless Project Engineer



Craig received his B.S.E.E. at the University of Kansas in Spring 1994 and his M.S.E.E. at KU two years later. His graduate work was in designing and building wireless radios in a project called Rapidly Deployable Radio Networks (RDRN). His areas of expertise include Radio Frequency (RF) and wireless digital communications system design. Craig then worked in the Wireless Local Area Network (WLAN) industry as an RF design engineer before returning to KU in June 1997 to take the position of Senior Project Engineer for the newly formed Information and Telecommunication Technology Center (ITTC). Craig is 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.

Scott Woodward, Systems Engineer



Scott Woodward received both his bachelor's and master's degrees in Electrical Engineering from the University of Kansas. He joined CECASE as an undergraduate/graduate student in 1992. After graduation in 1994, Scott became a full-time staff engineer with CECASE, concentrating on systems engineering research, requirements specification/systems design, and project management. After the CECASE-TISL merger which formed ITTC, he concentrated on project management and business development. Scott was with ITTC through July 1998, when he accepted a position with Accelerated Care Plus, Topeka. We feel very fortunate to have had Scott with us, and we wish him much success as he pursues his career.

ADMINISTRATIVE OFFICE STAFF

Peggy Williams, Secretary for Research

Peggy joined ITTC in March 1997 and is the ITTC secretarial office's key resource person for research-related documents and functions, including administration of ITTC's student researcher space and records. In the past she has held positions with the NSF EPSCoR program; Merck & Co., Inc.; CRINC administrative offices; and KU. Peggy's time outside ITTC is filled with raising her five young children.

Wendy Prescott, Student Office Assistant

Wendy joined CECASE in late December 1993 and currently fills the position of student assistant with ITTC. Her duties include assisting administrative staff in various clerical and data processing tasks. She has five years' past experience in administrative assistant duties at office supply stores. Wendy is a student at the University of Kansas, working toward her bachelor's degree in Geography.

Nancy Hanson, Office Mgr./Secretary for Operations

Nancy joined CECASE in January 1993 after several years as secretary with the Flight Research Laboratory at KU Center for Research, Inc. At ITTC she coordinates office procedures, handles purchasing records, and manages page-layout/ graphics/ copy editing functions for the Center. Nancy has a B.A. degree from Washburn University, Topeka, and major interests in languages, arts, and human interaction with the rest of nature.

POSTDOCTORAL RESEARCH ENGINEERS

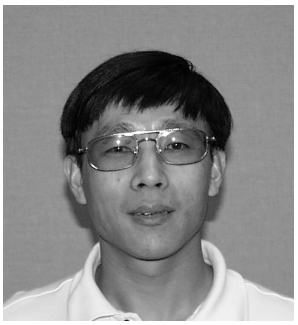
Vijay Peddanarappagari

Vijay has a Bachelor of Science degree in electronics and communication engineering from Osmania University, India. He completed the Master's and Ph.D. degrees in electrical engineering at the University of Virginia, Charlottesville, in 1993 and 1997, respectively. Sometime in late 1997, Vijay noticed an advertisement for ITTC; he followed up on it shortly thereafter, and it led him (in October) to one of the few postdoctoral positions nationwide with a lightwave communications laboratory. At ITTC Vijay is a research engineer, assisting students in their Master's thesis topics and coordinating work in the Lightwave Laboratory. He is interested in optical transmission systems and amplifiers and is pursuing design and analysis of multi-span wavelength division multiplexing (WDM) systems, with special attention to use of Erbium doped fiber amplifiers . Other research interests include modulation instability (parametric interaction between ASE and signals) in dense WDM systems, and evaluation and compensation of linear dispersion, fiber nonlinearities, and ASE noise. Upon completion of his postdoc work with ITTC, Vijay hopes to move into private industry and specialize in design.

Leen-Kiat Soh

Originally from Malaysia, Leen-Kiat came to the University of Kansas because his older siblings were attending classes here. After receiving a bachelor of science degree, with Highest Distinction, in electrical engineering, he studied for a master's and then a Ph.D. degree in electrical engineering. He received his Ph.D., with Honors, in the spring of 1998. Shortly afterward, he joined the team at ITTC as a research scientist, working with Associate Professor Costas Tsatsoulis in the Intelligent Systems and Intelligent Management Laboratory.

Leen-Kiat's doctoral thesis work focused on using image processing and machine learning methodologies to perform automated segmentation on satellite sea ice imagery. His research interests are data mining, image processing, computer vision, machine learning, and expert systems. When he eventually leaves ITTC, Leen-Kiat hopes to teach at the university level and continue to be involved in research. Currently, he is working with several faculty members on grant proposal writing in digital libraries, in addition to collaborating with researchers from other centers on sea ice classification.



Benyuan Zhu

An interest in optical fiber communications led Benyuan Zhu first from China to England and then from England to ITTC to continue his postdoctoral research, in February 1998. He received his bachelor's and master's degrees in physics from East China Normal University in Shanghai. Ben received his Ph.D. in opto-electronics from Bath University in Bath, England. He did post-doctoral research at Bath University and the University of Bristol in Bristol, England, as well.

At ITTC, Ben is doing research in the area of high-speed optical fiber communications systems. He has authored or co-authored more than 20 technical papers in leading international journals and conferences.

AFFILIATED FACULTY

Arvin Agah

Assistant Professor, Department of Electrical Engineering and Computer Science, The University of Kansas, Lawrence, Kansas, 1997-Present;

Visiting Lecturer, Department of Engineering Systems, University of Tsukuba, Tsukuba, Japan, 1996-1997;

Post-Doctoral Fellow, Bio-Robotics Division, Mechanical Engineering Laboratory, Tsukuba, Japan, 1995-1997;

Systems Analyst/Software Engineer, MIS Department, Ziffren, Brittenham, Branca & Fischer (Entertainment Law Firm), Century City, California, 1991-1995;

Research Assistant, Institute for Robotics and Intelligent Systems, University of Southern California, Los Angeles, California, 1991-1994;

Research Scientist, Los Angeles Scientific Center, IBM Corporation, Los Angeles, California, 1989-1990;

Research Scientist, Webster Research Center, Xerox Corporation, Rochester, New York, 1988-1988;

Instructor, Department of Computer Science, Purdue University, West Lafayette, Indiana, 1987-1988;

Instructor, Department of Mathematics and Computer Science, Mansfield Business School, Austin, Texas, 1986.

Education

Ph.D., Computer Science, University of Southern California, 1994.
M.S., Biomedical Engineering, University of Southern California, 1993.

M.S., Computer Science, Purdue University, 1988.

B.A. (Highest Honors), Computer Science, University of Texas at Austin, 1986.

Teaching

Robotics, Artificial Intelligence, Intelligent Agents, Software Engineering.

Research Interests

Human-robot interactions and service robots,
Human-computer interactions and intelligent multimedia interfaces,
Autonomous robots and tele-robotics,
Distributed robotics and multi-agent systems.

Recent Publications/Presentations

Arvin Agah, Kazuo Tanie, "Fuzzy Logic Controller Design Utilizing Multiple Contending Software Agents," accepted for *International Journal for Fuzzy Sets and Systems* (1998).

Arvin Agah, George A. Bekey, "Evolutionary Communication in Distributed Multi-Agent Systems," *Proceedings of The Seventh International Symposium on Robotics with Applications (ISORA'98)*, World Automation Congress (WAC'98), Anchorage, Alaska, May 1998.

Arvin Agah, Kazuo Tanie, "Robots Playing to Win: Evolutionary Soccer Strategies," *Proceedings of The 1997 IEEE International Conference on Robotics and Automation (ICRA'97)*, Albuquerque, New Mexico, Apr. 1997, pp. 632-637.

Arvin Agah, "Robots and Manufacturing Agents," Joseph Williams (Ed.), *Bots and Other Internet Beasties*, Sams.net Macmillan Computer Publishing, Indianapolis, Indiana, 1996, pp. 291-315.

Arvin Agah, George A. Bekey, "Phylogenetic and Ontogenetic Learning in a Colony of Interacting Robots," *Autonomous Robots Journal*, Vol. 4, 1997, pp. 85-100.

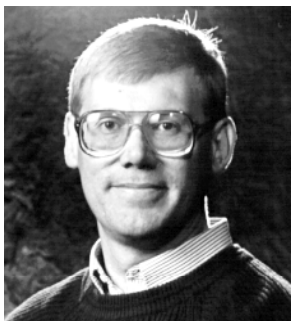
Professional Affiliations

American Society of Engineering Education (ASEE), American Institute of Aeronautics and Astronautics (AIAA), The Institute of Electrical and Electronics Engineers (IEEE), Association for Computing Machinery (ACM)

Honors and Awards

Marquis *Who is Who in Science and Technology, 1997-1998*; *Information Technology's Who is Who, 1997-1998*; Postdoctoral Fellowship, National Science Foundation (NSF), Mechanical Engineering Laboratory, Tsukuba, Japan, 1995-1997; Graduate Fellowship, Department of Computer Science, Purdue University,1987-1988; Highest Honors Graduation, Department of Computer Science, University of Texas at Austin, 1989.

Chris Allen



Assistant Professor, The University of Kansas, 1994–present;

Allied Signal, Kansas City, 1990-1994;

Sandia National Laboratories, New Mexico 1984-1990.

Education

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

Teaching

Circuits,
Electronic circuits,
Fiber optic communication systems,
High frequency circuit design.

Research Interests

High-speed digital technologies and applications,
Fiber optic communication systems,
Lightwave/photonics systems and devices,
Microwave remote sensing,
Synthetic aperture,
Radar design and analysis.

Recent Publications/Presentations

C.T. Allen, K. Shi, R.G. Plumb, "Characterization of a Cooperative Target for Ground-Penetrating Radar," *Proceedings of the 7th International Conference on Ground Penetrating Radar (GPR '98)*, Lawrence, Kansas, May 1998, pp. 561-565.

D. Dahl-Jensen, N.S. Gundestrup, K. Keller, S.J. Johnsen, S.P. Gogineni, C.T. Allen, T.S. Chuah, H. Miller, S. Kipfstuhl, E.D. Waddington, "A Search in North Greenland for a New Ice-Core Drill Site," *Journal of Glaciology*, Vol. 43, No. 144, 1997, pp. 300-306.

X. Fang, H. Ji, L. Pelz, K. Demarest, C. Allen, "A DC to Multigigabit/s Polarization-Independent Modulator Based on Sagnac Interferometer," *IEEE Journal of Lightwave Technology*, Vol. 15, No. 11, 1997, pp. 2166-2171.

S. Song, C. Allen, K. Demarest, L. Pelz, X. Fang, Y. Pua, "Experimental Study of Four-Wave Mixing in Non-Zero Dispersion Fiber," *IEEE Lasers and Electro-Optics Society 1997 Annual (LEOS '97)*, WAA2, San Francisco, CA, Vol. 2, Nov. 1997, pp. 224-225.

C. Allen, S. Gogineni, B. Wohletz, K. Jezek, T.S. Chuah, "Airborne Radio Echo Sounding of Outlet Glaciers in Greenland," *International Journal of Remote Sensing*, Vol. 18, No. 14, 1997, pp. 3103-3107.

Patents

G. S. Stump, C.T. Allen, "Trenchless Underground Boring System with Boring Tool Location," U.S. Patent Number 5,720,534, awarded Feb. 24, 1998.

Professional Affiliations

IEEE,
Silicon Prairie Information Technology Group.

Honors and Awards

Eta Kappa Nu,
Phi Kappa Phi,
Tau Beta Pi,
Harry Talley Excellence in Teaching Award (Apr. 1998),
Recognition for excellence in the classroom, by Center for Teaching Excellence (May 1998).

J. Michael Ashley

Assistant Professor, The University of Kansas, 1995—present;

Research Assistant, Indiana University, 1994-1995.

Education

Ph.D. in Computer Science, Indiana University, 1996
M.S. in Computer Science, Indiana University, 1992
A.B. in Computer Science (with high honors), Oberlin College, 1990

Teaching

Programming languages.

Research Interests

Programming language design and implementation.

Recent Publications/Presentations

Oscar Waddell, J. Michael Ashley, "Visualizing the Performance of Higher-Order Programs," *Proceedings of the ACM SIGPLAN/SIGSOFT Workshop on Program Analysis for Software Tools and Engineering*, 1998, pp. 75-82.

J. Michael Ashley, ed., *Proceedings of the 1998 Great Plains Programming Languages Workshop*, DesignLab Technical Report 1998-01, Apr. 1998.

J. Michael Ashley, "The Effectiveness of Flow Analysis for Inlining," *Proceedings of the 1997 ACM International Conference on Functional Programming*, 1997, pp. 99-111.

J. Michael Ashley, "A Practical and Flexible Flow Analysis for Higher-Order Programming Languages," *Proceedings of the 1996 ACM Symposium on Principles of Programming Languages*, 1996, pp. 184-194.

E. Hilsdale, J.M Ashley, R K. Dybvig, D.P. Friedman, "Compiler Construction Using Scheme," *Proceedings of the 1995 Conference on Functional Programming Languages in Education*, 1995, pp.251-267.

Swapan Chakrabarti

Associate Professor, The University of Kansas, 1992–present;

Assistant Professor, The University of Kansas, 1986–1992.

Education

Ph.D. in Electrical Engineering, University of Nebraska-Lincoln, 1986.
M.S. in Computational Physics, University of Nebraska-Lincoln, 1982.
M.Sc. in Physics and Electronics (specialization), Calcutta University, India, 1978.
B.Sc. in Physics, Honors, Calcutta University, India, 1976.

Teaching

Digital systems design,
Microcomputer applications,
Computer architecture,
Digital signal processing-I,
Neural networks and fuzzy systems.

Research Interests

Design of a true 3D display system,
Interpolating and computing artificial neural networks (ICANN) for high-speed computation of complex mathematical functions,
Signal and image processing using neural networks and fuzzy logic.

Recent Publications/Presentations

T. S. Chuah, S. Chakrabarti, P. Gogineni, "Neural Network Based Classification of SAR Scenes Using Spectral Information," *Special Issue of the Journal of Remote Sensing Reviews on KUREX-91*, Vol. 17, No. 1-4, 1998.

E. Setiawan, S. Chakrabarti, "Training an ANN for Synthesizing Surface Roughness of Varying Scales," *Proceedings of International Joint Conference on Neural Networks*, IEEE World Congress on Computational Intelligence, Anchorage, Alaska, May 4-9, 1998, pp. 832-836.

S. Svojanovsky, S. Chakrabarti, G. S. Wilson, M. Slavik, "Neural Network for Predicting the Anticancer Activity of Pharmaceutical Compunds," poster presentation (received "Best Poster" award), Research Forum of the University of Kansas School of Medicine-Wichita, Wichita, KS, Oct. 23, 1997.

Professional Affiliations

IEEE.

Honors and Awards

Honorary member, Golden Key National Honor Society, 1996;
Ned N. Fleming Teaching Award for Outstanding Classroom Teaching, 1992.

Kenneth R. Demarest

Professor, The University of Kansas, 1996–present;

Associate Professor, The University of Kansas, 1987–1996;

Assistant Professor, The University of Kansas, 1984–1987;

Assistant Professor, Lafayette College, 1979–1984;

NASA-ASEE Fellow, NASA Langley Research Center, 1983 and 1984;

Member of Technical Staff, Bell Telephone Laboratories, 1982.

Education

Ph.D., Ohio State University, 1980
M.S.E.E., Ohio State University, 1976.
B.S.E.E., John Brown University, 1974.

Teaching

Electromagnetics,
Fiber optic engineering,
Microwave systems,
Noise reduction in electrical systems,
Antennas,
Circuits.

Research Interests

Computational electromagnetic techniques,
Lightwave systems.

Recent Publications/Presentations

K. Demarest, *Engineering Electromagnetics*, Prentice Hall, 1998, 672 pages.

K. Demarest, "Waveguides", *Handbook of Electronics*, ed. J. Whitaker, CRC Press, 1996, pp. 259-268.

X. Fang, H. Ji, C.T. Allen, K. Demarest, L. Pelz, "A Compound High-Order Polarization-Independent Birefringence Filter Using Sagnac Interferometers," *IEEE Photonics Technology Letters*, Vol. 9, No. 4, 1997, pp. 458-460.

X. Fang, K. Demarest, H. Ji, C.T. Allen, L. Pelz, "A Sub-Nanosecond Polarization-Independent Tunable Filter/Wavelength Router Using a Sagnac Interferometer," accepted for *IEEE Photonics Technology Letters* (1997).

X. Fang, H. Ji, L. Pelz, K. Demarest, C.T. Allen, "A DC to Multigigabit/s Polarization-Independent Modulator Based on Sagnac Interferometer," *IEEE Journal of Lightwave Technology*, Vol. 15, No. 11, 1997, pp. 2166-2171.

Patents

L. Pelz, H. Ji, X. Fang, C. Allen, D. Demarest, V. Frost, "Method and Apparatus for Controlling an Optical Signal," patent application submitted to U.S. Patent Office, June 20, 1997.

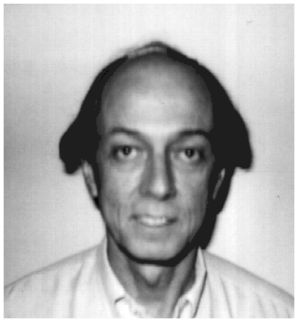
Professional Affiliations

Electromagnetic Fields (EMF) Advisory Committee, IEEE, Kansas Electric Utilities Research Program (KEURP), URSI Commission B.

Honors and Awards

Eta Kappa Nu.

Tyrone E. Duncan



Professor, Mathematics,
The University of Kansas, 1979-present;

Associate Professor, Mathematics,
The University of Kansas, 1974-1978;

Associate Professor, Applied Mathematics & Statistics, State University of New York, Stony Brook;

Assistant Professor, Aerospace Engineering, University of Michigan, 1967-1971;

Visiting Scholar & Research Fellow, Division of Applied Sciences, Harvard University, 1979-1980;

Gastprofessor, Institut fur Angewandte Mathematic und Informatik, Universitat Bonn, 1978-1979;

Consultant, RAND Corporation, 1964.

Education

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

Teaching

Stochastics of mathematical finance,
Stochastic analysis and its applications,
Stochastic adaptive control of linear partial differential equations,
Applied mathematics seminar,
Differential equations,
Probability theory.

Research Interests

Explicitly solvable stochastic control problems,
Stochastic control of distributed parameter systems,
Stochastic adaptive control of linear and nonlinear systems,
Mathematics of finance and stochastic modeling,
Mathematics and telecommunication,
Math education.

Recent Publications/Presentations

T. E. Duncan, B. Pasik-Duncan, L. Stettner, "Adaptive Control of a Partially Observed Discrete Time Markov Process," *Applied Mathematics and Optimization*, Vol. 37, 1998, pp. 269-293.

T. E. Duncan, B. Pasik-Duncan, L. Stettner, "Discretized Maximum Likelihood Estimates for Adaptive Control of Ergodic Markov Models," *SIAM Journal on Control & Optimization*, Vol. 36, 1998, pp. 422-446.

T. E. Duncan, B. Maslowski, and B. Pasik-Duncan, "Ergodic Boundary/Point Control of Stochastic Semilinear Systems," *SIAM Journal on Control & Optimization*, Vol. 36, 1998, pp. 1020-1047.

T. E. Duncan, "Identification and Control of a Stochastic Manufacturing System with Noisy Demand," *Lectures in Applied Mathematics*, Vol. 33, 1997, 83-88, American Mathematics Society.

T. E. Duncan, L. Guo and B. Pasik-Duncan, "Adaptive Continuous Time Linear Quadratic Gaussian Control," accepted for *IEEE Transactions on Automatic Control* (1998).

Professional Affiliations

American Mathematics Society,
Mathematics Association of America,
SIAM,
IEEE,
Sigma Xi.

Joseph B. Evans

Associate Professor, The University of Kansas, 1994–present;

Assistant Professor, The University of Kansas, 1989-1994;

Post-doctoral position, AT&T Bell Laboratories, 1988-1989.

Education

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

Teaching

Networking implementation,
DSP implementation,
Computer systems design I & II,
Integrated circuit design,
VLSI,
Electronics,
Programming,
Electrical engineering projects.

Research Interests

High speed (gigabit) networks,
Mobile and wireless systems,
Signal processing.

Recent Publications/Presentations

R. Sanchez, J. Evans, G. Minden, V. Frost, K. S. Shanmugan, "RDRN: A Prototype for a Rapidly Deployable Radio Network," *ACM Mobile Computing and Communications Review*, Vol. 2, No. 2, Apr. 1998, pp. 15-22.

F. Bennett, D. Clarke, J. Evans, A. Hopper, A. Jones, D. Leask, "Piconet-Embedded Mobile Networking," *IEEE Personal Communications*, Vol. 4, No. 5, Oct. 1997, pp. 8-15.

L. Dasilva, J. Evans, D. Niehaus, V. Frost, R. Jonkman, B. Lee, G. Lazarou, "ATM WAN Performance Tools, Experiments, and Results," *IEEE Communications Magazine*, Vol. 35, No. 8, Aug. 1997, pp. 118-125.

S. F. Bush, S. Jagannath, R. Sanchez, J.B. Evans, V. S. Frost, G. J. Minden, K. S. Shanmugan, "A Control and Management Network for Wireless ATMSystems," *ACM/Baltzer Wireless Information Networks (WINET) Journal*, Vol. 3, No. 4, July 1997, pp. 267-283.

S. Y. Cheng, J. B. Evans, "Implementation of Signal Power Estimation Methods," *IEEE Transactions on Circuits & Systems, II*, Vol. 44, No. 3, March 1997, pp. 240-250.

Professional Affiliations

ACM, ASEE,
IEEE (Circuits & Systems Society, DSP Technical Committee; Communications Society, Secretary; Gigabit Networking Technical Committee).

Honors and Awards

Eta Kappa Nu;
Tau Beta Pi;
Miller Award for Research, 1996;
AT&T Bell Laboratories Ph.D. Scholarship, 1984–1988;
Garden State Graduate Fellowship, 1983–1987.

Victor S. Frost

Dan F. Servey Distinguished Professor, The University of Kansas, 1997-present;

Professor, The University of Kansas, 1992–1997;

Acting Director, Information and Telecommunication Technology Center, 1998-present;

Executive Director for Research, Information and Telecommunication Technology Center, 1997;

Director, Telecommunication and Information Sciences Laboratory (TISL), 1987–1996;

Associate Professor, The University of Kansas, 1986–1992;

Associate Director, TISL, 1986–1987;

Assistant Professor, The University of Kansas, 1982–1986;

Member of Technical Staff at AT&T Information Systems Laboratory, Summer 1985;

United States Air Force Summer Faculty Fellow at Rome Labs;

Visiting Scientist, German Aerospace Research Establishment Institute for High Frequency, West Germany, 1981;

President, ST*AR Corporation, 1979–1981.

Education

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

Teaching

Communication networks and systems.

Research Interests

Communication networks and systems.

Recent Publications/Presentations

Don Endicott, V. S. Frost, "Guest editoral: Performance Experiences with Wide Area High Speed Networks," *IEEE Communications Magazine*, Vol 35, No. 8, Aug. 1997.

S. F. Bush, S. Jagannath, R. Sanchez, J. B. Evans, K, S. Shanmugan, V. S. Frost, G. Minden, "A Control and Management Network for Wireless ATM Systems," *ACM/Baltzer Wireless Infromation Networks (WINET) Journal*, Vol. 3, No. 4, 1997, pp 267-283.

L. Dasilva, J. B. Evans, D. Niehaus, V. S. Frost, R. Jonkman, B. Lee, G. Lazarou, "ATM WAN Performance Tools, Experiments, and Results," *IEEE Communications Magazine*, Vol 35, No. 8, Aug.1997, pp 118-125.

K. Liu, H. Zhu, D.W. Petr, V.S. Frost, C. Braun, W. Edwards, "Design and Analysis of a Bandwidth Management Framework for ATM-Based Broadband ISDN," *IEEE Communications Magazine*, Vol. 35, No. 5, May 1997, pp. 138- 145.

A. Kulkarni, G. Minden, V. Frost, J. Evans, "An Active Network Architecture for ATM WANs," 3rd International Workshop on Mobile Multimedia Communications Conference, Princeton, New Jersey, Sept. 25-27, 1996. Selected for publication in *Mobile Multimedia Communications*, Plenum Publishing, Chapt. 3, Nov. 1997.

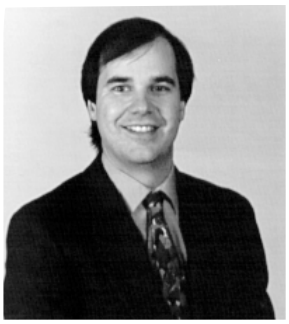
Professional Affiliations

IEEE (Fellow 1998);
Eta Kappa Nu;
Sigma Xi;
Tau Beta Pi.

Honors and Awards

National Science Foundation Presidential Young Investigator Award, 1984;
Keynote Address, 18th Biennial Symposium on Communications, Kingston, Ontario;
1991 Miller Award for Distinguished Service to Engineering;
1986 Miller Award for Distinguished Service to Engineering Research;
Society of Automotive Engineers Ralph R. Teetor Educational Award, 1984.

John M. Gauch



Associate Professor, The University of Kansas, 1996 - present;

Assistant Professor, The University of Kansas, 1993–1996;

Assistant Professor, Northeastern University, 1989–1993.

Education

Ph.D. in Computer Science, University of North Carolina at Chapel Hill, 1989.
M.Sc. in Computer Science, Queen's University at Kingston, Ontario, 1982.
Honours B.Sc. in Computer Science, Queen's University at Kingston, Ontario, 1981.

Teaching

Digital Image Processing,
Computer Vision,
Programming I (Java).

Research Interests

Computer vision, digital image processing, and multimedia systems with emphasis on image segmentation and motion analysis. Specific applications include tracking cells in microscopic images, tracking eye motion in retina images, measuring object deformation in ultrasound images, classifying ice types in remote sensing images, detecting ice layers in radio echo sounder images, segmentation of multi-spectral images, temporal segmentation of video sequences, and real-time digital video feature analysis and recognition.

Recent Publications/Presentations

J.M. Gauch, "Image Segmentation and Analysis via Multiscale Gradient Watersheds," accepted for *IEEE Transactions on Image Processing* (1998).

J.M. Gauch, "Noise Removal and Contrast Enhancement," *Colour Image Processing*, Sangwine and Home Ed., Chapman and Hall Ltd., 1998.

J.M. Gauch, "Segmentation and Edge Detection," *Colour Image Processing*, ed. Sangwine and Home, Chapman and Hall Ltd., 1998.

S.E. Gauch, W. Li, J.M. Gauch, "The VISION Digital Video Library," *Information Processing and Management,* Vol. 33, No. 4, Apr. 1997, pp. 413-426.

Patents

"An Automated, Pipelined, Digital System for Real-Time Capture, Scene Detection, Indexing, and Encoding (Compression) of Video Content," Kazeroonian, Kamins, Twitchell, J. Gauch, S. Gauch, Pankratz, and O'Connell, U.S. patent pending.

Professional Affiliations

ACM, IEEE Computer Society, SPIE.

Honors and Awards

Francois Erbsman award for the best paper by a young investigator at the 10th Information Processing in Medical Imaging Conference in Utrecht, June 1987.

Susan Gauch

Associate Professor, The University of Kansas, 1998-present;

Assistant Professor, The University of Kansas, 1993-1998;

Senior Research Scientist, Northeastern University, 1991-1993;

Visiting Assistant Professor, Wellesley College, 1989-1991.

Education

Ph.D. in Computer Science, University of North Carolina at Chapel Hill, 1990.
M.Sc. in Computer Science, Queen's University at Kingston, Ontario, Canada, 1982.
Honours B.Sc. in Mathematics & Computer Science, Queen's University at Kingston, Ontario, Canada, 1981.

Teaching

Distributed and advanced databases,
Algorithmic problem solving,
Structured programming,
Information retrieval,
Software engineering,
Intelligent agents.

Research Interests

Full-text information retrieval,
Multimedia databases,
Intelligent search agents,
Searching the World Wide Web,
Corpus Linguistics.

Recent Publications/Presentations

D. Haverkamp, S. Gauch, "Intelligent Information Agents: Review and Challenges for Distributed Information Sources," *Journal of the Society for Information Science*, Vol. 49, No. 4, Apr. 1998, pp. 304-311.

S. Gauch, J. Wang and S. M. Rachakonda, "A Corpus Analysis Approach for Automatic Query Expansion," *CIKM '97: 6th International Conference on Information and Knowledge Management*, Las Vegas, NV, Nov. 1997, pp. 278-284.

Y. Fan and S. Gauch, "An Adaptive Multi-Agent Architecture for the ProFusion Meta Search System," WebNet '97: The Second World Conference of the Web Society, Oct. 1997, Toronto, Canada.

S. Gauch, W. Li and J. Gauch, "The VISION Digital Video Library System," *Information Processing & Management*, Vol. 33, No. 4, Apr. 1997, pp. 413-426.

S. Gauch, G. Wang, M. Gomez, "ProFusion: Intelligent Fusion from Multiple,Distributed Search Engines," *Journal of Universal Computer Science*, Vol. 2 , No. 9, Sept. 1996.

W. Li, S. Gauch, J. Gauch, K.M. Pua, "VISION: A Digital Video Library," *ACM Digital Libraries '96,* Mar. 1996, pp. 19-27.

Professional Affiliations

ACM, ACM/SIGIR, ASIS,
Member of CIKM Steering Committee,
Treasurer for ACM SIGIR.

Honors and Awards

PC Professionell, Editor's Choice Award, for ProFusion;
Miller Research Award, School of Engineering, 1998;
PC Magazine Editor's Choice Award, "Best Advanced Meta-Search Engine," Dec. 1997, for ProFusion;
ONR Fellowship, 1988;
NF Dupuis Prize in Mathematics, Queen's University, 1978.

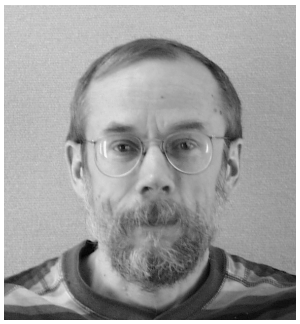
Patents/Licenses

ProFusion, licensed to ProFusion, L.L.C., January 1997;

VISION, licensed to Worldwide Broadcasting Network, March 1997;

"An Automated, Pipelined, Digital System for Real-Time Capture, Scene Detection, Indexing, and Encoding (Compression) of Video Content," Kazeroonian, Kamins, Twitchell, J. Gauch, S. Gauch, Pankratz, and O'Connell, U.S. patent pending.

Jerzy W. Grzymala-Busse



Professor, The University of Kansas, 1981-present;

Visiting Professor, The University of Kansas, I980-1981;

Visiting Professor, The University of Kansas, 1977;

Visiting Professor, Stefan Banach International Mathematical Center, Warsaw, 1974;

Associate Professor, Technical University of Poznan, 1973-1980;

Assistant Professor, Technical University of Poznan, 1970-I973.

Education

Doctor habilitatus in Engineering, Technical University of Warsaw, Poland, 1972.

Ph.D. in Engineering, Technical University of Poznan, Poland, 1969.

M.S. in Mathematics, University of Wroclaw, Poland, 1967.

M.S. in Electrical Engineering, Technical University of Poznan, Poland, 1964.

Teaching

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, probabilistic analysis.

Research Interests

Knowledge discovery, data mining, machine learning, expert systems, reasoning under uncertainty, rough set theory.

Recent Publications

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

J.W. Grzymala-Busse, "Applications of the Rule Induction System LERS," *Rough Sets in Knowledge Discovery 1: Methodology and Applications*, ed. L. Polkowski and A. Skowron, Physica-Verlag, 1998, pp. 366–375.

H. Moradi, J.W. Grzymala-Busse, J. Roberts, "Entropy of English Text: Experiments with Humans and a Machine Learning System Based on Rough Sets,"*Information Sciences: An International Journal*, Vol. 104, 1998, pp. 31-47.

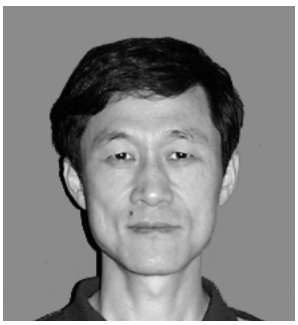
J.W. Grzymala-Busse, S. Than, "Inducing Simpler Rules from Reduced Data," *Proceedings of the Seventh Workshop on Intelligent Information Systems (IIS'98)*, Malbork, Poland, June 15–19, 1998, pp. 371–378.

J.W. Grzymala-Busse, X. Zou, "Classification Strategies Using Certain and Possible Rules," *Proceedings of the First International Conference on Rough Sets and Current Trends in Computing*, Warsaw, Poland, June 22–26, 1998. *Lecture Notes in Artificial Intelligence*, No. 1424, Springer Verlag, 1998, pp. 37–44.

Honors and Awards

Chairman of a conference session: RSSC'97—5th International Workshop on Rough Sets and Soft Computing in the 3rd Joint Conference on Information Sciences, Research Triangle Park, North Carolina, March 2-5, 1997.
Member of the Program Committee: UAI'97—13th Annual Conference on Uncertainty in Artificial Intelligence, Providence, Rhode Island, August 1-13, 1997.
Member of the Advisory Board, and Chairman of a conference session: RSCTC'98—The First International Conference on Rough Sets and Current Trends in Computing, Warsaw, Poland, June 22–26, 1998.
Member of the Program Committee: UAI'98—14th Annual Conference on Uncertainty in Artificial Intelligence, Madison, Wisconsin, July 24-26, 1998.

Rongqing Hui



Assistant Professor, The University of Kansas, 1997-present;

Member of Scientific Staff, Bell-Northern Research, Ottawa, Canada, 1994-1997;

Post Doctoral Research Fellow, Department of Electrical Engineering, The University of Ottawa, Canada, 1993-1994;

Research Associate, Department of Electronics, Politecnito di Torino, Italy, 1990-1993;

Research Fellow, Italian Telecommunication Research Center (CSELT), Torino, Italy, 1990-1991.

Research Fellow, Fondazione Ugo Bordoni, Rome, Italy (a research institute of Italian Post & Telecommunication Ministry), 1989-1990;

Research Associate, Optical Communication Lab, Beijing University of Posts & Telecommunications, China, 1985-1989;

Junior Lecturer, Department of Physics, Anhui University, Hefei, China, 1982-1985.

Education

Ph.D., Electrical Engineering, Politecnico di Torino, Italy, 1994.

M.S, Electrical Engineering, Beijing University of Posts & Telecommunications, China, 1988.

B.S., Electrical Engineering, Beijing University of Posts & Telecommunications, China, 1982.

Teaching

Electrical circuits,
Optical fiber communication networks,
Selected topics in fiber-optic communications (graduate).

Research Interests

Fiber-optic communication systems and photonic devices.

Recent Publications/Presentations

R. Hui, Y. Wang, K. Demarest, C. Allen, "Frequency Response of Cross Phase Modulation in Multi-Span WDM Optical Fiber Systems," *IEEE Photonics Technology Letters*, Vol. 10, No. 9, 1998.

R. Hui, M. Vaziri, J. Zhou, M. O'Sullivan, "Separation of Noise from Distortion for Amplified Optical Fiber System Link Budgeting," *Proceedings of International Conference on Applications of Photonic technology ICAPT'98*, Ottawa, Canada, July 27-30, 1998 (post-deadline paper).

R. Hui, M. O'Sullivan, A. Robinson, M. Taylor, "Modulation Instability and Its Impact in Multi-Span Optical Amplified Systems: Theory and Experiments," *IEEE Journal of Lightwave Technology*, Vol. 15, No.7, 1997.

R. Hui, D. Chowdhury, M. Newhouse, M. O'Sullivan, M. Poettcker, "Nonlinear Amplification of Noise in Fibers with Dispersion and Its Impact in Optically Amplified Systems," *IEEE Photonics Technology Letters*, Vol. 9, No. 3, 1997.

R.A. Saunders, A. Robinson, D. Garthe, R. Hui and M. O'Sullivan, "Compensation of Cross-Phase Modulation in 10-Gbit/s WDM Systems by Interfering Channel Pre-Chirping," Optical Fiber Communication Conference; OFC'98, San Jose USA, Feb. 1998.

Recent Patents

M. O'Sullivan, R. Hui, J. Zhou, "Eye Distortion Mask Technique for Optical Transmission Systems," U.S. patent #5774242.

R.A. Saunders, A. Robinson, D. Garthe, R. Hui, M. O'Sullivan, "Optical Transmission Systems with Cross-Phase Modulation Compensation," European patent #98306290.2-2211; U.S. patent pending.

J. Hong, R. Hui, M. O'Sullivan, "Compact High-Speed Soliton Sources Using Dual-Wavelength SGC-DFB Semiconductor Lasers," U.S. patent pending.

Professional Affiliations

IEEE (Senior Member)

Gary J. Minden

Professor, The University of Kansas, 1998-present;

Associate Professor, The University of Kansas, 1987-1998;

Program Manager, Advanced Research Project Agency (ARPA),1994 -1996 (on leave of absence from University of Kansas);

Visiting Engineer, Digital Equipment Corporation System Research Center, Palo Alto, California, 1991;

Assistant Professor, The University of Kansas, 1981–1987;

Visiting Engineer, TRW, Inc., Redondo Beach, California, Summer 1982;

V.P. Systems Architecture, CHILD, Inc., Ann Arbor, MI, 1975–1981;

Project Engineer, The University of Kansas Center for Research, 1973–1979.

Education

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

Teaching

Digital systems design,
Computer architecture,
Computer networks.

Research Interests

Mobile networking systems,
Active networking,
Implementation of high performance integrated networks,
Distributed systems.

Recent Publications/Presentations

S. F. Bush, S. Jagannath, R. Sanchez, J. B. Evans, V. S. Frost, G. J. Minden, K. S. Shanmugan, "A Control and Management Network for Wireless ATM Systems," *ACM/Baltzer Wireless Information Networks (WINET) Journal,* Vol. 3, No.4, 1997, pp. 267-283.

D. L. Tennenhouse, J. M. Smith, W. D. Sincoskie, D. J. Wetherall, G. J. Minden, "A Survey of Active Network Research," *IEEE Communications Magazine*, Vol. 35, No. 1, Jan. 1997, pp. 80-86.

A. B. Kulkarni, G. J. Minden, V. S. Frost, J. B. Evans, "An Active Network Architecture for ATM WANs," Third International Workshop on Mobile Multimedia Communications, Princeton, New Jersey, Sept. 25-27, 1996. Selected for publication in *Mobile Multimedia Communications,* Plenum Publishing, Nov. 1997.

A. B. Kulkarni, G. J. Minden, R. Hill, Y. Wijata, S. Sheth, F. Wahhab, H. Pindi, A. Nagarajan, "Implementation of a Prototype Active Network," accepted for First IEEE Conference on Open Architectures and Network Programming, San Francisco, CA, Apr. 3-4, 1998.

R. Sanchez, J. B. Evans, G. J. Minden, V. S. Frost, K. S. Shanmugan, "RDRN: A Prototype for Rapidly Deployable Radio Network," *ACM Mobile Computing and Communications Review*, Vol. 2, No. 2, Apr. 1998, pgs. 15-22.

G. J. Minden, "Integrated Capabilities for Rapid Deployment Forces," DARPA Global Mobile PI Meeting, Washington, D.C., July 28-30, 1998.

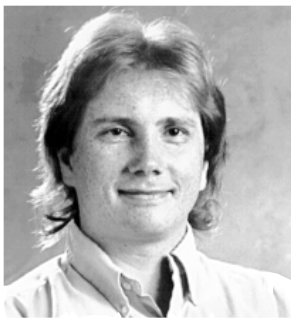
Professional Affiliations

ACM, IEEE, AAAS, Computer Professionals for Social Responsibilities.

Honors and Awards

Eta Kappa Nu.

Douglas Niehaus



Assistant Professor, The University of Kansas, 1993–present;

Senior Software Engineer, Convergent Technologies, 1986–1987;

Member of Technical Staff, AT&T Bell Laboratories, AT&T Information Systems, 1981–1986.

Education

Ph.D., Computer Science, University of Massachusetts, 1994.
M.S., Computer, Information and Control Engineering, University of Michigan, 1981.
B.S., Computer Science, Northwestern University, 1980.

Teaching

Operating systems,
Software engineering,
Distributed systems,
Concurrent and distributed software development,
Real-time systems.

Research Interests

Real-time and conventional distributed systems,
Implementation and evaluation of high performance networks,
Operating systems,
Programming tools and environments.

Recent Publications/Presentations

B. Srinivasan, S. Pather, R. Hill, F. Ansari, D. Niehaus, "A Firm Real-Time System Implementation Using Commercial Off-the-Shelf Hardware and Free Software," *Proceedings of the Real-Time Technology and Applications Symposium*, Denver, June 1998.

D. Niehaus, A. Battou, A. McFarland, B. Decina, H. Dardy, V. Sirkay, B. Edwards, "Performance Benchmarking of Signaling in ATM Networks," *IEEE Communications Magazine*, Vol. 35, No. 8, Aug. 1997, pp. 134-143.

L. DaSilva, J. Evans, D. Niehaus, V. Frost, R. Jonkman, B. Lee, G. Lazarou, "ATM WAN Performance Tools and Results," *IEEE Communications Magazine*, Vol. 35, No. 8, Aug. 1997, pp. 118-125.

L. DaSilva, J. Evans, D. Niehaus, V. Frost, R. Jonkman, B. Lee, G. Lazarou, "Performance Experience in a Wide Area Network," *Proceedings of IEEE ICC '97*, Montreal, June 1997.

D. Niehaus, "Multi-Mode System Support for Real-Time Object Oriented Middleware," *Proceedings of the OpenSig Workshop*, Columbia University, Oct. 1997.

G. Lazarou, V. Frost, J. Evans, D. Niehaus, "Simulation and Measurement of TCP/IP over ATM Wide Area Networks," *IEICE Transactions on Communications*, Vol. E81-B, No. 2, Feb. 1998.

Professional Affiliations

ACM, ACM/SIGOPS, ACM/SIGPLAN, ACM/SIGARCH.

Honors and Awards

Tau Beta Pi.

Karen J. Nordheden

Assistant Professor, The University of Kansas, 1994–present;

Senior Process Engineer, Electronics Laboratory, Martin Marietta Corporation, Syracuse, New York, 1993-1994;

Senior Process Engineer, Electronics Lab, General Electric, Syracuse, New York, 1990-1993;

Process Engineer, Electronics Lab, General Electric, Syracuse, New York, 1988-1990.

Education

Ph.D. in Electrical Engineering, University of Illinois at Urbana, 1988.

M.S. in Electrical Engineering, University of Illinois at Urbana, 1984.

B.S. in Physics, Michigan State University, 1980.

Teaching

Electrical devices and properties of materials,
Semiconductor device fabrication,
Control systems,
Advanced engineering mathematics.

Research Interests

Plasma processing of semiconductors,
Lightwave technology.

Recent Publications/Presentations

K. J. Nordheden and M. H. Hoeflich, "Undergraduate Research and Intellectual Property Rights," *The Kansas Journal of Law & Public Policy*, Vol. VI, Number III, Summer/Fall 1997.

L.W. Yang, J.J. Komiak, D.P. Smith, M.Y. Kao, R.S. Brozovich, K.J. Nordheden, D.R. Helms, D.E. Houston, F.R. Bardsley, "Manufacturing Technology for High Performance HBT Linear Power Amplifiers," *IEEE GaAs Integrated Circuit Symposium Technical Digest*, Philadelphia, Pennsylvania, Oct. 16-19, 1994, pp. 127-130.

L.W. Yang, J.J. Komiak, M.Y. Kao, D.E. Houston, D.P. Smith, K.J. Nordheden, "E-Beam Realigned HBTs and a New Broadband MMIC Power Amplifier Using Bathtub as Heatsink," *IEEE International Electron Devices Meeting Technical Digest*, San Francisco, California, Dec. 1994, pp. 203-206.

P.C. Chao, M.Y. Kao, K. Nordheden and A.W. Swanson, "HEMT Degradation in Hydrogen Gas," *IEEE Electron Device Letters*, Vol. 15, No. 5, 1994, pp. 151-153.

V.S. Wang, R.J. Matyi, and K.J. Nordheden, "Triple Crystal X-Ray Diffraction Analysis of Reactive Ion Etched Gallium Arsenide," *Journal of Applied Physics*, Vol. 75, No. 8, 1994, pp. 3835.

Professional Affiliations

IEEE (Senior Member), American Vacuum Society (AVS), American Physical Society (APS), Electrochemical Society (ECS), Society of Women Engineers (SWE), American Society for Engineering Educators (ASEE).

Honors and Awards

Eta Kappa Nu; Golden Key; Phi Kappa Phi; Tau Beta Pi;
H. Bernerd Fink Award for Excellence in Teaching, 1998;
Harry Talley Excellence In Teaching Award, 1997;
IBM Fellowship, 1983.

Bozenna Pasik-Duncan

Professor, Mathematics,
The University of Kansas, 1993–present;

Associate Professor, Mathematics,
The University of Kansas, 1989-1993;

Assistant Professor, Mathematics,
The University of Kansas, 1987-1989;

Instructor, Mathematics Department,
The University of Kansas, 1984-1987;

Assistant Professor, Mathematics,
Warsaw School of Economics,
1978-1984.

Education

Habilitation Doctorate Degree,
Department of Mathematics, Warsaw School of Economics, 1986.
Ph.D., Department of Mathematics,
Warsaw School of Economics, 1978
M.Sc., Department of Mathematics,
Warsaw University.

Teaching

Stochastic adaptive control;
Statistics of stochastic processes;
Continuous time adaptive control;
Optimization theory;
Dynamical systems;
Stochastic processes,
Honors calculus I, II, III;
Stochastic adaptive control seminar;
Honors differential equations,
Probability theory.

Research Interests

Identification of stochastic systems,
Stochastic analysis and its applications to mathematics of finance and telecommunications,
Stochastic adaptive control of distributed parameter systems,
Stochastic adaptive control of partially observed systems and computational aspects of stochastic control,
Mathematics education for K-12,
Mathematics education for women in science and engineering.

Recent Publications/Presentations

B. Pasik-Duncan, T. Duncan, B. Maslowski, "Ergodic Boundary/Point Control of Some Stochastic Semilinear Systems in Hilbert Spaces," *SIAM Journal of Control Optimization*, Vol. 36, 1998, pp. 1020-1047.

B. Pasik-Duncan, "Limit Theorems of Probability Theory and Optimality in Stochastic Evolution Systems," *Journal of Mathematical Systems, Estimation and Control*, Vol. 7, No. 4, 1997, pp. 417-437.

B. Pasik-Duncan, T. Duncan, L. Guo, "Weighted Least Squares and Continuous Time Adaptive LQG Control, *Proceedings of 36th Conference on Decision and Control*, San Diego, 1997, pp. 4058-4063.

B. Pasik-Duncan, "Stochastic Adaptive Control and Manufacturing Systems," *Lectures in Applied Mathematics*, American Mathematics Society, Vol. 33, 1997, pp. 201-217.

B. Pasik-Duncan, T. Duncan, B. Maslowski, "Ergodic Distributed Control for Parameter Dependent Stochastic Semilinear Systems in Hilbert Space," *Proceedings of Conference on Stochastic Differential and Differentia Equations*, Birkhauser, 1997.

Professional Affiliations

Vice President, Membership Activities, IEEE Control Systems Society;
Member, Board of Governors, IEEE Control Systems Society;
Chair, standing committees on Assistance of Engineers at Risk and Women in Control; Associate Editor-at-Large, *IEEE Transactions on Automatic Control*; Associate Editor, *Journal of Intelligent Fuzzy Systems*;
Associate Editor , *Ulam Quarterly*;
Member, SIAM Master Program Committee and Steering Committee.

Honors and Awards

NSF Career Advancement Award,
Excellence in Teaching Award from the Ministry of Higher Education and Sciences in Poland,
Several Chancellor's Awards from the Warsaw School of Economics,
IREX Scholar to US in 1982,
Visiting appointments in Poland, Hungary, Czech Republid, France, Italy, Japan, China,
USA coordinator of Polish Mathematicians,
Kemper Fellowship for Teaching Excellence and Advising in Public Outreach,
A main speaker at serveral international conferences.

David W. Petr

Associate Professor, The University of Kansas, 1995–Present;

Assistant Professor, The University of Kansas, 1990–1995;

Member of Technical Staff, AT&T Bell Laboratories, 1977–1986.

Education

Ph.D.E.E., The University of Kansas, 1990, Honors.
M.S.E.E., Stanford University, 1978.
B.S.E.E., Southern Methodist University, 1976, Highest Honors.

Teaching

Circuits,
Communication systems,
Integrated telecommunication networks,
Optimization with applications,
Random signal theory,
Signal and system analysis.

Research Interests

Communication networks
(packet switching, congestion control, traffic integration, performance analysis),
Optimization (dynamic programming),
Digital signal processing (speech coding),
Adaptive Systems.

Recent Publications/Presentations

D. W. Petr, W. G. Huang, M. P. Mischler, "Subjective Effects of Cell Losses in Voice Over ATM," *IEEE Communications Letters*, Vol. 2, No. 7, July 1998, pp. 186-188.

L. A. DaSilva, D. W. Petr, N. Akar, "Equilibrium Pricing in Multiservice Priority-Based Networks," *Proceedings of the IEEE Globecom Conference*, Nov. 1997, pp. S38_6.1-S38_6.5. Also presented at the University of Missouri-Kansas City, as part of Computer Science Telecommunications Program Faculty Seminar Series, Sept. 1997.

K. Liu, D. W. Petr, C. Braun, "A Measurement-Based CAC Strategy for ATM Networks," *Proceedings of the IEEE International Conference on Communications (ICC)*, June 1997, pp. 1714-1718.

K. Liu, H. Zhu, D.W. Petr, V.S. Frost, C. Braun, W.L. Edwards, "Design and Analysis of a Bandwidth Management Framework for ATM-Based Broadband ISDN," *IEEE Communications Magazine*, Vol. 35, No. 5, May 1997, pp. 138-145.

Q. Hu, D.W. Petr, C. Braun, "Self-Tuning Fuzzy Traffic Rate Controller for ATM Networks," *Proceedings of the IEEE International Conference on Communications (ICC)*, June 1996, pp. 424-428.

D.W. Petr, V.S. Frost, C. Braun, T.G. Kelley, A. Demirtjis, "Cell Loss Quality of Service in an Integrated Traffic ATM Network," *International Journal of Communication Systems*, Vol. 9, No. 2, Mar.-Apr. 1996, pp. 97-104.

Professional Affiliations

IEEE (senior member), American Society for Engineering Education (ASEE).

Honors and Awards

Eta Kappa Nu;
Sigma Xi Honor Society;
Tau Beta Pi;
Runner-up for first annual Harry Talley Excellence in Teaching Award (voted by KU EECS graduating seniors (1996);
IEEE Frank A. Cowan Scholarship for Graduate Study in Communications (1987-1988);
University of Kansas Center for Research, Graduate Fellowship (1987-1989);
International Communications Association Scholarship for Graduate Study in Communications (1987-1989);
AT&T Bell Laboratories internal nominee for Eta Kappa Nu Outstanding Young Electrical Engineer (1984).

Glenn E. Prescott

Associate Professor, The University of Kansas, 1989–present;

Assistant Professor, Air Force Institute of Technology, 1984–1989;

Adjunct Associate Professor, Wright State University, 1987–1988;

Adjunct Assistant Professor, Wright State University, 1984–1987.

Education

Ph.D., Electrical Engineering, Georgia Tech, 1984.
M.S., Electrical Engineering, University of Missouri, 1977.
B.E., Electrical Engineering, Georgia Tech, 1974.

Teaching

Digital signal processing,
Digital communications,
Electronic design,
Modulation and coding,
Linear systems.

Research Interests

Digital signal applications for communications and radar;
Digital communications,
Military radio systems,
Low probability of intercept communications,
Time-frequency signal analysis.

Recent Publications/Presentations

"An Architecture for Transmit Beamforming for Rapidly Deployable Radio Networks," G. Prescott, C. Sparks, S. Sivaprakasam, Space Technology and Applications International Forum, Albuquerque, New Mexico, July 26-30, 1997, pp. 945-950.

"Software Radio: Using DSP to Implement Radio Systems," G. Prescott, *Proceedings of the 1997 DSP World Spring Design Conference*, Washington D.C., Mar. 25 - 27, 1997, pp. 217-219.

"Digital Beamforming Receiver Design," S. Gurrapu, G. Prescott, S. Shanmugan, ITTC Technical Report, ITTC-FY97-1092-25, May 1997.

"Prototyping of Military Radio Systems Using Field Programmable Gate Arrays and DSP Microprocessors," G. Prescott, S. Tyler, *Proceedings of the International Conference on Signal Processing Applications and Technology*, San Diego, Sept. 14-17, 1997, pp. 1599-1603.

"Design and Implemenation of a DSP Digital Beamforming Receiver," G. Prescott, S. Gurrapu, *Proceedings of the International Conference on Signal Processing Applications and Technology*, San Diego, Sept. 14-17, 1997, pp. 1557-1562.

"Transmitter Beamforming for a Rapidly Deployable Radio Network," G. Prescott, C. Sparks, *Proceedings of the 1997 Military Communications Conference, MILCOM-97*, Monterey, CA, Nov. 2-5, 1997, pp. 515-520.

Professional Affiliations

IEEE (Senior Member), American Society for Engineering Education, Armed Forces Communications Electronics Association, American Radio Relay League, Air Force Association, Air Force Sergents Association.

Honors and Awards

Sharp Teaching Professorship (1998-2000).

James A. Roberts

Associate Vice Chancellor for Research, The Univeristy of Kansas, 1998-present;

Vice President, KU Center for Research, Inc., 1998-present;

Professor EECS, The University of Kansas, 1990-present;

Chairman, EECS, The University of Kansas, 1990-1997;

Manager, TRW Denver Operations, 1987-1990;

Program Manager, TRW, 1983-1987;

Adjunct Lecturer in EECS, Santa Clara University, 1978-1983;

MTS, Dept.. Mgr., Lab. Mgr., ESL Inc., 1969-1983;

Member of Technical Staff, RCA, 1966-1969;

Research Assistant, RSL, The University of Kansas, 1965-1966.

Education

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

Teaching

Statistical communication theory,
Stochastic processes,
Wireless communications,
Information theory and coding.

Research Interests

Wireless communication systems,
Information theory,
Statistical communication theory.

Recent Publications/Presentations

J. M. Bargallo, J. A. Roberts, "Performance of BPSK and TCM Using the Exponential Multipath Profile Model for Spread-Spectrum Indoor Radio Channels," *IEEE Transactions on Communications*, Vol. COM-43, Feb. 1995, pp. 615-623.

J. A. Roberts, J. R. Abeysinghe, "A Two-State Rician Model for Predicting Indoor Wireless Communication Performance," *Proceedings of the IEEE International Communications Conference*, Seattle, Washington, June 18-22, 1995, pp. 40-43.

J. R. Abeysinghe, J. A. Roberts, "Bit Error Rate Performance of Antenna Diversity Systems with Channel Correlation," *Proceedings of IEEE GLOBECOM'95*, Singapore, Nov. 13-17, 1995, pp. 2022-2026.

V. J. Paulrajan, J. A. Roberts, D. L. Machamer, "Capacity of a CDMA Cellular System with Variable User Data Rates," *Proceedings of IEEE GLOBECOM'96*, London, UK, Nov. 18-22, 1996, pp. 1458-1462.

H. Moradi, J. W. Grzymala-Busse, J. A. Roberts, "Entropy of English Text: Experiments with Humans and a Machine Learning System Based on Rough Sets," *Information Sciences*, Vol. 104, Jan. 1998, pp. 31-47.

M. Mangal, J. A. Roberts, D. L. Machamer, "Performance Analysis of a DS-CDMA Packet Cellular Network in a Multi-User Environment," *Proceedings of the IEEE Vehicular Technology Conference*, Ottawa, Canada, May 18-21, 1998, pp. 1461-1465.

Professional Affiliations

IEEE, ACM, American Association for Engineering Education, Registered Professional Engineer in Kansas.

Honors and Awards

Tau Beta Pi; Eta Kappa Nu; Sigma Xi; Omicron Delta Kappa;
Listed in *American Men and Women of Science*, *Who's Who in the Midwest*, and *Who's Who in Science and Technology*.

Kim Roddis

Licensed Professional Engineer, States of Massachusetts and Kansas;

Associate Professor, Civil Engineering, University of Kansas, 1994-present;

Assistant Professor, Civil Engineering, University of Kansas, 1988-1994.

Education

Ph.D., Civil Engineering, Massachusetts Institute of Technology, 1988.

M.S., Civil Engineering, Massachusetts Institute of Technology, 1987.

B.S., Civil Engineering, Massachusetts Institute of Technology, 1977.

Teaching

Structural design,
Advanced steel design,
Knowledge-based expert systems in engineering.

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 and evaluation of structures.

Recent Publications/Presentations

N. O. Attoh-Okine, W. M. Kim Roddis, "Uncertainties of Asphalt Layer Thickness Determination in Flexible Pavements—Influence Diagram Approach," *Civil Engineering and Environmental Systems*, Gordon and Breach Publishers, Vol. 15, 1998, pp. 107-124.

L. Zhang, W. M. Kim Roddis, "Machine Learning in Updating Predictive Models of Planning and Scheduling Transportation Projects," *Transportation Research Record*, TRB, No. 1588, Transportation Research Board, Sept. 1997, pp. 86-94.

W. M. Kim Roddis, "Torsion and Stability of Steel Bridge Girders during Construction," 43rd Annual Structural Engineering Conference, The University of Kansas Department of Civil Engineering and Division of Continuing Education, Lawrence, Kansas, Mar. 19, 1998.

R. R. Greenfield, W. M. Kim Roddis, "Steel Bridge Fabrication Errors Indexed Examples and Solutions: Combining Rules and Cases," SL Report 98-2, The University of Kansas Center for Research, Inc., June 1998.

W.M. Kim Roddis, "Regional/National Bridge Fabrication Expert System," National Steel Bridge Construction Collaborative, AISC National Steel Bridge Association and AASHTO, Cincinnati, Ohio, September 9, 1997.

Professional Affiliations

American Association for Artificial Intelligence, AASHTO/NSBA Steel Bridge Collaboration, American Concrete Institute, American Institute of Steel Construction, American Society of Civil Engineers, American Society for Engineering Education, Society of Women Engineers, Transportation Research Board.

Honors and Awards

American Society of Civil Engineers Fellow, 1997; Miller Engineering Research Award, School of Engineering, University Of Kansas, 1997; Quest for the Best Faculty Competition, Academic Computing Services, University of Kansas, 1993; Harold E. Lobdell Distinguished Service Award, Alumni/Alumnae Association of MIT, 1988; Fannie and John Hertz Fellow, 1986 to 1988; American Institute of Steel Construction Fellowship, 1987; American Society of Civil Engineers O.H. Ammann Research Fellow, 1986; Cameron Scholarship Recipient CRSI, 1984-1985.

K. Sam Shanmugan

Acting Chairman, EECS Department, The University of Kansas, 1998-present;

Director ITTC 1997;

Southwestern Bell Distinguished Professor, The University of Kansas, 1986-present;

Vice President and General Manager, Alta Group of Cadence, SanJose, California, 1993-1995;

Senior Vice President, Comdisco Systems, Foster City, California, 1988-1993;

President, ST*AR Corporation, Lawrence, KS, 1986-1988;

Director of Telecommunications Laboratory, The University of Kansas, 1982-1987;

Professor, The University of Kansas, 1982-1986;

Associate Professor, The University of Kansas, 1980-1982;

Member of Technical Staff, Bell Telephone Laboratories, 1978-1980;

Associate Professor, Wichita State University, 1977-1978;

Assistant Professor, Wichita State University, 1973-1977.

Education

Ph.D., Oklahoma State University, 1970.
M.E., Indian Institute of Science, 1966.
B.E., Madras University, 1964.

Teaching

Communication theory and systems,
Simulation of communication systems
Probabilistic analysis,
Signals and systems.

Research Interests

Communications systems theory,
Wireless communication systems and networks,
Communication systems simulation.

Recent Publications/Presentations

K.S. Shanmugan, M. Jeruchim, P. Balaban, *Modeling and Simulation of Communication Systems*, 2nd edition, Plenum-Kluewer (to appear in print by July 1999, appox. 1,000 pgs.)

S. Bush, S. Jagannath, R. Sanchez, J. Evans, V. Frost, G. Minden, K.S. Shanmugan, "A Control and Management Network for Wireless ATM Systems," *Wireless Information Networks*, Vol. 3, 1997, pp. 267-283.

R. Sanchez, J. Evans, G. Minden, V. Frost, K.S. Shanmugan, "RDRN: A Prototype for a Rapidly Deployable Radio Network," *ACM Mobile Computing and Communication Review*, Vol. 2, No. 2, 1997, pp. 15-22.

J. B. Evans, G. J. Minden, K. S. Shanmugan, G. Prescott, V. S. Frost, B. Ewy, R. Sanchez, C. Sparks, K. Malinimohan, J. Roberts, R. Plumb, D. W. Petr, "An Overview of the The Rapidly Deployable Radio," accepted for *IEEE Journal on Selected Areas in Communications* (1998).

P. Rajagopalan, K. Sam Shanmugan, "Channel Estimation and Adaptive Communication Techniques," Information and Telecommunication Technology Center Technical Report, ITTC-FY97-TR-10920-28, Dec. 1996.

Professional Affiliations

IEEE (Fellow).

Honors and Awards

Eta Kappa Nu, Phi Kappa Phi;
Listed in Who's Who in Engineering, Who's Who in Technology, and American Men and Women of Science;
H.O.P.E. Award, Finalist, 1994;
Higuchi Award for Research at the University of Kansas, 1990;
Burlington-Northern Outstanding Teaching Award, 1987;
Henry E. Gould Award for Distinguished Service to Undergraduate Engineering Education, 1982;
Amoco Foundation Outstanding Teacher Award, 1982;
Society of Automotive Engineers Ralph Teetor Outstanding Young Engineering Educator Award, 1979.

Costas Tsatsoulis

Associate Professor, The University of Kansas, 1993–present;

Assistant Professor, The University of Kansas, 1988–1993;

Visiting Scientist, Lockheed-Martin AI Center, 1995.

Education

Ph.D., Electrical Engineering, Purdue University, 1988.

M.S., Electrical Engineering, Purdue University, 1984.

B.A., German, Purdue University, 1987, with distinction.

B.S., Electrical Engineering, Purdue University, 1983, with distinction.

Teaching

Artificial intelligence,
Knowledge-based systems,
Image processing and computer vision,
Case-based reasoning,
Artificial intelligence,
Introduction to database systems,
Structured programming,
Microprocessors and assembly language,
Machine learning.

Research Interests

Case-based reasoning,
Multiagent systems and distributed artificial intelligence,
Image processing and computer vision.

Recent Publications/Presentations

C. Tsatsoulis, R. Kwok (Eds.), *Analysis of SAR Data of the Polar Oceans*, Springer Verlag, 1998.

C. Tsatsoulis, P. Alexander, "Integrating Cases, Sub-Cases, and Generic Prototypes for Design," *Issues and Applications of Case-Based Reasoning in Design*, ed. M.L. Maher, P. Pu, Lawrence Erlbaum, Mahwah, New Jersey and London, 1997, pp. 261-300.

L.-K. Soh, C. Tsatsoulis, "Texture Analysis of SAR Sea Ice Imagery Using Gray Level Co-occurrence Matrices," accepted for *IEEE Transactions on Geoscience and Remote Sensing* (1998).

M. Kinney, C. Tsatsoulis, "Learning Communication Strategies in Multiagent Systems," *International Journal of Applied Intelligence, Special Issue on Adaptive Agent Systems,* Vol. 9, pp. 70-91, 1998.

L.-K. Soh, C. Tsatsoulis, "Segmentation of Satellite Imagery of Natural Scenes Using Data Mining," accepted for *IEEE Transactions on Geoscience and Remote Sensing* (1998).

C. Tsatsoulis, Q. Cheng, H.-Y. Wei, "Integrating Case-Based Reasoning and Decision Theory: Theory and Experiments," *IEEE Expert*, July/August, 1997, pp. 46-55.

Professional Affiliations

Association for Computing Machinery (ACM), American Association for Artificial Intelligence (AAAI), IEEE, IEEE Computer Society.

Honors and Awards

Eta Kappa Nu;
Sigma Xi;
Senior Member, IEEE, 1998;
Big-12 Faculty Fellowship to University of Colorado, Boulder, 1997;
AT&T Engineering Education Excellence Award by the State of Kansas, 1995;
National AT&T Engineering Education Excellence Award, National Finalist, 1995;
Miller Award for Research Excellence, 1994.

Victor L. Wallace

Professor (EECS), The University of Kansas, 1993-present;

Graduate Director (EECS), 1993-1998;

Professor (Computer Science), The University of Kansas, l976-1993;

Acting Chairman (Computer Science), The University of Kansas, 1988-1989;

Chairman (Computer Science), The University of Kansas, 1976-1983;

Associate Professor, University of North Carolina, 1969-1976;

Academic Visitor, University of London, 1969-1970;

Associate Research Scienfist, University of Michigan, 1961-1969;

Instructor, University of Michigan, 1957-1961;

Mathematician-Programmer, International Business Machines, 1956-1957;

Member of Technical Staff, Bell Telephone Laboratories, 1955-1956.

Education

Ph.D., University of Michigan, 1969.
B.E.E., Polytechnic Institute of Brooklyn, summa cum laude, 1955.

Teaching

Introduction to Operating Systems,
Advanced Operating Systems,
Programming Language Foundations,
Computer Graphics,
Interactive Graphics,
Data Structures.

Research Interests

Operating systems, computer graphics, user-machine interaction, computer networks, distributed systems, queueing theory, numerical analysis, computer performance.

Recent Publications

J. Foley and V. L. Wallace, "The Art of Natural Graphic Man-Machine Conversation." *IEEE Proceedings*, Vol. 62, 1974. Reprinted in *Seminal Graphics: Pioneering Efforts that Shaped the Field, SIGGRAPH 98 Conference in Computer Graphics and Interactive Techiques*, Orlando, Aug. 1998, pp. 417-426 (in celebration of the 25th anniversary of the first SIGGRAPH conference).

Y. Lee, A. van de Liefvoort, V. L. Wallace, "An Analytical Network Traffic Model using Generalized Interrupted Poisson Processes and Generalized Interrupted Bernoulli Processes", SPIE International Symposium on Voice, Video, and Data Communications, Boston, Nov. 1998.

V. Wallace, G. Zhang, W. G. Bulgren, "A Performance Model of Space-Division ATM Switches with Input and Output Queueing," *Proceedings Hawaii International Conference on System Sciences*, Wailea, Vol. I,1996, pp. 72-79.

Professional Affiliations

ACM, ACM/SIGGRAPH, ACM/SIGOPS, ACM/SIGCHI,
IEEE (Senior Life Member), IEEE Computer Society,
Institute for Operations Research and Management Science (INFORMS),
American Association of University Professors (AAUP).

Honors and Awards

Eta Kappa Nu, Sigma Xi, Tau Beta Pi, Upsilon Pi Epsilon;
Computer Graphics Pioneer Award, 1984, ACM-SIGGRAPH;
Outstanding Senior (Irving Faye Memorial Award), Polytechnic University, 1955;
AIEE National Student Paper Contest, second prize, 1955;
Listed in *Who's Who in Science and Engineering*, *Who's Who in America*, and *American Men and Women of Science*.

ADVISORY BOARD

ITTC is guided by an Industry Advisory Board, many of whom are experienced team members of nationally known information and telecommunications companies. This board guides the ITTC by

- reviewing and selecting internally funded faculty development projects with commercial potential;
- counseling and assisting in the Center's strategic planning;
- providing guidance in marketing and commercialization strategies;
- networking and promoting ITTC;
- reviewing selected policies, procedures, and operations.

During Fiscal Year 1998 the following persons served as members of the ITTC Industry Advisory Board:

Dr. Phil Anderson, Kantronics, Lawrence, KS.

Bob Boaldin, Elkhart Telephone Co., Inc., Elkhart, KS.

Darren S. Braun, Integrated Telecom Technology (IgT), San Jose, CA.

Chris Brown, TRW, Inc., Redondo Beach, CA.

Gerard J. Canavan, Globalstar, San Jose, CA.

Steve Chaddick, Ciena Corporation, Linthicum Heights, MD. (Represented by Joe Berthold at 4/17/98 meeting.)

Terry Champion, Rome Laboratories, Digital Speech Lab (RL/ERT), Hanscom AFB, MA.

Dale Clements, Allied Signal, Inc., KS City, MO. (Represented by Kathy Thomas at 4/17/98 meeting.)

Jim Dahmen, Columbus Telephone Company, Inc., Columbus, KS.

Frank DeNap, Advance Technology Laboratories of Sprint, Burlingame, CA. (Represented by Rick Lett at 4/17/98 meeting.)

Marc Epard, Farallon Communications, Inc., Lawrence, KS.

Andrew J. Ernstein, Ascend Communications, Inc., Overland Park, KS.

Charles Holt, Midwest Research Institute, KS City, MO.

Dr. Andy Hopper, Olivetti & Oracle Research Laboratory, Cambridge, England.

Dr. James Isaacs, ITT Aerospace Optical Div., Ft. Wayne, IN.

Dr. Ali S. Kazeroonian, Active Research, Inc., San Francisco, CA.

Richard Kennedy, Lucent Technologies, Inc., Overland Park, KS.

John R. LaLonde, Integrated Imaging Solutions, GE Medical Systems, New Berlin, WI.

Leland Langston, Systems Technology Laboratory, Texas Instruments Corporate Research, Dallas TX.

Tom Lyon, Ipsilon (The IP Switch Company), Sunnyvale, CA. (Represented by Peter Newman at 4/17/98 mtg.)

Jake Maczuga, Kansas Innovation Corporation, Lawrence, KS.

David Nicol, Product Management & Development, Overland Park, KS.

Susan Norris, Technology Research & Development, Sprint, Overland Park, KS.

Dr. Maurice O'Sullivan, Nortel Broadband Networks, Ottawa, Ontario, Canada.

Joe Ozorkiewicz, Cadence Design Systems, Inc., Lawrence, KS.

Robert Parker, USC-IC, Arlington, VA.

Brian Ruf, RUF Corporation, Olathe, KS.

B. S. (Sam) Samra, Lenexa, KS.

Robert Sansom, FORE Systems, Inc., Warrendale, PA.

David Smith, Public Networks Group, NEC, Irving, TX.

Michael F. Sobek, Information Control Systems, Inc. (ICSI), Overland Park, KS.

Dr. Arun Sobti, Third Generation Cellular Systems Development, Arlington Heights, IL.

Jerry White, Black & Veatch, Overland Park, KS.

Gregory G. Williams, SBC Technology Resources, Inc., Austin, TX.

Mike Wojcicki , KS Technology Enterprise Corporation (KTEC), Topeka, KS.

Ken Young, Bellcore, Morristown, NJ.

Dr. Bob Zerwekh, The University of KS, Lawrence, KS.

RESEARCH HIGHLIGHTS

Accessing Sources with Diverse Ontologies

Student Investigator: Andrew Williams

Faculty Investigator: Costas Tsatsoulis

Individual agents lack a commitment to a common, pre-defined ontology but share a distributed, collective memory of objects. We are developing a system where each agent creates and learns conceptualizations, or ontologies, which are useful for its individual purposes, but it also shares its knowledge to improve group problem solving performance. Our work shows that multiagent learning of ontologies among individual agents with diverse conceptualizations is feasible and these learned ontologies can be used by the agents to improve group search performance for related semantic concepts through experience in the problem domain.

In our work we use supervised inductive learning to learn semantic concept descriptions in the form of interpretation rules. Each source agent contains a description of the information and knowledge contents of the resident source and a representation of the concept hierarchy it is familiar with. A representation hierarchy can contain bookmarks, or URLs, pointing to a semantic concept object, or Web page. Each set of bookmarks in a hierarchy is used as training instances for the semantic concept learner. The semantic concept learner learns a set of interpretation rules for all of the agent's known semantic concept objects. An entire set of these types of semantic concept descriptions can then be used for future semantic concept interpretation.

ACTS ATM Internetwork

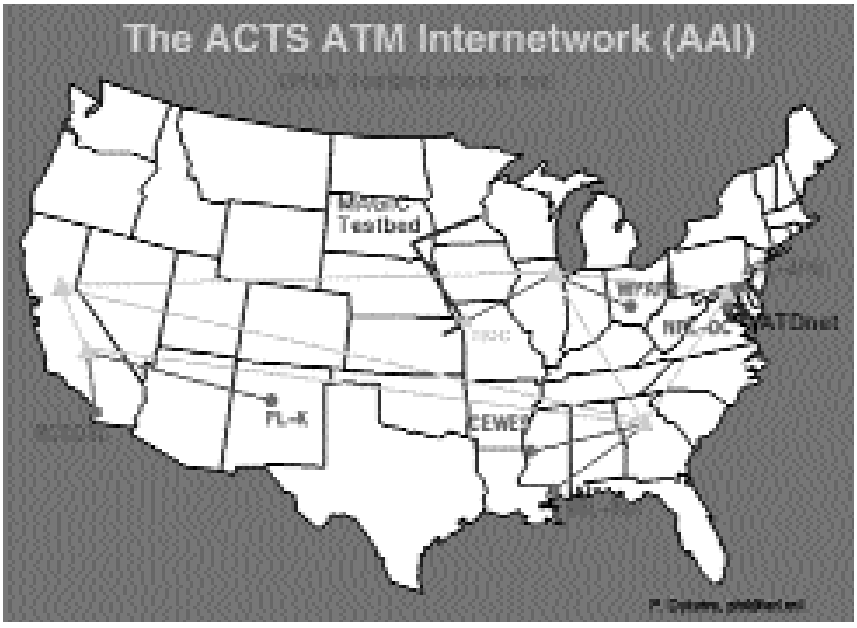
The ACTS ATM Internetwork (AAI) will be composed of a large number of network elements, connected by both ATM DS-3 (45 Mb/s) and OC-12c (622 Mb/s) satellite (ACTS) facilities. There is a need to perform a quantitative evaluation of the performance of the AAI under a variety of conditions. Such an evaluation will provide valuable information required for the ubiquitous deployment of large ATM networks. The thrust of the tasks for the Information and Telecommunication Technology Center will be on the measurement of AAI network performance and the use of those measurement capabilities to determine the efficacy of call admission and congestion control (that is, the performance of the network under stress) as well as to profile the user applications, i.e., traffic characterization. Thus, the issues associated with control and management of "realistic networks" are being addressed. The results from these tasks will demonstrate if techniques developed and tested on "small" systems scale up to networks with a "large" number of users. The work is a direct outgrowth of our on-going, high-speed networking projects. As part of the MAGIC testbed, ITTC has conducted some preliminary ATM measurements and will be conducting an extensive measurement program.

Student Investigators:
Charalambous P. Charlambous,
Roelof J.T. Jonkman, Georgios Lazarou,
Beng Lee, Steven Pennington

Faculty Investigators: Victor S. Frost,
David Petr, Joseph Evans,
Douglas Niehaus

Prime Contractor: Sprint Corp.

Sponsor: DARPA



Analysis and Modelling of ATM Traffic

Student Investigators: Dora Matache, Peter Zimmer

Faculty Investigators: Tyrone Duncan, Bozenna Pasik-Duncan

Sponsor: Sprint Corp.

In this project, trace data from the Sprint network is analyzed and stochastic models, those based on probability, are developed to describe the ATM traffic. In the analysis of the data, the Hurst parameter is estimated. The stochastic models are used to investigate the behavior of the switch buffers using various queuing criteria.

ATM Adaptation Layer for Composite Users (AAL-CU) Research

Student Investigators: Prema Sampath, Raghu Vatte, Aarti Iyengar

Faculty Investigator: David W. Petr

Sponsor: Sprint Corp.

AAL-CU (ATM Adaptation Layer for Composite Users) is a new AAL currently being discussed and standardized within the ATM Forum and ITU-T.

The intent is for AAL-CU to fill a need (not met by existing AALs) for multiplexing several small data units from different sources/connections into a single ATM VC connection. This will limit packetization delay for compressed voice without wasting transmission bandwidth due to partial filling of ATM cells.

The original motivation for AAL-CU was to support compressed voice as found in many cellular systems, but voice trunking and ATM to the desktop have since been added as potential AAL-CU applications.

Proposed Project Goals:

- Provide a detailed performance evaluation of the new AAL-CU, including comparisons with AAL1 and AAL5 alternatives, and recommendations for appropriate protocol parameter values.
- Provide an evaluation of the various impacts of this new protocol on the ATM control plane (e.g., signaling).
- Provide specific recommendations concerning the application of AAL-CU to wireless/cellular networks and concerning interworking of AAL-CU between wireless/cellular networks and fiber-optic ATM networks.
- Provide a technical assessment of AAL-CU's capabilities for other potential applications besides wireless/cellular.

Bi-directional Optical Recirculating Loop for Multi Channel WDM Applications

Optical fiber recirculating loop has been used widely in fiber optical communication labs. It is a very important way to evaluate transmission performance of both ultra long distance submarine fiber-optic systems and wideband terrestrial fiber-optic systems without actually using many spans of fibers and optical amplifiers. To date, all of the optical fiber recirculating loop test beds were designed for unidirectional operation. To evaluate transmission performance of bi-directional optical systems, the development of a bi-directional, fiber-optic recirculating loop test bed is indispensable.

We investigate and optimize the configurations of bi-directional, fiber-optic recirculating loops to construct a well packaged, user-friendly, bi-directional loop test fundation that can be used in high-speed bi-directional SONET/SDH fiber-optic transmission experiments.

Student Investigator: Yonggang Wang

Faculty Investigator: Rongqing Hui

Sponsor: Nortel Broadband Networks

CDMA Capacity Assessment for Personal Wireless Communications

This project assesses the capacity of a cellular personal communications system using code-division-multiple-access (CDMA). With a multiple user CDMA system where all the users have the same data rate, the same activity factor, and the same fidelity requirement, and where perfect power control is employed for users talking to the cellular base station, the formulas for computing the maximum number of CDMA users that can be accommodated in a given bandwidth have been found. However, the case with different classes of users—differentiated by their individual data rate, activity factor, and fidelity requirement—had not. This project is developing a methodology for predicting the allowable number of users of each class. Such an analysis is important for considering the mixing of voice and data users in a wireless system.

Student Investigators: Ranjit Cavatur, Manish Mangal, Vijay Paulrajan

Faculty Investigators: Victor Frost, James Roberts, Glenn Prescott, Sam Shanmugan

Sponsor: Sprint Corp.

Corpus Linguistics for Information Retrieval

Student Investigators: Jianying Wang, Satya Rachakonda

Faculty Investigator: Susan Gauch

Sponsor: NSF (Infrastructure Grant)

Rapidly increasing storage media capabilities and spreading interconnectivity have heralded the arrival of the information age. Unfortunately, accessing on-line information remains an inexact science. While valuable information can be found, typically many irrelevant documents are also retrieved and many relevant ones are missed. Terminology mismatches between the user's query and document contents are one cause of retrieval failures. Expanding a user's query with related words can improve search performance, but the problem of identifying related words remains.

This research uses corpus linguistics techniques to automatically discover word similarities directly from the contents of an untagged textual database and to incorporate that information in an information retrieval system. These similarities are calculated based on the contexts in which the words appear. Using these similarities, user queries are automatically expanded, resulting in conceptual retrieval rather than requiring exact word matches between queries and documents. The effects of using different algorithms to calculate the similarities and the effects of expanding different sets of query words is evaluated.

In addition, the search performance of the retrieval engine serves as a task-based method for comparing the quality of word-word similarities calculated using different corpus linguistics techniques.

We have demonstrated improved search results on the TREC-5 database and dramatic improvements with the Cystic Fibrosis database. Work is currently being done to extend the results to distributed databases.

Data Discovery on the Information Highway (includes ProFusion and ProFilter)

Student Investigators: Yizhong Fan, Tapash Majumder, Edgar Casasola

Faculty Investigator: Susan Gauch

Sponsors: National Science Foundation, KU Faculty Development Fund, ITTC

The Information Highway has become a reality. Increased access to the Internet by the public at large, combined with the development of easy-to-use graphical browsing interfaces—for example, Mosaic and Netscape—has led to an explosion of added information. The World Wide Web (WWW) in particular is being used to present an exponentially growing amount and range of information which people can browse through. Unfortunately, "too much information" can be the same as "not enough information": if the information you seek is buried under an avalanche, is it really there? This research has developed a pilot system which can automatically browse the on-line information, filter it, and display it, bringing the information to the user rather than requiring the user to seek it out.

ProFusion Logo

In the first phase of this project, we developed a meta search engine, ProFusion. The goal of this project was to develop an intelligent, adaptive Web search tool. ProFusion, was awarded the PC Magazine Editor's Choice Award in the "Advanced Meta-Search" category for 1997.

ProFusion analyzes incoming queries, categorizes them, and automatically picks the best search engines for the query, based on a priori knowledge (confidence factors) which represents the suitability of each search engine for each category. It uses these confidence factors to merge the search results into a re-weight list of the returned documents, removes duplicates and, optionally, broken links, and presents the final rank-ordered list to the user.

The main goals of this phase of the research were to (1) provide ProFusion with a multi-agent architecture which is easier to extend, maintain, and distribute; and (2) to include automatic adaptation algorithms to replace the hard-coded a priori knowledge. Our multi-agent architecture demonstrates various desirable agent characteristics, including task-oriented modules, task-specific solutions, de-emphasized representations, decentralized control structure, and learning and development.

The second phase of our information filtering project, ProFilter, uses a database to store queries (and their results) for individual users. Over time, the queries are automatically re-run and the new results added to the user's collection. User feedback can be used to eliminate irrelevant results from those displayed to the user. The irrelevant data, however, remain in the database to prevent their being presented to the user as the result of a later search. We are conducting research on how to incorporate intelligent pre-filtering of the search results based on user feedback into the operational system.

Data Mining of Blood Incident Databases

Student Investigator: Leen-Kiat Soh

Faculty Investigator: Costas Tsatsoulis

Sponsor: National Institutes of Health

The U.S. public and the various health organizations and providers place extreme importance on the quality of the blood supply. While all blood banks, blood handling organizations, and hospitals have very strict quality control procedures, there are still thousands of incidents of incorrect handling of blood and blood products. The goal of the project is to mine very large databases of blood incidents and identify patterns that can lead us to a better understanding of why such incidents occur and how we can minimize them.

We are working together with a group of blood suppliers organized by the University of Texas' Southwestern Medical Center to collect and analyze reports of blood handling incidents. We are using techniques from KDD and data mining—such as clustering and induction—to generate coherent, novel, describable, significant patterns.

Determination of the Impact of Advanced Traffic Controls on the Performance of Edge/Core ATM Network Architectures

Student Investigators: Sandeep Bhat, Isaac Eyeson, Sohel Khan, Shyam Murthy, Haritha Pindi

Faculty Investigators: Victor Frost, Douglas Niehaus, David Petr,Joseph Evans

Sponsors: Sprint Corp, NEC of America

Understanding the customer-perceived performance as high-speed networks rapidly evolve is critical to the success of service providers. Using analysis, simulation, and measurements on the MAGIC and AAI system, we have come to comprehend the performance implications of the first generation of ATM products and networks. This proposal addresses the next challenges: to consider the issues related to the variety and interactions of Available Bit Rate (ABR) control algorithms, implications of Virtual Source/Virtual Destination (VS/VD) architectures, and interactions between TCP/IP, ABR and Quality of Service (QoS) guarantees provided by policing traffic flows.

We will approach obtaining an understanding of these issues using the tools we have successfully developed and applied to the first generation of ATM networks: algorithmic analysis, simulation, and measurements on prototype networks, specifically using the KU/TIOC facilities, MAGIC, AAI, and SPARTAN. It is significant to note that these facilities will allow us to evaluate the impact of hosts connected over a range of link capabilities, from low-speed wireless to 622 Mb/s (OC-12c). The results of this effort will enable the deployment of an efficient long distance ATM network that meets customer expectations for functionality and quality of service.

Development and Testing of Advanced Signaling Protocols for ATM Networks

Student Investigators: Furquan Ansari, Raghavan Menon, Scott Shumate, Michael Swink

Faculty Investigators: Douglas Niehaus, Joseph B. Evans, Victor S. Frost, David W. Petr

Sponsor: Sprint Corp.

B-ISDN protocols and technology make it possible to offer a wide variety of new services, such as multiparty multimedia communications and interactive video distribution, which require transport capabilities more complex than permanent point-to-point virtual circuits (PVCs). These new services require switched virtual circuits (SVCs) supporting point-to-point, point-to-multipoint, and multipoint-to-multipoint connections. Such complex connection types require the support of a flexible signaling system, exceeding the capabilities of existing systems.

This project will investigate the signaling issues associated with creating and maintaining SVCs in broadband networks. Several approaches have been proposed to the further evolution of signaling in broadband networks, ranging from simple extensions of existing protocols to complex architectures which address the interworking of ATM and existing networks. We will evaluate existing signaling software and will investigate extensions capable of supporting future services, and provide those whose implementation is within the range of the available programming resources.

Distributed, Intelligent Search Agents for the World Wide Web

With the expanding amount of information available on the Internet, a centralized agent for information discovery usually has limited capabilities for finding diverse and distributed information, or for providing a quick, effective mechanism to help users find information on-line. The purpose of this project is to allow distributed information agents to work together to index, retrieve, browse, and visualize information on the WWW.

In the system of decentralized search agents, each agent is able to coordinate and cooperate with the other agents to achieve a goal. Once a user issues a query, the local search agent then sends the query to other search agents that have information relevant to this query at their site, brings back the results, and merges them when necessary. The information at each site is categorized relative to a common ontology. The search agents analyze the user's query to identify the concepts in the ontology that are most relevant and then identifies the best sites for that query. Future research will explore ways to allow local sites to adapt their ontologies to their local document collection.

Student Investigators: Xiaolan Zhu, Sean Blaes.

Faculty Investigator: Susan Gauch

Sponsor: NSF CAREER/EPSCoR

Equation Discovery in Databases

Student Investigator: Liye Zhang

Faculty Investigator: Kim Roddis

Sponsor: ITTC

With the growth in the storage of data in an electronically accessible form, increasing attention is being directed at how better to use this data. The overall process of extracting usable knowledge from electronically stored data is described as Knowledge Discovery in Databases. This process begins with data retrieval and results in consolidating and using the newly discovered knowledge in conjunction with existing knowledge. The part of the process where patterns are extracted or models are built is referred to as Data-Mining. This work concentrates on the Data Mining step of Knowledge Discovery in Databases. Knowledge Discovery in Databases is directly related to ITTC's core technical focus area of Intelligent Systems and Information Management, emphasizing the application of advanced, intelligent methodologies as applied to solving problems in information identification, retrieval, analysis, and fusion.

Many approaches can be used in Data Mining and many different kinds of patterns discovered or models built. This work focuses on one particular kind of model construction with wide applicability suitable for a particular set of characteristics of the data base. One model form widely used for both prediction and description is to represent the discovered patterns in a system of multivariable equations. The proposed method to automatically induce models in the form of mathematical functions from data is applicable to data having the following characteristics:

1. High dimensionality of variables or attributes are of mixed types, numeric and symbolic.
2. Numerical equations to be discovered are multidimensional and homogeneous, that is to say, the same relationship does not hold over the entire problem domain. Different relationships hold in different parts of the problem space.
3. A model of numerical equations cannot be assumed a priori because the significant variables used in numerical equations are unknown before analysis.

The method combines a machine learning technique and regression analysis to automatically and intelligently help in discovery of knowledge hidden in data.

Evaluation of Distributed Control and Signaling Infrastructure for ATM Networks

Student Investigators: Robert Hill, Anil Gopinath, Sachin Sheth, Arvind Kaushal.

Faculty Investigators: Douglas Niehaus, Dave Petr.

Sponsor: Sprint Corp.

Two of the most important problems that must be solved before large-scale, multi-service ATM networks can become a practical reality are the efficient provision and management of services, especially effective available bit rate (ABR) services, and adequate support for network management computations. The focus of this project is on the creation of a testbed within which the performance of network services and network management can be evaluated. This has required the creation and integration of a number of tools, some developed under other projects, to enable us to consider all factors affecting network performance.

The tools which are part of the testbed include NetSpec, the ATM Reference Traffic System (ARTS), Call Generator(CG), and the Data Stream Kernel Interface (DSKI). NetSpec is a tool for describing and conducting network level performance evaluation experiments. ARTS is a system designed to record and produce packet level ATM traffic reproducibly. The CG is designed to set up and tear down ATM connections according to various load patterns. The DSKI is a device driver which provides a general interface for collecting event traces from the operating system. With these tools integrated into a single suite under the control of NetSpec, we can now describe and conduct performance evaluation experiments addressing the role of every level of the user, operating system, and network signaling software in determining the performance of an ATM connection.

The architecture of next-generation network management software (NMS) will be required to support an increasingly complex set of services and must be able to continuously evolve. The NMS will be object oriented and subject to significant real-time performance constraints. The TINA standards are addressing these issues, but they are still very general and do not consider implementation details that will have a vital influence on network performance. Our work is to address this by creating the ability to test the performance of CORBA-based applications under NetSpec. This will enable us to consider how each component of the total system affects the performance of NMS structures described by TINA, and thus what type of computational resources will be required to manage next-generation networks using TINA based control architectures.

Exploiting Open Control of ATM Networks

Student Investigator: Parasuram Ranganathan

Faculty Investigator: Joseph Evans

Sponsor: Sprint Corp.

The objective of the project is to get a proof-of-concept implementation of multiple control architectures sharing resources on the switch and the control plane handling resource allocation and monitoring employing the concept of "SWITCHLETS." Thus we intend to achieve multiple virtual networks running control architectures such as Q.2931, IP switching, FORE native onboard SPANS and ORB-based architecture and resource partioning and management being handled by the switchlet environment. Also involved in the project are investigation of performance, fault tolerance, and scalability.

A Functional Programming Environment for Design and Implementation of High Performance Radio and Synthetic Aperture Radar Processing Functions

Student Investigators: Mahalingam Karthik, Majid Mahmood, Claudio Santos, Sandeep Mukthavaram

Faculty Investigators: Gary J. Minden, Joseph B. Evans, Glenn Prescott, J. Michael Ashley, Douglas Niehaus

Staff Investigators: Mohan Kambhammettu, Scott Woodward

Sponsor: DARPA

This project has three research focus areas:

(1) The design and implementation of a Functional Programming Environment (FPE) to express signal and image processing algorithms, mapping (compiling) those algorithms to field programmable gate array (FPGA) architectures, and managing adaptive computing resources.

(2) The implementation and demonstration of radio communication functions with the FPE and mapping these functions onto field programmable gate arrays.

(3) The implementation and demonstration of synthetic aperture radar (SAR) processing algorithms with the FPE and mapping these algorithms onto FPGAs.

The first area creates an important technology for expression and manipulation of signal and image processing algorithms. The second and third areas will be used to evaluate the FPE and implement important radio communications and SAR processing functions and modules.

Generating a Rule Base for Sea Ice Classification

The goal of this project is to generate an implementable rule base to assist in the classification of different sea ice types from Synthetic Aperture Radar (SAR) satellite images.

We are interviewing sea ice experts and sea ice observers from the U.S. National Ice Center and the Canadian Ice and Environment Center to generate a rule base for classification. The qualitative rules experts are providing are also matched with quantitative image features and characteristics. For example, "rough-looking ice" is translated by our work into a fuzzy description of various texture parameters that can be computed from the image.

The result is a collection of rules and of image analysis algorithms that generate the predicates and descriptions used in the rules.

Our system is being tested on SAR imagery of the Beaufort Sea and is being evaluated by human experts in the U.S. National Ice Center and the Canadian Ice and Environment Center.

Student Investigator: Leen-Kiat Soh

Faculty Investigator: Costas Tsatsoulis

Sponsors: Naval Research Laboratory, NASA Headquarters

Integrated Evaluation of Network, System, and Application Software Architecture and Performance Issues in ATM Networks

Student Investigators: Anil Gopinath, Sridhar Nimmagadda, Chanaka Liyannaarchchi, Shyam Pather, Matt Peters, Charles Dymond, Aaron Hoyt, William Dinkel, Robert Hill, Balaji Srinivasan, Gowri Dhandapani

Faculty Investigators: Douglas Niehaus, Costas Tsatsoulis

Sponsor: Sprint Corp.

Three major forces are interacting to create changes in networks, system software architectures, and the nature of application software. The latest generation of network technology supports huge bandwidths. Potentially, these provide system and application software with communication channels whose speed, capacity, and varied Quality of Service (QoS) greatly extend how software can use networks. Advances in system software and middleware continue to motivate changes in the software architecture and operational requirements of leading-edge applications, thus changing the services they require from the operating systems and networks supporting them. Finally, emerging applications such as multimedia conferencing, video delivery, interactive WWW interfaces, and distributed multi-user virtual reality environments (e.g. multi-user games) require new types of services from the underlying end system and network. The gradual but continuing emergence of real-time execution constraints in leading edge applications is of particular interest, since it is especially challenging to add real-time abilities to existing systems and software.

Initial experience shows that while the potential of the emerging network and middleware technologies is real, realizing that potential will require progress in addressing their influence on the end-to-end performance of applications. The isolated consideration of system components' properties by researchers is a necessary, but often not sufficient, condition for understanding the causes of the end-to-end application. The interest of the service providers in end-to-end evaluation is motivated by a simple principle: customers pay for application performance, not for network services. This project concentrated on creating the ability to take an integrated view of end-to-end performance.

We created the Adaptable Performance Evaluation Testbed (APET) within which the influence of all components of the system—from the network to the application—can be evaluated, individually and collectively, in detail and in a single consistent hardware and software context. Extensions to the Data Stream Kernel Interface (DSKI) improved our ability to gather performance data from the internal operating system's components. We extended and improved the KU real-time (KURT) extensions to Linux for support of applications with real-time execution constraints that we use to support real-time ORB experiments, to experiment with real-time support for video client and server software, and to support real and proportional time simulation and emulation of ATM networks. We created the Performance Measurement Object (PMO) to enable the specification and execution of ORB real-time and conventional ORB performance evaluation experiments under NetSpec control. We have created an initial ORB benchmark suite using the PMO and have a prototype for a Performance Pattern Language (PPL), which provides higher-level semantics for describing application-level performance experiments. We also considered how agent technology could be applied to network management in the emerging object-oriented, real-time environment.

Intelligent Agents and Multiagent Systems

We are developing a Java-based, graphical, robust agent tool-set that allows the easy and quick implementation of agents for a variety of applications. The tool-set implements the basic characteristics of agents: autonomy, reaction, pro-action, persistence, and learning. We are also developing Web-based tools to allow the agents to be implemented remotely over the Internet, and a set of performance metrics and metric presentation tools.

The tool-set will be tested on three domains of resident expertise: information retrieval from heterogeneous sources, data mining, and image databases. Currently we are finishing the implementation of agent-based data mining of an extensive S&P 500 financial dataset.

Our agent tool-set uses KQML as the preferred agent language and CORBA for agent communication.

Student Investigators: Michalakis Michael, Chien Chen, Danico Lee, Steve Ganje

Faculty Investigator: Costas Tsatsoulis

Sponsor: IITTC

Intelligent Information Dissemination Server (IIDS)

Information needed by the warfighter is available from many different sources and in many different formats: unstructured and semi-structured text (e.g., news wires and intelligence reports), structured data in database systems (e.g., logistics and inventory databases), and image and video data (e.g., weather maps from satellites, area maps and battlefield snapshots from UAVs or fly-bys). All this information needs to be integrated into a comprehensive scenario called the "Battlefield Infosphere."

Our work supports the generation of this infosphere by providing intelligent dissemination of information to the warfighters. KU is working as a member of a consortium of universities and companies, namely Global InfoTek, ISX, Lockheed-Martin, and Stanford University, that is designing and implementing IIDS.

The project involves research in AI, multiagent systems, adaptive and learning agents, CORBA, and heterogeneous databases.

Student investigator: Huseyin Sevay

Faculty Investigator: Costas Tsatsoulis

Sponsors: DARPA, Lockheed

Investigation of FPGA Rapid Prototyping of Military Software Radio Systems

Student/Staff Investigaors: Artur Leung, Charalambous Charalambos, Dan Depardo

Faculty Investigators: Glenn Prescott, Joseph Evans Sam Shanmugan

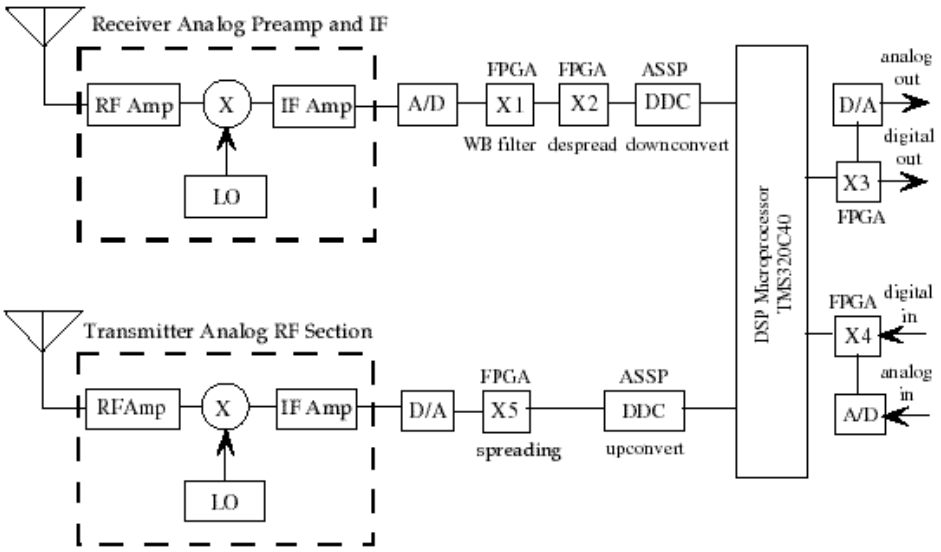
Sponsor: USAF Rome Lab

The objective of this effort is to develop efficient signal processing algorithms for military tactical radio systems. Specifically, we will implement a rapid prototyping system using both state-of-the-art Digital Signal Processors (DSPs) and Field Programmable Gate Arrays (FPGAs) and demonstrate the capability of this system to prototype a limited digital radio transmitter and receiver system.

Previous research efforts with Rome Laboratories have led to the development of a digital signal processing rapid prototyping system consisting of Cadence Systems Signal Processing Worksystems (SPW), and Synopsys software tools, with algorithms implemented on FPGAs and paralled-DSP processors. With this system we developed and tested radio algorithms for several of the Air Force's "Smart Radio" programs. With the use of FPGAs, we are investigating ways to speed up the radio algorithms and to reduce the signal processing tasks required of the DSP processor.

The scope of the present effort includes the development, implementation, and demonstration of an operating prototype of a limited-capability digital radio transmitter/receiver system. This demonstration prototype is to be developed using the DSP and FPGA Evaluation and Prototyping System to achieve an optimal system configuration. The effort will look at which radio functions should be partitioned to the DSPs and which functions to the FPGAs.

Another component of the research focuses on interference excission. An essential requirement in military communications is extraction of interference from the received signal as early in the detection process as possible. Military radio systems employ spread spectrum techniques, which produce extremely wide bandwidth signals. To excise interference at spread spectrum bandwidths, high speed digital signal processing is required. The processing speeds needed for interference excision at the spread bandwidth normally exceed those available in traditional DSP microporcessors. Therefore, we are investigating the implementation of certain interference excision algorithms using FPGA technology to facilitate the rapid (and possibly adaptive) excision of narrow band interferers within a large operating bandwidth.



Tactical Radio Testbed

KEURP Net & Link

In Phases I and II, we implemented technologies which created a World Wide Web site for the Kansas Electrical Utilities' Research Program (KEURP). This site created a World Wide Web presence for KEURP, providing information about KEURP to the world at large. In addition to providing information about KEURP, the site provides custom programs to allow the Technical Committee to operate electronically, distributing, commenting on, and voting on pending proposals via any World Wide Web browser. Finally, the site contains a suite of management tools, including an online meeting scheduler, electronic calendar of meetings, and electronic mailing list support.

The goals for Phases I and II have been completed, and a useful and reliable World Wide Web site for KEURP is operational. However, there is no mechanism by which KEURP can maintain its site independently. As new information is generated (e.g., yearly research objectives) and as old information needs updating (e.g., the members of various committees), KEURP cannot currently add or update its own Web pages. The goal for Phase III, therefore, is to provide easy-to-use facilities whereby KEURP staff members can remotely add, remove, and update information.

Faculty Investigators: Susan Gauch, Doug Niehaus, Joe Evans

Sponsor: Kansas Electric Utilities Research Program (KEURP)

The KUIM Image Analysis System

Student Investigators: Jacque Bride, Sylvain Bouix, Brett Close, Scott Daugherty, Felix Fernandez, Scott Graham, Xiodong Hong, Chunyen Liu, Edu Metz, Jay Peterson, Yu Zhao, Bona Nasution, Anthony Nicholson, Yanning Zhu

Faculty Investigator: John Gauch

Sponsor: NSF Infrastructure Grant

The KUIM image analysis system is a collection of general- and special-purpose image processing and computer vision applications developed at the University of Kansas. At the heart of the system is an image I/O library which supports a variety of image formats. Over fifty application programs provide basic image analysis operations, such as contrast enhancement, noise removal, image restoration, and image compression. The KUIM image analysis system is currently available on most UNIX platforms (DEC, HP, SGI, Sun) and is now being ported to Windows NT.

Our current research focuses on fast and effective tools for image segmentation and motion analysis. Specific segmentation applications include identifying cells in microscopic images, classifying ice types in remote sensing images, segmentation of multispectral images and medical images, and temporal segmentation of video sequences. Other research areas include multisensor image fusion, stereo correspondence, and parallel algorithms for image processing. Some of our 1996 projects follow:

- Algorithms for Video Segmentation (J. Bride, S. Bouix, S. Daugherty). This project's goal is to partition video sequences into short clips for use in a digital video library. To do this, we must identify the starting and ending points of video segments that were spliced together. Simple measures like mean squared pixel difference are effective for identifying sharp transitions, but more advanced computer vision methods are needed to distinguish camera fadings from camera or object motions. To support this computationally demanding approach, we are developing parallel algorithms using PVM on a network of workstations.
- Color Image Segmentation Using Gradient Watersheds (X. Hong). The intensity gradient helps identify edges in an image (high gradients) and homogeneous regions within objects (low gradients). One method for segmenting an image into visually sensible regions is to view the intensity gradient image as elevation, and calculate the watershed regions (i.e., collections of pixels that are surrounded by pixels with high gradients). Extending this notion to color images requires an appropriate metric for calculating differences in pixel color. Our goal is to evaluate different color spaces and difference metrics for this purpose.
- Framework for Parallel Image Processing. A number of image processing applications have high computational requirements and lend themselves well to parallel implementation. For example, non-linear contrast enhancement methods that process local pixel neighborhoods to generate output images can be partitioned into subimages and run in parallel on multiple machines. In a heterogeneous network of workstations, the challenge is how to "best" divide the input image into subimages to balance the work while minimizing communication among processors. The project goal was to develop an object-oriented framework on top of PVM to assist in the development of load balanced parallel implementations of image processing applications.

A Large-Scale Internetwork Supporting High Speed Distributed Storage, Processing, and Applications—MAGIC II

Student Investigators: William Dinkel, Anand Subramanian, Yulia Wijata, Amit Kulkarni, Isfahan Deendar

Faculty Investigators: Victor S. Frost, Joseph B. Evans, Gary Minden, Douglas Niehaus

Sponsors: Sprint Corp., Defense Advanced Research Projects Agency (DARPA)

The current MAGIC Gigabit Testbed (MAGIC-I) has demonstrated a high-speed, wide-area IP/ATM testbed that supports a real-time terrain visualization application and a high-speed, distributed storage system. The MAGIC-II effort extends that environment by connecting the MAGIC-I testbed to other wide-area IP/ATM testbeds and adding a variety of capabilities that enable large-scale, distributed information systems. MAGIC-II has two major inter-related goals: (a) to develop a proof-of-concept visualization application that demonstrates the utility and capabilities of distributed processing and network-based storage coupled with high-speed networks, and (b) to create a very large internetwork with many end-users to provide a realistic test environment for ATM technology and for the above application.

The MAGIC-II application is based on a general paradigm in which high-performance computing, storage, and communications are used to provide rapid access to large collections of data that have to be quickly processed and delivered to an end-user. Applications that use this paradigm arise in a variety of situations, including military operations, intelligence imagery analysis, and natural disaster response. These applications share a requirement for access to large amounts of data, the exact type, location, and ownership of which may not be known in advance. They also require a large amount of processing to transform data into useful information, which may have to be delivered to mobile end users. KU will incorporate a wireless component into the MAGIC-II testbed, which will demonstrate mobile access to broadband services. MAGIC-II will provide an environment for experimenting with mobile wireless access to broadband services. The MAGIC visualization application will be designed to operate with the user interface on a wireless node.

A challenge for large-scale distributed information systems is the need to compute and communicate independent of a wired connection to the broadband infrastructure. Users on the move or in remote locations will require access to the distributed information systems over a wireless link. A major component of the MAGIC-II program is the development, implementation, and demonstration of a wired/wireless internetwork that can scale. This is being accomplished by integrating the wireless ATM networking elements being developed at KU into the MAGIC-II internetwork. Thus the MAGIC-II provides an environment for experimenting with mobile wireless access to broadband services. Further, the MAGIC visualization applications are being designed to operate with the user interface on a wireless node. This process will create a large scale wired/wireless internetwork testbed.

Lightwave Communications Systems Research

Student Investigators: Shuxian Song, Helin Ji, Yuyi Guo, Chris Johnson, Hok-Yong Pua

Faculty Investigators: Kenneth Demarest, Christopher Allen, Victor S. Frost, Joseph Evans, Karen Nordheden

Staff Investigator: Xiaojun Fang

Sponsors: Sprint Corp., National Science Foundation, Kansas Technology Enterprise Corporation, Lucent Technologies, Inc.

Advances in high speed electronics and lightwave devices offer the potential for significant efficiency improvements in long distance communications. However, how to construct systems that provide reliable advanced communications services using these evolving devices is an open issue. The purpose of this research is to identify and investigate those issues that are necessary to integrate high-speed electronics and lightwave devices into efficient and robust systems to support leading edge services. The focus will be on how to migrate from the existing network to a system more heavily dependent upon lightwave elements. This research will address fully utilizing the capability offered by optical communications by using techniques such as wavelength-division-multiplexing (WDM), soliton, and coherent modulation, which are viable approaches to utilizing the 25,000 GHz bandwidth of a single optical fiber.

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Note: SFM = Single-mode fiber; DCF = Dispersion-compensating fiber.

Object Motion Analysis for Biomedical Applications

This project addresses two fundamental problems in biomedical image analysis: object motion quantification and shape change characterization. It will result in powerful new tools to assist researchers interested in studying the biomedical mechanisms responsible for object motion and shape change. There are three phases to this project: (1) the development of new motion quantification methods, (2) the development of new shape change characterization methods, and (3) the evaluation of these techniques by collaborators in biology and medicine.

The first phase of this project involves the development of new methods for detecting object motion in biomedical image sequences and quantifying this motion. Our objective is to construct an integrated boundary-based and region-based motion detection system based on the calculus of variations. Here, we plan to build on our experience with 2D and 3D deformable object models for image segmentation, multisensor data fusion, and robust optic flow calculation methods. By simultaneously detecting object boundaries and tracking their motion, researchers will be able to quantify the motion of objects or regions of interest in images more reliably.

The second phase of this project involves the development of new methods for characterizing shape change using the motion information obtained above. Shape change analysis (also known as morphometrics) is typically performed based on manually identified biological landmarks. Our objective is to automatically identify visually distinct landmarks that follow the motion field we have calculated. To do so, we plan to make use of multiscale shape analysis applied to object boundaries to identify image landmarks based on their geometric properties. Thus, we will be extending morphometric tools to a wider range of applications.

The third phase of this project involves the evaluation of our motion analysis tools. We have been working with Max Fiskin and Elliot Goldstein at the University of Kansas Medical Center (KUMC) on a project to track and quantify the motion of white blood cells (PMNs) in microscopic image sequences. Since PMNs play an important role in fighting infection, the motility of these cells in different patients with different treatments is of great medical interest. In our current system, moving PMN cells are video taped, digitized on a PC, and processed using KUIM software to locate and track moving cells. The movement of individual cells is then statistically analyzed to determine the motility of the population cells. Our future goals are to investigate two fundamental questions: (1) How do PMNs change shape prior and during motion? and (2) How do Ca+ and pH vary in PMNs as they change shape and move?

Student Investigators: Chun Yen Liu, Jay Peterson, Edu Metz

Faculty Investigators: John Gauch, Max Fiskin (Microbiology, KU Med Center), Elliot Goldstein (Medicine, KU Med Center)

Sponsors: The Whitaker Foundation's Biomedical Engineering Research Program

Plasma Research Laboratory

Student Investigators: Xuan-Dong Hua, Yao-Sheng Lee, Sumit Misra, Therapon Therapontos, Stefan Lazaridis, Bogdan Pathak

Faculty Investigator: Karen J. Nordheden

Sponsors: National Science Foundation, Kansas Technology Enterprise Corporation, TRW, TriQuint, The University of Kansas

The Plasma Research Laboratory (PRL) is developing new reactive ion etching (RIE) processes for semiconductor device improvement. We have recently developed a through-the-wafer slot via hole etch process for GaAs based HEMTs and MMICs. The use of small RIE slot vias to connect to each individual source contact has been shown to result in an increased packing density (smaller chip area), lower source inductance (eliminates the need for source airbridges), more uniform heat distribution, and increased gain and efficiency. Via holes are etched from the back of the thinned wafer to the front of the devices, then metalized to provide ground for source contacts. These slot vias require very high aspect ratios; vias are typically on the order of 20 x 60 µm2 or smaller on a 50-micron-thick substrate. An optimum via hole etching process using a Plasma Therm 790 RIE system was determined to be 300V bias voltage, gas flow ratio of Cl2:BCl3:Ar = 4:3:10, and chamber pressure of 15 mTorr. The average etch time for 20 µm wide x 60 µm long vias on a 50-micron-thick, three-inch-diameter wafer is 180 minutes using a total flow rate of 50 sccm, which corresponds to an average etch rate of 0.3 µm/min. This process has been succesfully implemented on K and Ka band HEMT power amplifiers fabricated by TRW.

The Pricing of Services in ATM Networks

Faculty Investigator: David Petr

Student Investigator: Luiz DaSilva

Sponsors: Sprint Corp.

While a great deal of research has been carried out in the last few years on traffic management and traffic models for ATM networks, the issue of pricing remains largely unexplored. The pricing structure affects not only revenue, but customer behavior, statistical multiplexing capabilities, and ultimately network performance.

We wish to study desirable pricing sturctures for commercial ATM networks, taking into account the following:

a. customer's decision-making process;
b. economic efficiency requirements (maximizing network provider and customer benefits).

The customer's decision process consists of finding, at any given time, the service that optimizes his/her individual cost/benefit relationship. Network providers, on the other hand, must take into account the staisfaction of all users, as well as fairness, network performance, and overall revenue when deciding which pricing structure to implement. While at times these may be conflicting objectives, pricing can be used as a way to encourage users to exibit behavior that is beneficial to the network as a whole. The ultimate goal is to identify properties of a pricing structure for a commercial ATM network which best achieves the objectives of the network provider, as well as the customer's goals.

Rapidly Deployable Radio Network

The primary objective of the RDRN project is to create architectures, protocols, and prototype hardware and software for a high-speed network that can be deployed rapidly in areas of military conflicts or civilian disasters. For example, in Desert Storm, Bosnia, Hurricane Andrew, and the LA earthquake, communication infrastructures were lacking and/or destroyed. The rapid deployment requirement, coupled with higher speed requirements and seamless integration with other commercial networks, has lead to an approach that uses wireless technology for communication links and ATM for networking. The Rapidly Deployable Radio Network (RDRN) being developed by the University of Kansas is a wireless ATM network: it consists of portable (mobile) communication nodes which can be deployed on the ground or on mobile platforms such as trucks, helicopters, or fixed wing aircraft. When deployed, the nodes use GPS-derived location information to automatically configure themselves into a high capacity, fault-tolerant network infrastructure.

Student Investigators: Ricardo Sanchez, Syed Fazal, Tim Gallagher, Ken Filardo, Richard Killoy, Saravanan Radhakrishnan, Fadi Wahhab, Rupul Safaya, Shane Haas, John Paden, Chris Bartels, Benjamin Schulte

Staff: Dan Depardo, Artur Leung, Craig Sparks

Faculty Investigators: Joseph Evans, Sam Shanmugan, Gary Minden, Victor Frost, David Petr, Glenn Prescott, James Roberts

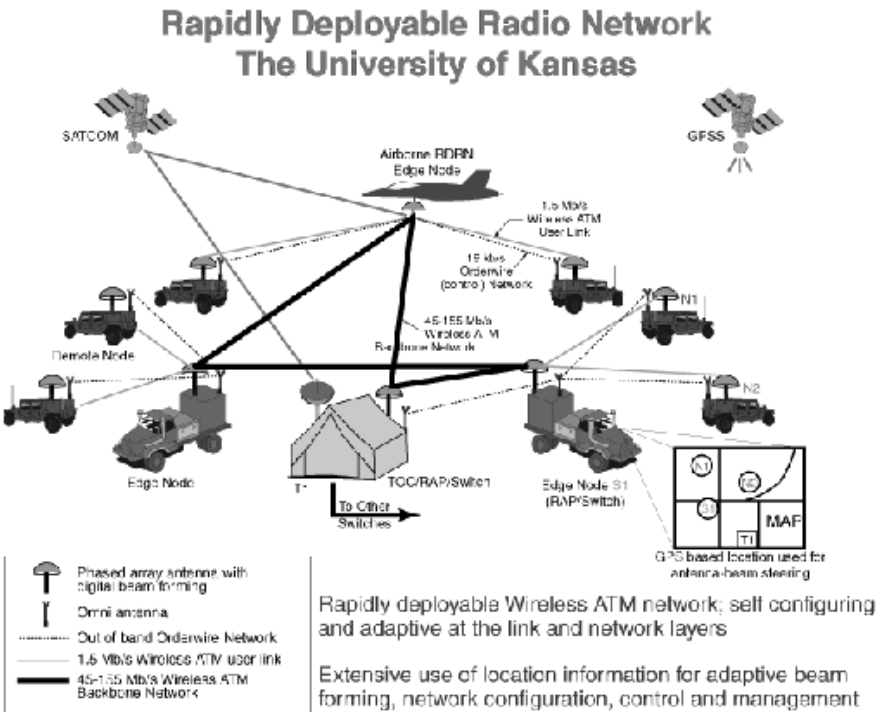
Sponsor: Information Technology Office (ITO) of the Defense Advanced Research Projects Agency (DARPA)

RDRN is made up of two types of nodes: end-user nodes provide wireless ATM access for users at a rate of up to 1.5Mbit/sec.; edge nodes serve as Radio Access Points (RAPs) or base stations and provide switching and connectivity between users. Both contain GPS receivers for location determination; software-controlled radios with phased-array antennas for beam forming and pointing in the right direction, using GPS derived location information; and Network Control (NC) software. The edge nodes also have built-in ATM (software) switches and are interconnected by high capacity (45 to 155Mbit/sec.) directional radio links. Edge nodes can interface to wired ATM networks.

The RDRN architecture consists of three overlaid radio networks:

(1) a low bandwidth, low power, omni-directional order wire packet radio network for broadcasting location information, network configuration, and management;
(2) a cellular-like ATM radio network for end-user access to edge nodes with hand-offs;
(3) a high capacity wireless ATM backbone network providing connection between switches using high-capacity radios with multiple, directional beams.

RDRN is adaptable to changes in the quality of the radio communication environment. While ATM is designed to operate on high-quality (almost error-free) wired links, typical radio links suffer higher error rates and the link quality changes as a function of time due to mobility and changes in the environment. By estimating the channel parameters such as multipath



Rapidly deployable Wireless ATM network; self configuring and adaptive at the link and network layers

Extensive use of location information for adaptive beam forming, network configuration, control and management

spread and signal-to-noise ratio, communication parameters at the link and network levels are adapted to provide appropriate throughput and quality of service.

Prototype algorithms, hardware, and software have been developed to demonstrate the following key concepts of RDRN:

(1) software controlled radio, (2) phased array antenna with digital beam forming, (3) orderwire network for network configuration and control, and (4) protocol stack(s) for wireless ATM and IP over ATM.

We have finished Phase I, and a follow-on contract has been awarded. We are now in the initial stages of RDRN Phase 2.

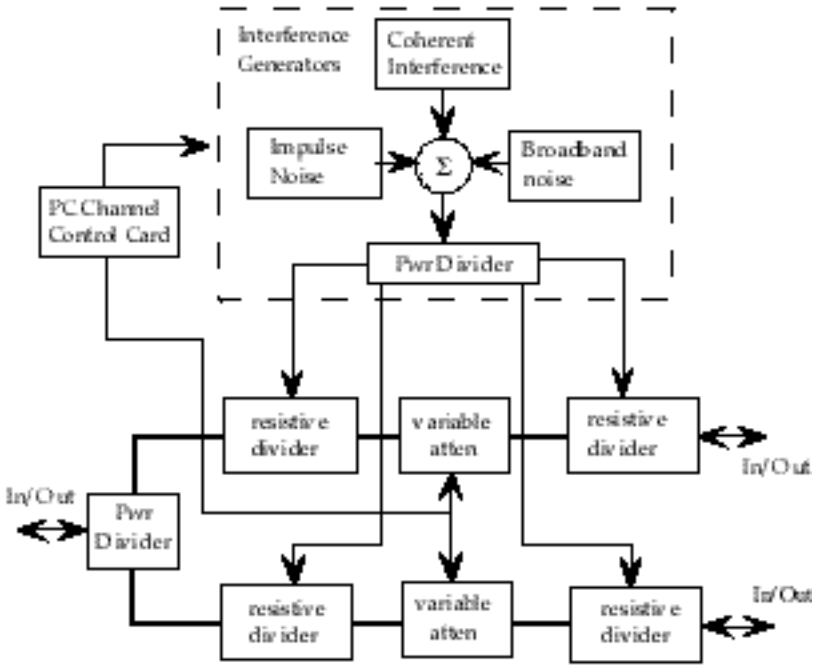
RF Channel Simulation for a UHF Wireless Communication System

Student Investigators: Artur Leung, Ali Serener

Faculty Investigators: Glenn E. Prescott, James A. Roberts

Sponsor: (proprietary)

This research involves the design, implementation, and testing of a hardware-based, wireless communications channel simulator. The purpose of the simulator is to provide a laboratory test instrument for evaluating UHF radios. The simulator allows the radios to be tested in a controlled RF environment that can be configured under operator control to approximate closely the propagation conditions found in the confines of a typical hospital. This environment includes flat fading, coherent interference, background noise, and impulsive noise. In order to provide realistic performance, the behavior of the simulator is based on actual channel measurements.



Proposed RF Channel Simulator

These measurements have been incorporated into a software tool (SircimPlus), which generates the behavior files based on parameters that are input to this program by the operator. Our task is to verify the preliminary design of a channel simulator, assemble the necessary RF components, fabricate any external circuitry that may be required, program the user interface and any necessary software drivers, and integrate the system into an operational unit.

Tracking Internal Layers of the Greenland Ice Sheet Using Airborne Radio Echo Sounder Images

Faculty Investigator: John M. Gauch

Sponsor: National Aeronautics and Space Administration (NASA)

The Greenland ice sheet holds a tremendous amount of information about its history and flow in the internal layering structure of the ice. This study uses an existing data set to aid in the understanding and interpretation of glacial processes. It applies various signal-processing techniques to the analysis of the layers identified by the University of Kansas ice-penetrating radar (Coherent Antarctic Radar Depth Sounder, or CARDS). This instrument has been flown on the NASA P-3 Orion Aircraft over the Greenland ice sheet and has provided a valuable record of the ice sheet thickness. These data contain a detailed picture of the internal layer structure of the ice sheet, which when treated with care, can be correlated over large distances and between crossing radar profiles.

An original proposal by Zwally and others sought to develop tools for analyzing radar data and tracing the ice layers. They proposed to trace all ice layers identifiable in available radar data to the extent possible, expand the understanding of the horizontal distribution of age vs. depth relationships of dated layers, and examine the layer structure for interpretation of spatial accumulation distribution.

We will contribute to these objectives first by removing the effects of multiple reflections. Secondly, we will contribute to the development of correlation I pattern-recognition software to identify matching layers. Finally, we will investigate the applicability of various warping functions to effectively interpolate the layering structure to provide meaningful data in the areas not covered by the radar overflights.

One product of this research will be processing software that will convert the original radioechograms into deconvolved echograms. The effects of multiple reflections will be removed and the return strengths amplified with depth. This software will be applicable to all subsequent CARDS surveys of the ice sheet internal structure. With some small modifications, it should also be applicable to any similar radar surveys of Greenland and Antarctica with minimal dependence on the instrument and data processing technique used by the radar engineers and operators.

A second product will be a set of pattern recognition software that will identify patterns in the ice layering and track them through the ice to the extent they are identifiable.

Finally, the research will help develop a method of interpolating between lines of the radar surveys. The results of this work will feed directly into the production of maps of different layers within the ice sheet.

Traffic Management and Controls for ATM Networks

Student Investigators: Qingyang Hu, Kunyan Liu, Jason Keimig, Sampat Sreepathi-Komanduri

Faculty Investigators: David W. Petr, Victor S. Frost, Doug Niehaus

Sponsor: Sprint Corp.

Component 1: Integration and Evaluation of CBR/VBR/ABR Controls with Voice/Data/Video/ Image Traffic

There have been several traffic controls proposed and studied for CBR, VBR and ABR services. Some of these would function within customer equipment, some at the ATM access point (or User-Network Interface—UNI), and others would be distributed throughout the ATM network. This component will focus on UNI and network-distributed controls, and only those that are applicable once a connection has been established.

Component 2: Development and Evaluation of Dynamic Renegotiation of Traffic Contract

Recent traffic measurements indicate that a connection may have traffic requirements that vary significantly with time, even when the time scale is large (tens of seconds, minutes, or even hours). If the traffic contract is static, the connection user must estimate the most demanding values for the traffic contract parameters that would be expected over the duration of the connection. This would be not only difficult but also wasteful of network resources. ITTC plans to develop a complete dynamic traffic contract renegotiation system and evaluate its performance.

Component 3: Modeling and Evaluation of a Global Network Management Overlay for Call Admission Control (CAC) and Network Resource Management

A major unknown in network resource management is the uncertainty about what information is needed by the "resource allocator" and how often this information should be collected. ITTC's approach will be to structure simulation-based experiments to determine the sensitivity relationships between control parameters: e.g., the CAC policy on a VP, and the QoS.

Component 4: Real-Time Experimental Evaluation of ATM Network Controls With Multimedia Connections

ITTC will evaluate the feasibility of implementing various traffic controls within a real-time control and measurement framework, choose a set of controls to implement, design experiments to evaluate the performance of these controls with multimedia connections, perform the experiments, and analyze the results.

Component 5: Evaluation of Service Aspects, Controls, and Signaling for Network Interfaces (BICI/NNI)

This component will provide a careful evaluation of the service aspects, controls, and signaling for interfaces between network service providers.

The VISION Digital Video Library System

Student Investigators: Aravind Saraff, Bhaswati Ray, Sylvain Bouix

Faculty Investigators: Susan Gauch, John Gauch

Sponsors: ITTC, DesignLab, KU Research Development Fund

This project has developed a prototypical digital video library system called VISION (Video Indexing for SearchIng Over Networks. VISION can digitize, compress, store, index, search, and retrieve video, audio, and closed-caption information. We have developed a client and server that can provide video information over the Internet or the evolving National Information Infrastructure. To be effective, such a library system must allow users to find the video segments they want. This project is conducting ground-breaking research into automatic content-based segmentation and indexing of videos that will significantly improve users' ability to access specific segments of interest with videos.

Videos, soundtracks and closed-captions are digitized, and the video and audio signals are used together to provide scene-based segmentation rather than pixel-based segmentation. Information from the closed captions is used to automatically index the segments based on their contents. Together, these features allow users to quickly search indices for multiple videos to locate segments of interest, and to view and manipulate these segments on their remote computers. Future work will investigate using soundtrack and transcripts for further indexing information.

While this technology would be applicable to any collection of videos, we will demonstrate the effectiveness of our approach using educational videos provided by our industrial partners. We are building an initial video database containing five hours of selected videos provided by WGBH, and current events videos provided by CNN. A graphical user interface has been created for VISION that provides different interaction mechanisms over a variety of communication channels and video display workstations. In particular, the use of ATM versus Ethernet, decompression at the server versus the client, are being evaluated.

Voice Transport Over ATM

Student Investigators: Raghushankar Vatte, Aarti Iyengar

Faculty Investigator: David W. Petr

Sponsors: Sprint Corp.

There has been a recent resurgence of interest in transporting voice over ATM, sparked in part by the introduction and standardization of AAL2, a new ATM Adaptation Layer (AAL) that fills a need (not met by previous AALs) for multiplexing several small data units from different sources/connections into a single ATM VC connection. This limits packetization delay for compressed voice without wasting transmission bandwidth due to partial filling of ATM cells. The original motivation for AAL2 was to support compressed voice as found in many cellular systems, but voice trunking and ATM to the desktop have since been added as potential AAL2 applications.

The intent of this two-year project is to expand our current studies of AAL2 into the broader arena of Voice Transport over ATM. Another proposal from ITTC (AAL2 Call/Correction Control Signaling, with Joe Evans as Principal Investigator) will focus on signal/control and implementation issues for AAL2.

The goals below are listed in approximate order of priority. As the project evolves over its two-year length, goals may be revised, deleted, or added as mutually agreed.

• Provide a performance characterization for compressed voice over AAL2, especially in terms of delay jitter (packet delay variation).

• Provide an assessment of potential voice service quality under various connection composition scenarios, including wireless/cellular segments.

• Provide an overall system-level plan for end-to-end Voice Transport Over ATM under various connection composition scenarios, including wireless/cellular segments.

• Provide specific recommendations concerning the application of AAL2 to wireless/cellular networks and concerning interworking of VTOA between wireless/cellular networks and fiber-optic ATM networks.

• Specify (as needed) and evaluate appropriate Service-Specific Convergence Sublayer (SSCS) protocols for VTOA using AAL2 (and perhaps AAL1).

• Provide performance evaluations of Voice/Data integration with AAL2.

A Wireless ATM Adaptive Voice/Data Network

Student Investigators: Erik Lindsley, Zhu Lei, Vishal Moondhra

Faculty Investigators: Joseph B. Evans, Victor S. Frost, John M. Gauch

Sponsor: Rome Laboratories

The objective of this project is the implementation and demonstration of a complete adaptive voice/data (AVD) network, including switches and terminal units, based on wireless asynchronous transfer mode (ATM) technology. This network will serve as a testbed for investigation into the delivery of voice, images, and data to remote users using highly interoperable ATM technology. Dynamic bandwidth allocation algorithms using low bit rate speech coding based on the Sinusoidal Transform Coder are used in the ATM wireless environment. Existing ATM standards are the basis for network control and management where possible, and research into extending the technology into the narrowband arena is being performed. A testbed to evaluate the use of the bit-rate adaptive characteristics of the Sinusoidal Transform Coder (STC) as a means of congestion control for voice/data networks is being designed and built. The testbed consists of two existing network switches and three voice/data terminal units developed in this project. The terminal units are connected to the switches by wireline or wireless modems, and support voice or data traffic. The terminals support bit rate adaptation protocols implemented in the AVD switch. The components of the network support dynamic allocation of bandwidth between voice and data streams, using the bit rate transformation schemes associated with the Sinusoidal Transform Coder. The narrowband network is interfaced to other ATM facilities such as the MAGIC gigabit testbed or the Rapidly Deployable Radio Network (RDRN), as well as to standard ISDN facilities, to demonstrate interoperability.

This project consists of several major tasks:

- AVD switch modifications for ATM networks
- implementation of the terminal units for the AVD network
- development and implementation of the ATM wireless network architecture
- host application software design
- demonstration of interoperability over ISDN facilities
- demonstration of interoperability over future facilities typified by the DREN Testbed

A Wireless Extension to the ACTS ATM Internetwork

Faculty Investigators: Joseph Evans, Glenn Prescott, Victor Frost

Student Investigators: Rajit Cavatur, Sunil Jagannath, John Paden, Rajesh Yelisetti

Sponsor: Sprint Corp.

Wireless ATM based services will provide Sprint's customers the ability to seamlessly use advanced communications services independent of a connection to the wired infrastructure. For example, future networks will support the seamless movement of users from fixed high speed wired connection (i.e., a ATM-based service in the office) to mobile platforms. The network must be able to recognize the change in capabilities caused by such movements and respond appropriately. To realize this vision, issues in mobile networks, such as, mobile-IP users, and network management must be addressed.

This effort is investigating such issues. The approach will focus on implementing a prototype wire/wireless network that contains the critical elements of these future systems. The prototype system will be used to demonstrate the delivery of wireless ATM based services, and then to investigate mobile-IP and network management issues.

PROJECTS DURING PAST SIX YEARS

AASERT Program FY92: LPI Signal Detection Using the Wavelet Transform
AFOSR
PRESCOTT, Glenn

ACTS ATM Internetwork
Sprint
FROST, Victor
(w/Evans, Petr, Niehaus, Minden, Co-Is)

Adaptive Voice/Data Networks
Calspan-UB Res. Ctr.
EVANS, Joseph (w/Johnson, Tim, Co-I)

Advanced ATM Research
NEC America
FROST, Victor
(w Evans, Niehaus, Petr, Co-Is)

Advanced Telecommunication Network Signaling Model
TRW
ROBERTS, James
(w/Evans, Petr, Minden, Frost, Co-Is)

Aerodynamic Modeling for Aircraft in Unsteady Flight Conditions
NASA-Langley
LAN, C. Edward

Air Force Defense Research Sources Program: Rapid Prototyping of Software Radio System Using Field Programmable Gate Arrays
AFOSR
PRESCOTT, Glenn

Analysis and Simulation of Traffic Management Algorithms for Frame Relay/Fast Packet Networks
Sprint/KTEC
PETR, David (w/Frost, Evans)

Analysis of Canopy Architecture and Solar Radiation Regimes for Australian Eucalyptus Forests
Stanford U.
RICH, Paul

Analysis of Hemispherical Photographs for Quantification of the Light Regime in Giant Forest Canopy Gaps
Sequoia & Kings Canyon Natl. Park
RICH, Paul

Analysis of Hemispherical Photographs of Southern Swamplands
US Army Corps of Engineers
RICH, Paul

Analytic and Simulation Based Models for the Investigation of Low Probability of Intercept (LPI) Waveform Detactability
AFOSR
PRESCOTT, Glenn

Analytic Models for the Detection and Interception of Low Probability of Intercept (LPI) Communication Signals
AFOSR, RDL
PRESCOTT, Glenn

Application of Artificial Intelligence Techniques in Air Combat Simulation
ARL-Taipei Econ. & Cult. Rep. Ofc.
LAN, C. Edward

Application of Computational Aerodynamics to Interference Assessment/Correction in Wind Tunnel Testing
Aeronautical Res. Lab-Taiwan
LAN, C. Edward

ATM Adaptation Layer for Composite Users (AAL-CU) Research
Sprint/United Management Co.
PETR, David

ATM Available Bit Rate Service Simulation Models
Integrated Telecom Technology
EVANS, Joseph (w/Frost, Co-I

ATM Reference Traffic System
Sprint
NIEHAUS, Douglas
(w/Evans, Frost, Co-Is)

Automatic E-Mail Answering
ProFusion, LLC
JOHNSON, Tim

Battlefield and Data Disssemination System Intelligent Information Dissemination Server (IIDS)
Lockheed/DARPA
TSATSOULIS, Costas

Battle Lab's CINCUSAREUR Project
SRI International
FROST, Victor

Bi-Directional Optical Recirculating Loop for Multi Channel WDM Applications
Nortel Broadband Networks
HUI, Rongqing

Biometry and Hemispherical Photography Measurements of Auxiliary Sites in Support of BOREAS
Canada C.R.S.
RICH, Paul

Block Oriented Network Simulation (BONeS)
Sprint/United Mgmt. Co.
PETR, David (w/Frost, Co-I)

Calculation of Aircraft Parameters for Mooney M20J
Azure Technology
LAN, C. Edward

CAREER/EPSCoR: Cooperative Agents for Conceptual Search and Browsing of World Wide Web Resources
NSF CAREER/EPSCoR
GAUCH, Susan

CDMA Capacity Assessment for Personal Wireless Communications
Sprint
ROBERTS, James
(w/Frost, Prescott, Shanmugan, Co-Is)

Characterization of Vegetation Properties
Univ. CA Los Alamos
RICH, Paul

COEDS Analysis on Frequency Hopping Communication Systems
San Diego St. U. Fd.
HOLTZMAN, Julian

COEDS Analysis on Wideband Communication Systems
San Diego St. U .Fd.
HOLTZMAN, Julian

Collection and Application of ATM Network Performance Characteristics
Sprint
FROST, Victor (w/Evans, Co-I)

Color Displays for COEDS
San Diego St. U. Fd.
HOLTZMAN, Julian

Consulting Service Support on RDD 100™ - BONeS™ Interface Project
COMDISCO
HOLTZMAN, Julian

Design Rules and Associated Tools for ATM Networks
KTEC
PETR, David (w/Frost, Co-I)

Design Rules and Associated Tools for ATM Networks
Sprint Comm. Co.
PETR, David (w/Frost, Co-I)

Design, Code, and Test the Electromagnetic Antenna Computer Model
ITT Defense
CHAKRABARTI, S.

DesignLab
NSF
Ambler, A.
(w/Brown, Darwin, Evans, J. Gauch, S. Gauch, Miller, Niehaus, Roddis, Tsatsoulis, Wallace, Co-Is)

Determination of the Impact of Advanced Traffic Controls on the Performance of Edge/Core ATM Network Architectures
Sprint/United Management Co.
FROST, Victor
(w/Evans, Niehaus, Petr, Co-Is)

Developing Modules for Simulating Military Communications Systems Using SPW
RADC
SHANMUGAN, Sam (w/Prescott, Co-I)

Development and Testing of Advanced Signaling Protocols for ATM Networks
Sprint
NIEHAUS, Douglas
(w/Evans, Frost, Petr, Co-Is)

Development of a Geographical Information System Database for Las Cruces Biological Station and Vicinity, Costa Rica
Organ. for Tropical Studies
RICH, Paul

Development of a Large-scale ATM Simulation Environment (LANSE)
Sprint
FROST, Victor (w/Evans, Petr, Co-Is)

Development of a Transonic Small-Disturbance Aerodynamic Code for Airplane Configurations
Aero. Ind. Dev. Ctr., Taiwan
LAN, C. Edward

Development of a Transonic Small-Disturbance Aerodynamic Code for Store Separation Simulations
Aero. Ind. Dev. Ctr., Taiwan
LAN, C. Edward

Development of an Autorotative Toy
Hewitt & Howe
LAN, C. Edward

Development of an Unsteady Transonic Small Disturbance Code for Airplane Flutter Prediction
Aero. Ind. Dev. Ctr.
LAN, C. Edward

Development of Bandwidth Assignment and Performance Simulation Software
Telesat Canada
PETR, David (w/Frost, CO-I)

Development of New Modeling Structures within the Block Oriented Network Simulation (BONeS)
COMDISCO/KTEC
FROST, Victor

Development of Project Activity Duration and Resource Requirement Algorithms Based on Historical Data
KDOT/KTRAN
RODDIS, Kim

Digital Signal Processing (DSP) Rapid Prototyping for Military Communication Systems
Rome Laboratory
SHANMUGAN, Sam
(w/Prescott and Johnson, Co-Is)

Digital Signal Processing (DSP) Rapid Prototyping of Advanced Tactical Communication Systems with Field Programmable Gate Arrays (FPGA)
AFMC/Rome Lab.
PRESCOTT, Glenn
(w/Shanmugan, Evans, Co-Is)

DSP Rapid Prototyping Implementation of Advanced Tactical Communications Waveform and Signal Processing Functions
Rome Laboratory Air Force
SHANMUGAN, Sam
(w/Prescott and Johnson, Tim, Co-Is)

Establishment of a National Geospatial Data Clearinghouse (NGDC) Node for Biological Resource Geospatial Data
U.S.G.S.
RICH, Paul (w/Luckey, Co-I)

Evaluation of Distributed Control and Signaling Infrastructure for ATM Networks
Sprint
NIEHAUS, Douglas (w/Petr, Co-I)

Expert System for Fabrication Error Solutions
KDOT/K-TRAN
RODDIS, Kim

Exploiting Open Control of ATM Networks
Sprint Corp.
EVANS, Joe

Functional Programming Environment for Design and Implementation of High Performance Radio and Synthetic Aperture Radar Processing Functions
DARPA
MINDEN, Gary; EVANS, Joe
(w/Prescott, Ashley, Niehaus, Co-Is)

Generating a Rule-Base for Sea-Ice Classification
Naval Res. Lab
TSATSOULIS, Costas
(w/J. Gauch, Co-I added 6/97)

GIS-Based Pilot Study of Lepidoptera Biodiversity in the Spring Range, Nevada
Stanford U.
RICH, Paul

Global Change Fellowship Program: Donna S. Haverkamp
NASA-HQ
TSATSOULIS, Costas

Graduate Student Researchers Program: Donna Haverkamp "Multi-Image Data Classification of Sea-Ice Using a Blackboard"
NASA-HQ
TSATSOULIS, Costas

High Frequency-Digital Signal Processing Modem
Kantronics/KTEC
PRESCOTT, Glenn

Implementation of Distributed Electronic Mail System
MAMTC
HOLTZMAN, Julian

Improved Information Retrieval and Value-added Automated Search Based on Closed Caption Text and Customer Profile
Worldwide Broadcasting Network
GAUCH, Susan

Improved Video Processing System Worldwide Broadcasting Network
GAUCH, John

Improving Steel Design and Fabrication Using Integrated KBES-CADD; and Research Experience for Undergraduates (REU)
NSF
RODDIS, Kim

Integrated Evaluation of Network/System/and Application Software Architecture and Performance Issues in ATM Networks
Sprint Corp.
NIEHAUS, Douglas (w/Tsatsoulis, Co-I)

Intelligent Information Dissemination Server (IIDS) Project - Phase 0
Lockheed Martin
TSATSOULIS, Costas

Investigation of Aerodynamics for Maneuvering Aircraft
Aeronautical Res Lab-Taiwan
LAN, C. Edward

Investigation of Communication System Performance in a Hospital Environment
KTEC
ROBERTS, James (w/Minden, Co-I)

Investigation of Communication System Performance in a Hospital Environment
Radiant Systems
ROBERTS, James (w/Minden, Co-I)

Investigation of FPGA Rapid Prototyping of Military Software Radio Systems
USAF Rome Laboratory
PRESCOTT, Glenn
(w/Evans, Shanmugan, Co-Is)

Investigation to Determine the Information Needed to Design a Fiber Beacon
Bearfax
DEMAREST, Kenneth (w/Rummer, Co-I)

K*STAR First Awards - Type II
KTEC/NSF EPSCoR
NORDHEDEN, Karen

Kansas Integrated Commercialization Information Network: A Demonstration Project
KTEC
HOLTZMAN, Julian
(w/Johnson, Prescott, Co-Is)

KEURP - Link: Phase III
KEURP, Kansas Electric Utilities Research Program
GAUCH, Susan

KEURP - Net: Phase II
KEURP
NIEHAUS, Douglas (w/ S. Gauch, Co-I)

KEURP-Net, Phase I
KEURP
NIEHAUS, Douglas
(w/S. Gauch, J. Evans, Co-Is)

Lightwave Communications Systems Research
Sprint, NSF EPSCoR, KTEC
DEMAREST, Kenneth
(w/Frost, Evans, Allen, Hui, Minden, Co-Is; has included Nordheden, Fang)

MAGIC II: A Large-Scale Internetwork Supporting High Speed Distributed Storage, Processing and Applications
ARPA
FROST, Victor
(w Evans and Niehaus, Co-Is)

Multiple-Access Low Probability of Intercept (LPI) Communications Networks
AFOSR
PRESCOTT, Glenn

Novel Digital Speech Compression Techniques
AFOSR, RDL
EVANS, Joseph

Object Motion Analysis for Biomedical Applications
Whitaker Found.
GAUCH, John

Performance Evaluation of IP Firewalls over ATM Networks
Trusted Info. Systems, Inc.
EVANS, Joseph (w/ Frost, Co-I)

Prediction of Transonic Flutter Characteristics of Business Class Jet Aircraft
Raytheon Aircraft
LAN, C. Edward (w/Lim, Co-I)

The Pricing of Services in ATM Networks
Sprint/United Management Co.
PETR, David

Rapidly Deployable Radio Network (RDRN)
FBI, DARPA
SHANMUGAN, Sam; EVANS, Joseph (w/ Frost, Minden, Petr, Prescott, Plumb, Roberts,Co-Is)

Rapidly Deployable Radio Network (RDRN) - Phase II
DARPA
SHANMUGAN, Sam
(w/Evans, Frost, Minden, Petr, Prescott, Plumb, Roberts, Co-Is)

Reporting System to Improve Safety of the Blood Supply
U. of TX-SW Med. Ctr.
TSATSOULIS, Costas

Research in Technologies in Modeling of Telecommunications Networks
COMDISCO Systems
FROST, Victor

Research on Gigabit Gateways: Access to Future Public Switched Networks
Digital Eqpt Corp
MINDEN, Gary (w/Frost, Co-I)

Research on Gigabit Gateways: Access to Future Public Switched Networks
KTEC
FROST, Victor
(w/Minden, Evans, Petr, Co-Is)

Research on Gigabit Gateways: Access to Future Public Switched Networks
USAF (ARPA)
FROST, Victor
(w/Minden, Evans, Petr, Co-Is)

Research on the Real Time Estimation of Traffic Descriptors for High Speed Telecommunications Networks
BNR, Inc.
FROST, Victor
(w/Minden, Petr, Evans, Co-Is)

REU Site: Information Systems Engineering at the University of Kansas
NSF
ROBERTS, James

RF Channel Simulator for Wireless Communications
(Proprietary)
PRESCOTT, Glenn (w/Roberts, Co-I)

RIA: A Testbed for the Application of Corpus Linguistics to Information Retrieval
NSF
GAUCH, Susan

Sea-ice Classification by the Intelligent Integration of Active and Passive Microwave Data
NASA-HQ
TSATSOULIS, Costas
(w/Gogineni, Co-I)

Software System Installation and Support
Materials Tech. Institute
HOLTZMAN, Julian

Studies of Microwave Scattering and Canopy Architecture for Boreal Forests: Acquisition and Analysis of Hemispherical Photographs
NASA-Goddard
RICH, Paul (w/Gogineni, Co-I)

Study of the Role of ACTS in Remote Manufacturing Operations
NASA-HQ
TSATSOULIS, Costas (w/Frost)

Targeting Expert Systems for Bridge Engineering
KDOT/KTRAN
RODDIS, Kim

Technology Transfer
ProFusion, LLC
JOHNSON, Timouthy

Torsion of Exterior Girders of a Steel Girder Bridge During Concrete Deck Placement
KTRAN
RODDIS, Kim
(w/Ray Moore, Co-I)

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

Traffic Management and Controls for ATM Networks
Sprint
PETR, David (w/Frost, Niehaus, Co-Is)

Unsteady Transonic Aerodynamic Modeling for Prediction of Control Surface Buzz
Aero. Ind. Dev. Ctr.
LAN, C. Edward

Voice Transport over ATM
Sprint/United Management Corp.
Petr, David

Voice Transport via ATM Networks
Sprint Comm. Co.
PETR, David
(w/Evans, Frost, Co-Is)

Wireless ATM Adaptive Voice/Data Networks
U.S. Air Force
EVANS, Joseph
(w/Frost, J. Gauch, Co-Is)

Wireless Extension to the ACTS ATM Internetwork
Sprint
EVANS, Joseph
(w/Prescott and Frost, Co-Is).

ITTC-AFFILIATED PUBLICATIONS

Books and Book Chapters

1998

Analysis of SAR Data of the Polar Oceans,
C. Tsatsoulis, R. Kwok (eds.). Springer Verlag, 1998.

Applications of the Rule Induction System LERS,
J.W. Grzymala-Busse. *Rough Sets in Knowledge Discovery 1: Methodology and Applications*, ed. L. Polkowski, A. Skowron, Physica-Verlag, 1998, pp. 366–375.

Engineering Electromagnetics,
K. Demarest. Prentice Hall, 1998, 672 pages.

Identifying Ice Floes and Computing Ice Floe Distributions in SAR Images,
L-K Soh, C. Tsatsoulis, B. Holt. *Analysis of SAR Data of the Polar Oceans*, ed. C. Tsatsoulis, R. Kwok. Springer Verlag, 1998, pp. 9-34.

Introduction (to the book),
C. Tsatsoulis, R. Kwok. *Analysis of SAR Data of the Polar Oceans*, ed. C. Tsatsoulis, R. Kwok. Springer Verlag, 1998.

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

Local Area Networks (LANs),
J. B. Evans. Invited. *Encyclopaedia of Electrical Engineering*, Wiley, scheduled for publication in 1998.

Modeling and Simulation of Communication Systems,
K.S. Shanmugan, M. Jeruchim, P. Balaban, 2nd edition, Plenum-Kluewer (to appear in print by July 1999.)

Noise Removal and Contrast Enhancement,
J.M. Gauch, *Colour Image Processing*, ed. Sangwine and Home, Chapman and Hall Ltd., 1998.

Segmentation and Edge Detection,
J.M. Gauch. *Colour Image Processing*, Sangwine and Home Ed., Chapman and Hall Ltd., 1998.

Uncertainties of Asphalt Layer Thickness Determination in Flexible Pavements—Influence Diagram Approach,
N. O. Attoh-Okine, W. M. Kim Roddis. *Civil Engineering and Environmental Systems*, Gordon and Breach Publishers, Vol. 15, 1998, pp. 107-124.

1997

Integrating Cases, Sub-Cases, and Generic Prototypes for Design,
C. Tsatsoulis, P. Alexander. *Issues and Applications of Case-Based Reasoning in Design*, ed. M.L. Maher, P. Pu, Lawrence Erlbaum, Mahwah, New Jersey and London, 1997, pp. 261-300.

Nonlinear Filtering and Estimation,
T. Duncan. Accepted for *Encyclopedia of Electrical and Electronics Engineering*, John Wiley & Sons (1997).

1996

GIS-Based Solar Radiation Modeling,
R. Dubayah, P.M. Rich. *GIS and Environmental Modeling: Progress and Research Issues,* ed. M.F. Goodchild, L.T. Steyaert, B.O. Parks, C. Johnston, D. Maidment, M. Crane, S. Glendinning, GIS World Books, Fort Collins, CO, 1996.

Modeling and Simulation of Telecommunications Networks
V.S. Frost, B. Melamed. *The Froehlich/Kent Encyclopedia of Telecommunications*, Vol. 11, ed. F.E. Froehlich, A. Kent, C.M. Hall, M. Dekker, Inc., New York, 1996.

Robots and Manufacturing Agents,
A. Agah. *Bots and Other Internet Beasties*, ed. J. Williams, Sams.net Macmillan Computer Publishing, Indianapolis, Indiana, 1996, pp. 291-315.

Stochastic Adaptive Control,
T. Duncan, B. Pasik-Duncan. *The Controls Handbook*, ed. W.S. Levine, CRC Press, 1996, pp. 1127-1136.

Waveguides,
K.R. Demarest. *The Electronics Handbook*, ed. J. Whitaker, CRC Press, 1996, pp. 259-268.

1995

A Data Compression Technique for Synthetic Aperture Radar Images,
V.S. Frost, G.J. Minden. *IEEE Transactions on Aerospace Electronics Systems*, Vol. AES-22, No. 1, Jan. 1986, pp. 47-55. Selected for inclusion in *Image Data Compression: Block Truncation Coding*, ed. B.V. Dasarathy, IEEE Computer Society Press, 1995.

Implementation of Digital Filters,
J.B. Evans. Invited section. *Circuit and Filter Handbook,* ed.-in-chief W.K. Chen, section 16.5, CRC Press, 1995.

Stochastic Control Problems on Real and Complex Symmetric Spaces, T. Duncan, H. Upmeier. *Stochastic Processes, Physics and Geometry II*, ed. S. Albevero, U. Cattaneo, D. Merlini, World Scientific, 1995, pp. 209-220.

Journal Articles

1998

Adaptive Continuous Time Linear Quadratic Gaussian Control, T. E. Duncan, L. Guo, B. Pasik-Duncan. Accepted for *IEEE Transactions on Automatic Control* (1998).

Adaptive Control of a Partially Observed Discrete Time Markov Process, T. E. Duncan, B. Pasik-Duncan, L. Stettner. *Applied Mathematics & Optimization*, Vol. 37, 1998, pp. 269-293.

A Corpus Analysis Approach for Automatic Query Expansion and its Extension to Multiple Databases, S. Gauch, S. M. Rachakonda. Accepted for *ACM Transactions on Information Systems* (1998).

Discretized Maximum Likelihood Estimates for Adaptive Control of Ergodic Markov Models, T. Duncan, B. Pasik-Duncan, L. Stettner. *SIAM Journal of Control Optimization,* Vol. 36, 1998, pp. 422-446.

Entropy of English Text: Experiments with Humans and a Machine Learning System based on Rough Sets, H. Moradi, J. W. Grzymala-Busse, J. A. Roberts. *Information Sciences*, Vol. 104, Jan. 1998, pp. 31-47.

Ergodic Boundary/Point Control of Some Stochastic Semilinear Systems in Hilbert Spaces, T. Duncan, B. Maslowski, B. Pasik-Duncan. *SIAM Journal of Control & Optimization*, Vol. 36, 1998, pp. 1020-1047.

A Framework for Predictive Network Management of Predictive Mobile Networks, S.F. Bush, V.S. Frost. Accepted for *Journal of Network and Systems Management* (1998).

Frequency Response of Cross-Phase Modulation in Multi-Span WDM Optical Fiber Systems, R. Hui, Y. Wang, K. Demarest, C. Allen. Accepted for *IEEE Photonics Technology Letters* (June 1998).

Fuzzy Logic Controller Design Utilizing Multiple Contending Software Agents, A. Agah, K. Tanie. Accepted for *International Journal for Fuzzy Sets and Systems* (1998).

Image Segmentation and Analysis via Multiscale Gradient Watersheds, J.M. Gauch. Accepted for *IEEE Transactions on Image Processing* (1998).

An Improved Coherent Radar Depth Sounder, S. Gogineni, T. Chuah, K. Jezek, C. Allen, R.K. Moore. Accepted for *Journal of Glaciology* (Feb. 1998).

Information Technology: Drivers, Trends, and Impact, V. Frost. "Technology Resource Guide," pp. 3-4, *Kansas City Business Journal*, Vol. 16, No. 20, Jan. 30-Feb. 5, 1998.

Intelligent Information Agents: Review and Challenges for Distributed Information Sources, D. Haverkamp, S. Gauch. *Journal of the Society for Information Science*, Vol. 49, No. 4, Apr. 1998, pp. 304-311.

Learning Communication Strategies in Multiagent Systems, M. Kinney, C. Tsatsoulis. Accepted for *International Journal of Applied Intelligence: Special Issue on Adaptive Agent Systems* (1998).

A Methodology for Analyzing Lead Information from SAR Ice Type Images, M. Van Dyne, C. Tsatsoulis, F. Fetterer. Accepted for *IEEE Transactions on Geoscience and Remote Sensing* (1998).

Neural Network Based Classification of SAR Scenes Using Spectral Information, T. S. Chuah, S. Chakrabarti, P. Gogineni. *Special Issue of the Journal of Remote Sensing Reviews on KUREX-91*, Vol. 17, No. 1-4, 1998.

The Rapidly Deployable Radio, J. B. Evans, G. J. Minden, K. S. Shanmugan, G. Prescott, V. S. Frost, B. Ewy, R. Sanchez, C. Sparks, K. Malinimohan, J. Roberts, R. Plumb, D. W. Petr. Accepted for *IEEE Journal on Selected Areas in Communications* (1998).

RDRN: A Prototype for a Rapidly Deployable Radio Network, R. Sanchez, J. Evans, G. Minden, V.S. Frost, K.S. Shanmugan. *ACM Mobile Computing and Communications Review*, Vol. 2. No. 2, Apr. 1998, pp. 15-22.

Segmentation of Satellite Imagery of Natural Scenes Using Data Mining, L-K. Soh, C. Tsatsoulis. Accepted for *IEEE Transactions on Geoscience and Remote Sensing* (1998).

Simulation & Measurement of TCP/IP over ATM Wide Area Networks, G.Y. Lazarou, V.S. Frost, J.B. Evans, D. Niehaus. *IEICE Transactions on Communications, Special Issue on ATM Switching Systems for Future B-ISDN*, Vol. E81B, No. 2, Feb. 1998, pp 307-314.

Subjective Effects of Cell Losses in Voice Over ATM, D. W. Petr, W. G. Huang, M. P. Mischler. Accepted for *IEEE Communications Letters* (July 1998).

Texture Analysis of SAR Sea Ice Imagery Using Gray Level Co-occurence Matrices,
L-K. Soh, C. Tsatsoulis. Accepted for *IEEE Transactions on Geoscience and Remote Sensing* (1998).

1997

Adaptive Control of a Partially Observed Discrete Time Markov Process,
T. Duncan, B. Pasik-Duncan, L. Stettner. Accepted for *Journal of Applied Mathematical Optimization* (1997).

Airborne Radio Echo Sounding of Outlet Glaciers in Greenland,
C. Allen, S. Gogineni, B. Wohletz, K. Jezek, T.S. Chuah. *International Journal of Remote Sensing*, Vol. 18, No. 14, 1997, pp. 3103-3107.

ATM WAN Performance Tools and Results,
L. DaSilva, J. Evans, D. Niehaus, V. Frost, R. Jonkman, B. Lee, G. Lazarou. *IEEE Communications Magazine*, Vol. 35, No. 8, Aug. 1997, pp.118-125.

Case-Based Approach for Bridge Fabrication Errors,
W.M.K. Roddis, J. Bocox. *Journal of Computing in Civil Engineering*, American Society of Civil Engineers, Vol. 11, No. 2, Apr. 1997, p. 84-91.

A Compound High-Order Polarization-Independent Birefringence Filter Using Sagnac Interferometers,
X. Fang, H. Ji, C.T. Allen, K. Demarest, L. Pelz. *IEEE Photonics Technology Letters*, Vol. 9, No. 4, 1997, pp. 458-460.

A Control and Management Network for Wireless ATM Systems,
S.F. Bush. S. Jagannath, R. Sanchez, J.B. Evans, K.S. Shanmugan, V.S. Frost, G. Minden. *ACM/Baltzer Wireless Information Networks (WINET) Journal*, Vol. 3, No. 4, 1997, pp. 267-283.

A DC to Multigigabit/s Polarization-Independent Modulator Based on Sagnac Interferometer,
X. Fang, H. Ji, L. Pelz, K. Demarest, C. Allen. *IEEE Journal of Lightwave Technology*, Vol. 15, No. 11, 1997, pp. 2166-2171.

Design and Analysis of a Bandwidth Management Framework for ATM-Based Broadband ISDN,
K. Liu, H. Zhu, D.W. Petr, V.S. Frost, C. Braun, W. Edwards. *IEEE Communications Magazine*, Vol. 35, No. 5, May 1997, pp. 138-145.

The Effectiveness of Flow Analysis for Inlining,
J. Michael Ashley. *Proceedings of the 1997 ACM International Conference on Functional Programming*, 1997, pp. 99-111.

On Ergodic Control of Stochastic Evolution Equations,
T. Duncan, B. Pasik-Duncan, L. Stettner. Accepted for *Stochastic Processes and Applications* (1997).

Experimental Study of Four-Wave Mixing in Non-Zero Dispersion Fiber,
S. Song, C. Allen, K. Demarest, L. Pelz, X. Fang, Y. Pua. *IEEE Lasers and Electro-Optics Society 1997 Annual (LEOS '97)*, WAA2, San Francisco, CA, Vol. 2, Nov. 1997, pp. 224-225.

Guest Editoral: Performance Experiences with Wide Area High Speed Networks,
D. Endicott, V. S. Frost. *IEEE Communications Magazine*, Vol. 35, No. 8, Aug. 1997.

Identification and Control of a Stochastic Manufacturing System with Noisy Demand,
T. E. Duncan. *Lectures in Applied Mathematics*, American Mathematics Society, Vol. 33, 1997, pp. 83-88.

Implementation of Signal Power Estimation Methods,
S. Cheng, J.B. Evans. *IEEE Transactions Circuits & Systems II*, Vol. 44, No. 3, Mar. 1997, pp. 240-250.

Integrating Case-Based Reasoning and Decision Theory: Theory and Experiments,
C. Tsatsoulis, Q. Cheng, H-Y. Wei. *IEEE Expert*, July/Aug. 1997, pp. 46-55.

Intelligent Information Agents: Review and Challenges for Distributed Information Sources,
D. Haverkamp, S. Gauch. Accepted for *Journal of the American Society for Information Science* (1997).

A Kiefer-Wolfowitz Algorithm with Randomized Differences,
T. Duncan, H.F. Chen, B. Pasik-Duncan. Accepted for *IEEE Transactions on Automatic Control* (1997).

Limit Theorems of Probability Theory and Optimality in Stochastic Evolution Systems,
B. Pasik-Duncan. *Journal of Mathematical Systems, Estimation, and Control*, Vol. 7, No. 4 (1997), pp. 417-437.

Machine Learning in Updating Predictive Models of Planning and Scheduling Transportation Projects,
L. Zhang, W.M.K. Roddis. *Transportation Research Record*, TRB, No. 1588, Transportation Research Board, 1997, pp. 86-94.

Modulation Instability and Its Impact in Multi-Span Optical Amplified Systems: Theory and Experiments,
R. Hui, M. O'Sullivan, A. Robinson, M. Taylor. *IEEE Journal of Lightwave Technology*, Vol. 15, No. 7, 1997.

Nonlinear Amplification of Noise in Fibers with Dispersion and Its Impact in Optically Amplified Systems,
R. Hui, D. Chowdhury, M. Newhouse, M. O'Sullivan, M. Poettcker, *IEEE Photonics Technology Letters*, Vol. 9, No. 3, 1997.

Overview of the Rapidly Deployable Radio Network Proof of Concept System,
B. Ewy, C. Sparks, S. Bush, R. Sanchez, J. Evans, G. Minden, V. Frost, K. S. Shanmugan. Accepted for *IEEE Journal on Selected Areas in Communications* (1997).

Performance Benchmarking of Signaling in ATM Networks,
D. Niehaus, A. Battou, A. McFarland, B. Decina, H. Dardy, V. Sirkay, B. Edwards. *IEEE Communications Magazine*, Vol. 35, No. 8, Aug. 1997, pp. 134-143.

Phylogenetic and Ontogenetic Learning in a Colony of Interacting Robots,
G. A. Bekey, A. Agah, *Autonomous Robots Journal*, Vol. 4, 1997, pp. 85-100.

Piconet-Embedded Mobile Networking,
F. Bennett, D. Larke, J. Evans, A. Hopper, A. Jones, D. Leask. *IEEE Personal Communications*, Vol. 4, No. 5, Oct. 1997.

A Search in North Greenland for a New Ice-Core Drill Site,
D. Dahl-Jensen, N.S. Gundestrup, K. Keller, S.J. Johnsen, S.P. Gogineni, C.T. Allen, T.S. Chuah, H. Miller, S. Kipfstuhl, E.D. Waddington. *Journal of Glaciology*, Vol., 43, No. 144, 1997, pp. 300-306.

Simulation & Measurement of TCP/IP over ATM Wide Area Networks,
G.Y. Lazarou, V. S. Frost, J. B. Evans, D. Niehaus. Accepted for *IEICE Transactions on Communications: Special Issue on ATM Switching Systems for Future B-ISDN* (1997).

Stochastic Adaptive Control and Manufacturing Systems,
B. Pasik-Duncan. *Lectures in Applied Mathematics*, American Mathematics Society, Vol. 33, 1997, pp. 201-217.

A Sub-Nanosecond Polarization-Independent Tunable Filter/Wavelength Router Using a Sagnac Interferometer,
X. Fang, K. Demarest, H. Ji, C.T. Allen, L. Pelz. Accepted for *IEEE Photonics Technology Letters* (1997).

A Survey of Active Network Research,
D.L. Tennenhouse, J.M. Smith, W.D. Sincoskie, D.J. Wetherall, G.J. Minden. *IEEE Communications Magazine*, Vol. 35, No. 1, Jan. 1997.

The Use of Ground Penetrating Radar with a Cooperative Target in Microtunnelling Applications,
C.T. Allen, K. Shi, G. Plumb. Accepted for *IEEE Transactions on Geoscience and Remote Sensing* (Feb. 1997).

The VISION Digital Video Library,
S.E. Gauch, W. Li, J.M. Gauch. *Information Processing and Management*, Vol. 33, No. 4, 1977.

1996

Adaptive Boundary Control of Linear Distributed Parameter Systems Described by Analytic Semigroups,
T. Duncan, B. Maslowski, B. Pasik-Duncan. *Journal of Applied Mathematical Optimization,* 33, 1996, pp. 107-138.

Cell Loss Quality of Service in an Integrated Traffic ATM Network,
D.W. Petr, V.S. Frost, T. Kelley, C. Braun, A. Demirjis. *International Journal of Communications Systems*, Vol. 9, 1996, pp. 97-104.

Conmix: Integrating Specifications, Data and Models,
W. M. K. Roddis, D. L. Melber, G. P. Pasley. *Information Representation and Delivery in Civil and Structural Engineering Design*, ed. B. Kumar and A. Retik, Civil-Comp Press, Edinburgh, Scotland, 1996, pp. 99-104.

Constraint-Based Genetic Algorithm Optimization Applied to Reinforced Concrete Design,
W. K. Lucas, W. M. K. Roddis. *Information Processing in Civil and Structural Engineering Design*, ed. B. Kumar, Civil-CompPress, Edinburgh, Scotland, 1996, pp. 171-175.

Detection Models,
R.F. Mills, G.E. Prescott. *IEEE Transactions on Aerospace and Electronic Systems,* Jan. 1996.

Image Segmentation and Analysis via Multiscale Gradient Watersheds,
J.M. Gauch. Accepted for *IEEE Transactions on Image Processing* (1996).

In-Service Monitoring for Cell Loss Quality of Service Violations in ATM Networks,
H. Zhu, V.S. Frost. *IEEE/ACM Transactions on Networking*, Vol. 4, No. 2, Apr. 1996.

Knowledge Acquisition and Engineering for a Steel Bridge Fabrication Expert System,
H.G. Melhem, W.M.K. Roddis, S. Nagaraja, M.R. Hess. *Journal of Computing in Civil Engineering,* American Society of Civil Engineers, Vol. 10, No. 3, July 1996, pp. 248-256.

A 622 Mb/S LAN/WAN Gateway and Experiences with Wide-Area ATM Networking,
J.B. Evans, D. Niehaus, D.W. Petr, V.S. Frost, G.J. Minden, B.J. Ewy. *IEEE Network*, Vol. 10, No. 3, May/June 1996, pp. 40-48.

Mobile ATM Buffer Capacity Analysis,
S.F. Bush, J.B. Evans, V.S. Frost. *ACM/Baltzer Mobile Networks and Nomadic Applications (NOMAD): Topical Journal on Mobility of Systems, Users, Data and Computing*, Vol. 1, No. 1, 1996.

Noise Squeezing Due to Kerr Effect Nonlinearity in Optical Fibers with Negative Dispersion,
R. Hui, M. O'Sullivan. *IEEE Electronics Letters*, Vol. 32, No. 21, Oct. 1996.

Numerical Differentiation and Parameter Estimation in Higher Order Stochastic Systems,
T. Duncan, P. Mandl, B. Pasik-Duncan. *IEEE Transactions on Automatic Control*, Vol. 41, 1996, pp. 522-532.

ProFusion: Intelligent Fusion from Multiple, Distributed Search Engines,
S. Gauch, G. Wang, M. Gomez. *Journal of Universal Computer Science*, Sept. 1996.

Stochastic Adaptive Control for Continuous Time Linear Systems with Quadratic Cost,
T. Duncan, H.F. Chen, B. Pasik-Duncan. *Journal of Applied Mathematical Optimization*, Vol. 34, 1996, pp. 113-138.

VISION: A Digital Video Library,
W. Li, S. Gauch, J. Gauch, K.M. Pua, *ACM Digital Libraries '96,* Mar. 1996, pp. 19-27.

1995

Automatic Implementation of FIR Filters on Field Programmable Gate Arrays,
S. Mohanakrishnan, J.B. Evans. *IEEE Signal Processing Letters*, Mar. 1995, pp. 51-53.

BFX: An Operational Expert System for Bridge Fabrication,
W.M.K. Roddis, M. Hess, H. Melhem and S. Nagaraja. *Transportation Research Record*, TRB, No. 1491, Transportation Research Board, 1995, pp. 62-68.

A Comprehensive, Automated Approach to Determining Sea Ice Thickness from SAR Data,
D. Haverkamp, L-K Soh, C. Tsatsoulis. *IEEE Transactions on Geoscience and Remote Sensing*, Vol. 33, No. 1, 1995, pp. 46-57.

An Efficient Bit-Serial FIR Filter Architecture,
Y.C. Lim, J.B. Evans, B. Liu. *Circuits, Systems & Signal Processing*, Vol. 15, No. 5, 1995, pp. 639-651.

An Equivalent Markov Model for Burst Errors in Digital Channels,
K.S. Shanmugan, S. Sivaprakasam. *IEEE Transaction on Communications*, Apr. 1995, pp. 1347-1356.

FDTD Modeling of Scatterers in Stratified Media,
K. Demarest, R. Plumb, Z. Huang. *IEEE AP-S Transactions*, Vol. AP-43, No. 10, Oct. 1995, pp. 1164-1168.

Input-Queued Switch Based on a Scheduling Algorithm,
S. Motoyama, D.W. Petr, V.S. Frost. *Electronics Letters*, Vol. 31, No. 14, July 6, 1995, pp. 1127-1128.

Interferometric Synthetic Aperture Radar,
C.T. Allen. *IEEE Geoscience and Remote Sensing Society Newsletter*, Issue #96, Sept. 1995, pp. 6-13.

Limit Theorems of Probability Theory in Linear Controlled Evolution Systems with Quadratic Cost (Summary),
B. Pasik-Duncan. *Journal of Mathematical Systems, Estimation, and Control*, Vol. 5, 1995, pp. 99-102.

On Stochastic Adaptive Control of an Investment Model with Transaction Fees,
B. Pasik-Duncan, T. Duncan, M. Faul, O. Zane. *Ulam Quarterly*, 1995, pp. 101-109.

Performance of BPSK and TCM Using the Exponential Multipath Profile Model for Spread-Spectrum Indoor Radio Channels,
J.M. Bargallo, J.A. Roberts. *IEEE Transactions on Communications*, Vol. COM-43, Feb. 1995, pp. 615-623.

Recovery of Surfaces with Discontinuities by Fusing Shading and Range Data within a Variational Framework,
J. Shah, H.H. Pien, J.M. Gauch. *IEEE Transactions on Image Processing*, Vol. 5, No. 8, Aug. 1995.

Robust Target Classification Using ANN,
S. Chakrabarti, N. Bindal, K. Theagarajan. *IEEE Transactions on the Neural Network*, Vol. 6. No. 3, May 1995, pp. 760-766.

Simulation Comparison of Broadband Networking Technologies,
D.W. Petr, V.S. Frost, L. Neir, A. Demirtjis, C. Braun. *Simulation,* Vol. 64, No. 1, Jan. 1995, pp. 42-50.

Solvable Optimal Control of Brownian Motion in Symmetric Spaces and Spherical Polynomials,
T. Duncan. *Geometry in Nonlinear Control and Differential Inclusions*, Banach Center Publications, Vol. 32, 1995, pp. 183-197.

Some Results for the Adaptive Boundary Control of Stochastic Linear Distributed Parameter Systems,
T. Duncan. *Adaptive Control, Filtering and Signal Processing, IMA Volumes in Mathematics and Its Applications*, Springer-Verlag, Vol. 74, 1995, pp. 43-64.

Static and Dynamical Properties of Dispersive Optical Bistabilitiy in Semiconductor Lasers,
R. Hui. *IEEE Journal of Lightwave Technology*, Vol. 13, No. 1,1995.

Stochastic Control Problems and Spherical Functions on Symmetric Spaces,
T. Duncan, H. Upmeier. *Transactions Amer. Math. Soc.*, 1995, pp. 1083-1130.

A Variational Approach to Multi-Sensor Fusion of Images,
H.H. Pien, J.M. Gauch. *Applied Intelligence* (special issue on sensor fusion), Vol. 5, No. 3, July 1995.

Papers/Presentations

1998

An Analytical Network Traffic Model Using Generalized Interrupted Poisson Processes and Generalized Interrupted Bernoulli Processes,
Y. Lee, A. van de Liefvoort, V. L. Wallace. SPIE International Symposium on Voice, Video, and Data Communications, Boston, Nov. 1998.

The Art of Natural Graphic Man-Machine Conversation,
J. Foley, V. L. Wallace. *Seminal Graphics: Pioneering Efforts that Shaped the Field*, SIGGRAPH 98 Conference in Computer Graphics and Interractive Techiques, Orlando, Aug., 1998, pp. 417-426 (in celebration of the 25th anniversary of the first SIGGRAPH conference). (Reprint from *IEEE Proceedings*, Vol. 62, 1974.)

Characterization of a Cooperative Target for Ground-Penetrating Radar,
C.T. Allen, K. Shi, R.G. Plumb, *Proceedings of the 7th International Conference on Ground Penetrating Radar (GPR '98)*, Lawrence, Kansas, May 1998, pp. 561-565.

Classification Strategies Using Certain and Possible Rules,
J.W. Grzymala-Busse, X. Zou. *Proceedings of the First International Conference on Rough Sets and Current Trends in Computing*, Warsaw, Poland, June 22–26, 1998. Also *Lecture Notes in Artificial Intelligence*, No. 1424, Springer Verlag, 1998, pp. 37–44.

Compensation of Cross-Phase Modulation in 10-Gbit/s WDM Systems by Interfering Channel Pre-Chirping,
R.A. Saunders, A. Robinson, D. Garthe, R. Hui and M. O'Sullivan. Optical Fiber Communication Conference; OFC'98, San Jose USA, Feb. 1998.

Evolutionary Communication in Distributed Multi-Agent Systems,
A. Agah, G. A. Bekey, *Proceedings of The Seventh International Symposium on Robotics with Applications (ISORA'98)*, World Automation Congress (WAC'98), Anchorage, Alaska, May 1998.

A Firm Real-Time System Implementation Using Commercial Off-the-Shelf Hardware and Free Software,
B. Srinivasan, S. Pather, R. Hill, F. Ansari, D. Niehaus. *Proceedings of the Real-Time Technology and Applications Symposium*, Denver, June 1998.

Implementation of a Prototype Active Network,
A. B. Kulkarni, G. J. Minden, R. Hill, Y. Wijata, S. Sheth, F. Wahhab, H. Pindi, A. Nagarajan. Accepted for First IEEE Conference on Open Architectures and Network Programming, San Francisco, CA, Apr. 3-4, 1998.

Inducing Simpler Rules from Reduced Data,
J.W. Grzymala-Busse, S. Than. *Proceedings of the Seventh Workshop on Intelligent Information Systems (IIS'98)*, Malbork, Poland, June 15–19, 1998, pp. 371–378.

Integrated Capabilities for Rapid Deployment Forces,
G. J. Minden. DARPA Global Mobile PI Meeting, Washington, D.C., July 28-30, 1998.

Performance Analysis of a DS-CDMA Packet Cellular Network in a Multi-User Environment,
M. Mangal, J. A. Roberts, D. L. Machamer. *Proceedings of the IEEE Vehicular Technology Conference*, Ottawa, Canada, May 18-21, 1998, pp. 1461-1465.

Separation of Noise from Distortion for Amplified Optical Fiber System Link Budgeting,
R. Hui, M. Vaziri, J. Zhou, M. O'Sullivan. *Proceedings of International Conference on Applications of Photonic Technology*, ICAPT'98, Ottawa, Canada. July 27-30, 1998 (post-deadline paper).

Simulation and Measurement of TCP/IP over ATM Wide Area Networks,
G. Lazarou, V. Frost, J. Evans, D. Niehaus. *IEICE Transactions on Communications*, Vol. E81-B, No. 2, Feb. 1998.

Torsion and Stability of Steel Bridge Girders during Construction,
W. M. Kim Roddis. 43rd Annual Structural Engineering Conference, The University of Kansas Department of Civil Engineering and Division of Continuing Education, Lawrence, Kansas, Mar. 19, 1998.

Training an ANN for Synthesizing Surface Roughness of Varying Scales,
E. Setiawan, S. Chakrabarti. *Proceedings of International Joint Conference on Neural Networks*, IEEE World Congress on Computational Intelligence, Anchorage, Alaska, May 4-9, 1998, pp. 832-836.

Visualizing the Performance of Higher-Order Programs,
O. Waddell, J. M. Ashley. *Proceedings of the ACM SIGPLAN/SIGSOFT Workshop on Program Analysis for Software Tools and Engineering*, 1998, pp. 75-82.

1997

An Adaptive Multi-Agent Architecture for the ProFusion Meta Search System, Y. Fan, S. Gauch. WebNet '97: The Second World Conference of the Web Society, Oct. 1997, Toronto, Canada.

An Architecture for Transmit Beamforming for Rapidly Deployable Radio Networks,
G. Prescott, C. Sparks, S. Sivaprakasam. *Space Technology and Applications International Forum, 26-30 July 1997*, Albuquerque, NM, pp. 945-950.

Combination of Machine Learning and Regression Analysis in Knowledge Acquisition,
W.M.K. Roddis, L. Zhang. *Computing in Civil Engineering, Proceedings of the Fourth Congress*, ed. Teresa Adams, American Society of Civil Engineers, June 1997, pp. 312-318.

A Corpus Analysis Approach for Automatic Query Expansion,
S. Gauch, J. Wang. Accepted for CIKM '97: 7th International Conference on Information and Knowledge Management, Las Vegas, NV, Nov. 1997.

Design and Implemenation of a DSP Digital Beamforming Receiver,
G. Prescott, S. Gurrapu. *Proceedings of the International Conference on Signal Processing Applications and Technology*, San Diego, 14-17 Sept. 1997, pp. 1557-1562.

Equilibrium Pricing in Multiservice Priority-Based Networks,
L.A. DaSilva, D.W. Peter, N. Akar. *Proceedings of 1997 IEEE Globecom Conference*, Nov. 1997, pp. S38_6.1 - S38_6.5. Also presented at the University of Missouri-Kansas City, as part of their Computer Science Telecommunications Program Faculty Seminar Series, Sept. 1997.

Ergodic Distributed Control for Parameter Dependent Stochastic Semilinear Systems in Hilbert Space, T. Duncan, B. Maslowski, B. Pasik-Duncan. Accepted for *Proceedings of the Conference on Stochastic Differential and Differentia Equations*, Birkhauser (1997).

Experiences in a Wide Area ATM Network,
L. DaSilva, J. Evans, D. Niehaus, V. Frost, R. Jonkman, B. Lee, G. Lazarou. *IEEE International Conference on Communications,* June 1997, pp. 1694-1698.

Information Fusion from Distributed World Wide Web Sources,
S. Gauch. Accepted for *Proceedings of the ACM SIGIR '97 Workshop on Networked Information Retrieval*, Philadelphia, PA, July 1997.

Keyboardless Visual Programming Using Voice, Handwriting, and Gestures,
J. Leopold, A. Ambler. 1997 Symposium on Visual Languages, Capri, Italy, Sept. 1997, 28-35.

MAGIC-II,
I. Richer, J. B. Evans. 1997 IEEE Gigabit Networking Workshop, Apr. 1997.

A Measurement-Based CAC Strategy for ATM Networks,
K. Kiu, D.W. Petr, C. Braun. *Proceedings of the 1997 IEEE International Conference on Communications (ICC'97)*, June 1997, pp. 1714-1718.

Modulation Instability in Amplified Optical Systems with Dispersion Compensation,
R. Hui, M. O'Sullivan, A. Robinson. Optical Fiber Communication Conference, OFC'97, Dallas, TX, Feb. 1997.

Multi-Mode System Support for Real-Time Object Oriented Middleware, D. Niehaus. *Proceedings of the OpenSig Workshop*, Columbia University, Oct. 1997.

Neural Network for Predicting the Anticancer Activity of Pharmaceutical Compunds,
S. Svojanovsky, S. Chakrabarti, G. S. Wilson, M. Slavik. Poster presentation (received "Best Poster" award), Research Forum of the University of Kansas School of Medicine-Wichita, Oct. 23, 1997, Wichita, KS.

Performance Experience in a Wide Area Network,
L. DaSilva, J. Evans, D. Niehaus, V. Frost, R. Jonkman, B. Lee, G. Lazarou. IEEE ICC '97, Montreal, Quebec, Canada, June 1997.

Prototyping of Military Radio Systems Using Field Programmable Gate Arrays and DSP Microprocessors,
G. Prescott, S. Tyler. *Proceedings of the International Conference on Signal Processing Applications and Technology*, San Diego, 14-17 Sept. 1997, pp. 1599-1603.

Regional/National Bridge Fabrication Expert System,
W.M. Kim Roddis. National Steel Bridge Construction Collaborative, AISC National Steel Bridge Association and AASHTO, Cincinnati, OH, Sept. 9, 1997.

Robots Playing to Win: Evolutionary Soccer Strategies,
A. Agah, K. Tanie. *Proceedings of The 1997 IEEE International Conference on Robotics and Automation (ICRA'97)*, Albuquerque, New Mexico, Apr. 1997, pp. 632-637.

A Robust Speaker Independent Isolated Word Recognition System Using Modular Fuzzy Neural Network, J. Kim, S. Chakrabarti. *Proceedings of the Conference on Intelligent Engineering Systems through Artificial Neural Network*, St. Louis, MO, Vol. 7, Nov. 11-15, 1997, pp. 817-821.

Software Radio: Using DSP to Implement Radio Systems, G. Prescott. *Proceedings of the 1997 DSP World Spring Design Conference*, Mar. 25-27, 1997, Washington D.C., pp. 217-219.

Speaker Identification Using Combined Speech Coding and Neural Network Techniques, S.A. Oliva, S.D. Learned, S. Chakrabarti. *Proceedings of the Conference on Intelligent Engineering Systems through Artificial Neural Network*, St. Louis, MO, Vol. 7, Nov. 11-15, 1997, pp. 809-815.

Suggested Changes to the Draft Recommendation I.363.2, P. Sampath, D. W. Petr, Y. Q. Lu. Contribution to Standards Committee T1S1.5, Aug. 1997. A portion of this Contribution was accepted as a United States contribution to the International Telecommunication Union (ITU), Study Group 11, Sept. 1997.

Surface Roughness Synthesis Using ANN, E. Setiawan, S. Chakrabarti. *Proceedings of the Conference on Intelligent Engineering Systems through Artificial Neural Network*, St. Louis, MO, Vol. 7, Nov. 11-15, 1997, pp. 485-490.

Transmitter Beamforming for a Rapidly Deployable Radio Network, G. Prescott, C. Sparks. *Proceedings of the 1997 Military Communications Conference, MILCOM-97*, Monterey, CA, Nov. 2-5, 1997, pp. 515-520.

Visual Programming Challenge Chair, A. Ambler. 1997 IEEE Symposium on Visual Languages, Capri, Italy, Oct. 1997.

Undergraduate Research and Intellectual Property Rights, K. J. Nordheden and M. H. Hoeflich. *The Kansas Journal of Law & Public Policy*, Vol. VI, Number III, Summer/Fall 1997.

1997 Visual Programming Language Summary, A. Ambler, T. Green, T.D. Kimura, A. Repenning, and T. Smedley. *1997 Symposium on Visual Languages*, Capri, Italy, Sept.1997, pp. 11-18.

WAN Performance Studies in the MAGIC and AAI Testbeds, J. B. Evans. Measure Workshop, Cambridge, England, Feb. 1997.

Weighted Least Squares and Continuous Time Adaptive LQG Control, B. Pasik-Duncan, T. Duncan, L. Guo. *Proceedings of 36th Conference on Decision and Control*, San Diego, 1997, pp. 4058-4063.

Wireless ATM, J. B. Evans. Advanced Communication Networks '97, Tel Aviv, Israel, Feb. 1997.

1996

AAI ATM WAN Performance: Tools, Experiments, and Results, J.B. Evans, V.S. Frost, D. Niehaus, R. Jonkman, L. DaSilva, B. Lee, G. Lazarou. Invited presentation. 1996 DARPA ATM WAN Performance Workshop, June 1996.

An Active Network Architecture for ATM WANs, A.B. Kulkarni, G. Minden, V. Frost, J. Evans. Third International Workshop on Mobile Multimedia Communications, Princeton, NJ, Sept. 25-27, 1996. Selected for publication in *Mobile Multimedia Communications*, Plenum Publishing, Chapt. 3, Nov. 1997.

An Active Networking Program, G.J. Minden. DARPA ITO General PI Meeting, Dallas, TX, Oct. 6-9, 1996.

Adaptive Control of Markov Processes Using Large Deviations, T. Duncan, B. Pasik-Duncan, L. Stettner. *Proceedings of the 35th Conference on Decision and Control*, Kobe, Japan, 1996, pp. 360-365.

Capacity of a CDMA Cellular System with Variable User Data Rates, V.J. Paulrajan, J.A. Roberts, D.L. Machamer. *Proceedings of the IEEE GLOBECOM'96*, London, UK, Nov. 18-22, 1996, pp. 1458-1462.

A Comparison of Various Radiometer Experiences with Wide-Area ATM Networking: From Hardware Development to System Performance, Victor Frost. Keynote address, 18th Biennial Symposium on Communications, Queen's University, Kingston, Ontario, Canada, June 4, 1996.

Computational Methods for Stochastic Partial Differential Equations, T. Duncan, B. Pasik-Duncan, P. Zimmer. *Proceedings of the 35th Conference on Decision and Control*, Kobe, Japan, 1996, pp. 1765-1766.

Constraint-Based Reasoning for Optimal Concrete Design and Detailing, W.K. Lucas, W.M.K. Roddis. *Analysis and Computation Proceedings of the Twelfth Conference Held in Conjunction with Structures Congress XIV*, ed. Franklin Y. Cheng, American Society of Civil Engineers, Apr. 1996, pp. 154-165.

A Control and Management Network for Wireless ATM Systems, S.F. Bush, S. Jagannath, J.B. Evans, V.S. Frost. IEEE International Conference on Communications, Dallas, TX, June 1996.

Corpus Analysis for TREC-5 Query Expansion,
S. Gauch, J. Wang. TREC-5: The 5th Annual Text Retrieval Conference, Gaithersburg, MD, Nov. 1996.

DARPA ITO Experimental Networking Testbeds,
G.J. Minden. AIAA Conference, Washington, DC, Feb. 29, 1996.

Design and Analysis of a Bandwidth Management Framework for ATM-Based Broadband ISDN,
K. Liu, H. Zhu, D.W. Petr, V.S. Frost, C. Braun, W. Edwards. IEEE International Conference on Communications, Dallas, TX, June 1996.

Detection of Fast Frequency Hop Signals with Quadrature Mirror Filter Banks,
T. Farrell, G. Prescott. 1996 International Conference on Acoustics, Speech and Signal Processing (ICASSP-96), May 1996.

High Speed Optical Transmission Systems with Bidirectional Fiber Amplifiers,
R. Hui, M. Poettcker, M. O'Sullivan. SPIE Photonics China '96 , Beijing, Nov. 1996.

Information Fusion with ProFusion,
S. Gauch, G. Wang. *WebNet '96: The First World Conference of the Web Society*, San Francisco, CA, Oct. 1996, pp. 174-179.

The ITO Networking Systems Program,
G.J. Minden. ARPATech Symposium, Atlanta, GA, May 21-24, 1996.

Learning Reliability Models of Other Agents in a Multiagent System,
C. Tsatsoulis, G. Yee. AAAI-96 Workshop on Adaptive Multiagent Systems, Wsp-96-04, AAAI Press, 1996.

The MAGIC Gigabit Testbed Project,
G.J. Minden. Iowa State, Ames, IA, Oct. 23, 1996.

MAGIC Testbed Results,
J.B. Evans, V.S. Frost, D. Niehaus, D.W. Petr, G.J. Minden, B.J. Ewy. IEEE HOT Interconnects Conference, Stanford, CA, Aug. 14-16, 1996.

A 622 Mb/s ATM LAN/WAN Gateway with Cell Level Measurement and Pacing Capabilities,
J.B. Evans, V.S. Frost, D. Niehaus, D.W. Petr, G.J. Minden, B.J. Ewy. IEEE Hot Interconnects IV, Kresge Auditorium, Stanford University, Palo Alto, CA, Aug. 1996.

Measuring Glacier and Ice Sheet Thickness in Greenland with an Airborne Radio Echosounder,
C.T. Allen. University of Kansas Physics and Astronomy Department Colloquium, Nov. 4, 1996.

A Novel Technique of Modeling GPR Antennas,
Z. Huang, K. Demarest, R. Plumb. *Proceedings of the Sixth International Conference on Ground-Penetrating Radar, GPR '96*, Sendai, Japan, Oct. 1996, pp. 57-60.

Organization and Coordination Strategies for Complex Adaptive Systems: Derived Heuristics from Biological Systems,
A. Agah. *Proceedings of The First Asia-Pacific Conference on Simulated Evolution and Learning (SEAL'96)*, Taejon, Korea, Nov. 1996, pp. 125-134.

Over the Shoulder: Real-Time Collaboration Over High Speed Networks,
M.T. Swink, J.B. Evans, V.S. Frost. 1996 IEEE Gigabit Networking Workshop, Mar. 1996.

Performance Benchmarking of ATM Signaling Software,
A. Kaushal, S. Shumate, R. Hill, D. Niehaus, V. Sirkay, B. Edwards. *Proceedings of the OpenSig Workshop, Columbia University*, Oct. 1996.

Performance Considerations in File Transfers Using FTP Over Wide-Area ATM Networks,
L. DaSilva, R. Lett, V.S. Frost. 22nd International Conference for the Resource Management and Performance Evaluation of Enterprise Computing Systems, San Diego, CA, Dec. 8-13, 1996.

A Performance Model of Space-Division ATM Switches with Input and Output Queueing,
V. Wallace, G. Zhang, W. G. Bulgren. *Proceedings Hawaii International Conference on System Sciences*, Wailea, 1996, Vol. I, pp. 72-79.

Plasma Processes for GaAs Devices,
K.J. Nordheden. Department of Electrical and Computer Engineering, University of Illinois, Urbana, IL, Dec. 1996.

A Practical and Flexible Flow Analysis for Higher-Order Programming Languages,
J. Michael Ashley. *Proceedings of the 1996 ACM Symposium on Principles of Programming Languages*, 1996, pp. 184-194.

Predictive Systems in Network Management with Mobility,
S.F. Bush, V.S. Frost, J.B. Evans. 1996 IEEE Symposium on Planning & Design of Broadband Networks, Montebello, Quebec, Canada, Oct. 1996.

Projecting the Future for Engineering,
J.A. Roberts, Myron D. Calkins. Management Seminar, International Public Works Congress and Exposition, Washington, D.C., Aug. 26, 1996.

A Quadrature Mirror Filter Hopped Spread Spectrum System,
T. Farrell, G. Prescott. 1996 Military Communications Conference, McLean, VA, Oct. 21-24, 1996.

Radar Sounding of Glaciers in Greenland,
C.T. Allen. 1996 International Geoscience and Remote Sensing Symposium (IGARSS '96), Lincoln, Nebraska, May 31, 1996.

Radar Sounding of Greenland Outlet Glaciers,
C.T. Allen. XXVth General Assembly of the International Union of Radio Science (URSI), Lille, France, Sept. 5, 1996.

Real-Time Detection of Quality of Service Violations in High-Speed Networks,
V.S. Frost, H. Zhu. 1996 SIAM Annual Meeting, Kansas City, Missouri, July 22-26, 1996.

Self-Tuning Fuzzy Control for Available Bit Rate (ABR) Traffic,
Q. Hu, D.W. Petr. Mini-symposium talk, Society for Industrial and Applied Mathematics (SIAM) Annual Meeting, Kansas City, July 1996.

Self-Tuning Fuzzy Traffic Rate Controller for ATM Networks,
Q. Hu, D.W. Petr, C. Braun. *Proceedings of the IEEE International Conference on Communications (ICC)*, June 1996, pp. 424-428.

Single-Criteria Genetic Optimization for Design and Detailing of Concrete Structures,
W.M.K Roddis, W.K. Lucas, V. Chunnanond. *Computing in Civil Engineering, Proceedings of the Third Congress*, ed. J. Vanegas, P. Chinowsky, American Society of Civil Engineers, June 1996, pp. 91-96.

A Stochastic Approximation Algorithm with Random Differences,
T. Duncan, H.F. Chen, B. Pasik-Duncan. *Proceedings IFAC 1996 World Congress*, San Francisco.

Teaching Computing Service Courses for Fun and Profit,
M.C. Kong, J.A. Roberts. *Proceedings IEEE FIE'96*, Salt Lake City, UT, Nov. 6-9, 1996, pp. 7a4.21-7a4.24.

Texture Representation of SAR Sea Ice Imagery Using Multi-Displacement Co-Occurrence Matrices,
L. Soh, C. Tsatsoulis. *IGARSS '96 Conference*, Vol. I, 1996, pp. 112-114.

Transferring Artificial Intelligence Technology Through a Research Center of Excellence,
C. Tsatsoulis, J. Holtzman. *ITESM '96 International Symposium on Artificial Intelligence/International Conference on Industrial Fuzzy Control and Intelligent Systems*, Cancun, Mexico, Nov. 12-15, 1996, pp. 30-35.

Using Measurements to Validate Simulation Models of TCP/IP Over High Speed ATM Wide Area Networks,
G.Y. Lazarou, V.S. Frost, J.B. Evans, D. Niehaus. IEEE Int. Conference on Communications, Dallas, TX, June 1996.

Using Temporal Information in an Automated Classification of Summer, Marginal Ice Zone Imagery,
D. Haverkamp, C. Tsatsoulis. *IGARSS '96 Conference*, Vol. I, 1996, pp. 109-111.

VISION: A Digital Video Library,
W. Li, S. Gauch, J. Gauch, K.M. Pua. ACM Digital Libraries '96, Baltimore, Mar. 1996.

1995

Automatic Word Similarity Detection for TREC-4 Query Expansion,
S. Gauch, M.K. Chong. *Proceedings of TREC-4: The 4th Annual Text Retrieval Conference*, Gaithersburg, MD, Nov. 1995.

Benchmarking of High Performance Networks,
J.B. Evans. Invited presentation. 1995 International Conference on Computers, Communications, and Networks, Las Vegas, Nevada, Sept. 1995.

Bit Error Rate Performance of Antenna Diversity Systems with Channel Correlation,
J.R. Abeysinghe, J.A. Roberts. *Proceedings of the IEEE GLOBECOM'95*, Singapore, Nov. 13-17, 1995, pp. 2022-2026.

Compiler Construction Using Scheme,
E. Hilsdale, J.M Ashley, R K. Dybvig, D.P. Friedman. *Proceedings of the 1995 Conference on Functional Programming Languages in Education*, 1995, pp.251-267.

A Connection Admission Control Based on Real Time Traffic Statistics,
S. Motoyama, D.W. Petr, V.S. Frost. *Proceedings of the13th Brazilian Telecommunication Symposium*, Aguas de Lindoia, SP, Brazil, Vol. 1, Sept. 3-6, 1995, pp. 31-36.

Considerations for Automatic Gain Control in DSP Receivers and Modems,
G.E. Prescott. 1995 TAPR Symposium, St. Louis, MO, May 2-3, 1995.

Constraint-Based Reasoning for Concrete Design and Detailing,
W.K. Lucas, W.M.K. Roddis, F.M. Brown. CONSTRAINT-95, *Proceedings of LAIRS-95, The Eighth Florida Artificial Intelligence Research Symposium*, Apr. 26, 1995.

Credit-Based Flow Control for ATM Networks Revisited,
J.B. Evans, L. DaSilva, H. Zhu, V.S. Frost. 1995 IEEE Gigabit Networking Workshop, Apr. 1995.

Current Research at the University of Kansas Applying Artificial Intelligence in Structural Engineering, W.M.K. Roddis. *Applications of Artificial Intelligence in Structural Engineering, II: Proceedings of the 2nd Workshop of the European Group for Structural Engineering Applications of Artificial Intelligence (EG-SEA-AI)*, ed. M. Lazzari, P. Salvaneschi, ISMES, Bergamo, Italy, Mar. 18, 1995, pp. 48-52.

Discretized Maximum Likelihood Estimates and Almost Self-Optimizing Controls for Ergodic Markov Models, T. Duncan, B. Pasik-Duncan, L. Stettner. *Proceedings of the 34th IEEE Conference on Decision and Control*, New Orleans, 1995, pp. 1630-1634.

Electrical Engineering vs. Computer Engineering vs. Computer Science: Developing Three Distinct but Interrelated Curricula, K.R. Demarest, J.R. Miller, J.A. Roberts, C. Tsatsoulis. *Proceedings of the IEEE FIE'95*, Atlanta, GA, Nov. 1-5, 1995, pp. 4b2.1-4b2.4.

Entropy of English Text: Experiments with Humans and a Machine Learning System Based on Rough Sets, H. Moradi, J. Grzymala-Busse, J.A. Roberts. *Proceedings of the Fourth Annual Conference on Fuzzy Theory and Technology*, Wrightsville Beach, NC, Sept. 28-Oct. 1, 1995, pp. 87-88.

Experiences with a 622 Mb/s ATM/SONET Gateway, J.B. Evans, G.J. Minden, V.S. Frost, D.W. Petr, D. Niehaus, D. Braun, B. Buchanan, B. Ewy, C.N. Gupta, S. Seetharam, V. Sirkay, M. Swink, H. Uriona, E. Yousefi. Invited presentation. 1995 MAGIC Symposium, Minneapolis, Minnesota, July 1995.

A Forward Only Recursion Based HMM for Modeling Burst Errors, K.S. Shanmugan, S. Sivaprakasam. *Proceedings of Globecom'95*, Singapore, Nov. 1995, pp. 1054-1059.

A High Speed Implementation of Adaptive Shaping for Dynamic Bandwidth Allocation, C. Braun, V. Sirkay, H. Uriona, S. Seetharam, E. Yousefi, D. Petr, D. Niehaus, V.S. Frost, J.B. Evans, G.J. Minden. *Fourth IEEE Symposium on High Performance Distributed Computing*, Aug. 1995, pp. 94-101.

How to Encourage Cheating with Virtual Path Policing in ATM Networks, A. Demirtjis, D.W. Peter. *Proceedings of the International Conference on Computer Communication and Networks (IC3N)*, Sept. 1995, pp. 225-228.

Integrating KBES and CADD for Steel Design and Fabrication, W.M.K. Roddis, G.P. Pasley. IABSE Colloquium, *Knowledge Support Systems in Civil Engineering*, Bergamo, Italy, Mar. 16-17, 1995, pp. 131-134.

Knowledge-Based Systems for Steel Fabrication, W.M.K. Roddis. 40th Annual Structural Engineering Conference, The University of Kansas Department of Civil Engineering and Division of Continuing Education, Lawrence, Kansas, Apr. 4, 1995.

LPI Requirements for Military C3 Networks, G.E. Prescott. Workshop on Communications Networks for Command and Control, North Carolina State University, Raleigh, NC, Mar. 9-10, 1995.

Network Integrated Processing, J.B. Evans, V.S. Frost, D. Niehaus, D.W. Petr. 1995 IEEE Gigabit Networking Workshop, Apr. 1995.

Network Performance Measurement Tools: NetSpec and ARTS, D. Niehaus. *Proceedings of the Magic Technical Symposium*, Minneapolis, MN, Aug.1995.

A New Simulation Approach for Modeling Intelligent Networks Based on Signaling System No. 7, K. Medhat, J.B. Evans, J.A. Roberts. *Proceedings 4th Midwest Electro-Technology Conference*, Mar. 1995, pp. 108-111.

Numerical Methods for the Stochastic Adaptive Control of Some Investment and Consumption Models with Transaction Costs, T. Duncan, B. Pasik-Duncan, O. Zane. *Proceedings 34th Conference on Decision and Control*, New Orleans, 1995, pp. 3360-3365.

Parallel Implementation of the CELP Speech-Compression Algorithm on a Network of TMS320C40 DSP Processors, H. Chakravarthula, S. Srinivas, G. Prescott, T. Johnson, S. Tyler. *Proceedings of the Sixth International Conference on Signal Processing Applications and Technology (ICSPAT-95)*, Oct. 24-26, 1995.

Performance Evaluation of Congestion Control Mechanisms in ATM Networks, H. Zhu, L.A. DaSilva, J.B. Evans, V.S. Frost. 20th International Conference of the Computer Measurement Group, Nashville, TN, Dec. 3-8, 1995.

Performance of BPSK and TCM Using the Exponential Multipath Profile Model for Spread-Spectrum Indoor Radio Channels, J. M. Bargallo, J. A. Roberts. *IEEE Transactions on Communications*, Vol. COM-43, Feb. 1995, pp. 615-623.

Plasma Etching of HEMTs and MMICs, K.J. Nordheden. Department of Electrical and Computer Engineering, Washington University, St. Louis, MO, Mar. 1995.

Rapidly Deployable Radio Network: ATM to the End User,
G.E. Prescott. Defense Information Systems Agency/AFOSR/Rome Labs Technical Exchange, Reston, VA, Oct. 12, 1995.

Reactive Ion Etching of Via Holes for GaAs HEMTs and MMICs Using CI2/BCI3/Ar Gas Mixtures,
K.J. Nordheden. IEEE International Conference on Plasma Science (ICOPS), Madison, WI, June 1995.

A Real-Time Description Language,
D. Niehaus, J.A. Stankovic, K. Ramamritham. *Proceedings of the Real-Time Technology and Applications Symposium*, Chicago, IL, May 1995, pp. 104-115.

Real Time Implementation of an Adaptive Shaper for Dynamic Bandwidth Allocation in ATM Networks,
V. Sirkay, D. Niehaus, J.B. Evans, W. Edwards. *IEEE ATM '95 Workshop*, Oct. 1995, pp. W3A:11-W3A:22.

Single Point On-line Estimation of Cell Loss in ATM Networks,
H. Zhu, V.S. Frost. 14th European Conference of Operations Research, Jerusalem, Israel, June 3-6, 1995.

Some Approaches to Adaptive Control of Stochastic Linear Distributed Parameter Systems,
T. Duncan, B. Pasik-Duncan. *Proceedings Third IEEE Mediterranean Symposium on New Directions in Control and Automation II*, Limassol, Cyprus, 1995, pp. 197-204.

Some Computational Aspects of Stochastic Adaptive Control,
T. Duncan, B. Pasik-Duncan. *Proceedings International Conference on Control and Information*, Hong Kong, June 1995, pp. 81-186.

Some Results for the Identification and Adaptive Control of Stochastic Linear and Semilinear System,
T. Duncan, H.F. Chen, B. Pasik-Duncan. *Proceedings 1995 American Control Conference*, Seattle.

Targeting Expert Systems for Bridge Engineering,
W.M.K Roddis, H.G. Melhem. *Applications of Artificial Intelligence in Structural Engineering–II: Proceedings of the 2nd Workshop of the European Group for Structural Engineering Applications of Artificial Intelligence (EG-SEA-AI)*, ed. Marco Lazzari and Paolo Salvaneschi, ISMES, Bergamo, Italy, Mar. 18, 1995, pp. 147-149.

TCP/ATM Experiences in the MAGIC Testbed,
B.J. Ewy, J.B. Evans, V.S. Frost, G.J. Minden. *Proceedings of the Fourth IEEE Symposium on High Performance Distributed Computing*, Aug. 1995, pp. 97-93.

A Two-State Rician Model for Predicting Indoor Wireless Communication Performance,
J.A. Roberts, J.R. Abeysinghe. *Proceedings of IEEE ICC'95*, Seattle, WA, June 18-22, 1995, pp. 40-43.

The UNITE Project: Distributed Delivery and Contribution of Multimedia Objects Over the Internet,
C. Deniau, M. Swink, R. Aust, J. Evans, S. Gauch, J. Miller, D. Niehaus. *Proceedings of INET'95: The 5th Annual Conference of the Internet Society*, Honolulu, HI, June 1995, pp. 91-99.

Waveform Design and Analysis of Frequency Hopping LPI Networks,
R.F. Mills, G.E. Prescott. *Proceedings of the 1995 Military Communications Conference (MELCOM-95)*, San Diego, CA, Nov. 6 - 7, 1995, pp. 778 -782.

Technical Reports

1998

Proceedings of the 1998 Great Plains Programming Languages Workshop, J. Michael Ashley, ed. DesignLab Technical Report 1998-01, Apr., 1998.

Steel Bridge Fabrication Errors Indexed Examples and Solutions: Combining Rules and Cases,
R. R. Greenfield, W. M. Kim Roddis. SL Report 98-2, The University of Kansas Center for Research, Inc., June 1998.

1997

AAI Performance and Congestion Management Studies: Year 2 Technical Report,
V. Frost, J. B. Evans, D. Niehaus, D. Petr, L. DaSilva, R. Jonkman, G. Lazarou, S. Muppidi, B. Lee, Y. Wijata, S. Sheth. TISL Technical Report TISL-10980-21, Jan. 1997.

AAL2 Transmitter Simulation Study,
P. Sampath, D. W. Petr. Technical Report ITTC-FY98-TR-13110-01, July 1997.

Buckling Length of Unbraced Frame Columns,
H.A. Hamid, W.M.K. Roddis. SL Report 97-1, The University of Kansas Center for Research, Inc., 1997.

Digital Beamforming Receiver Design,
S. Gurrapu, G. Prescott, S. Shanmugan, ITTC Technical Report, ITTC-FY97-1092-25, May 1997.

A Framework for Bandwidth Management and Call Admission Control in ATM Networks,
K. Liu, D. W. Petr. Technical Report ITTC-FY97-TR-11230-03, May 1997.

1996

Case-Based Approach for Bridge Fabrication Errors,
J.C. Bocox, W.M.K. Roddis. SL Report 96-3, The University of Kansas Center for Research, Inc., June 1996.

CDMA Cellular Capacity Assessment,
M. Mangal, V.K. Paulrajan, J.A. Roberts. Technical Report TISL-11880-01, Dec. 1996.

Channel Estimation and Adaptive Communication Techniques,
P. Rajagopalan, K.S. Shanmugan. Technical Report, ITTC-FY97-TR-10920-28, Dec. 1996.

Digital Beamforming Receiver Architecture,
S. Gurappu, H. Samra, G. Prescott, K.S. Shanmugan. Technical Report TISL-10920-24, Oct. 1996.

Effects of Search Depth and Schedule Placement on WRR Schedules,
J. Keimig, D.W. Petr. Technical Report TISL-11230-02, Dec. 1996.

Genetic Algorithms Applied to Single Optimization of Reinforced Concrete Design and Detailing,
W.M.K. Roddis, V. Chunnanond, W.K. Lucas. SL Report 96-1, The University of Kansas Center for Research, Inc., May 1996.

GPR Simulations of a Buried Concrete Wall for Allied Signal,
Z. Huang, C. Leuschen, C. Allen, R. Plumb. RSL Technical Report 11910-1, Nov. 1996.

An Improved Coherent Radar Depth Sounder,
T. Chuah, S. Gogineni, C. Allen, B. Wohletz. RSL Technical Report 10470-4, Apr. 1996.

Maximizing the Minimum Signal-to-Interference Ratio in a Wireless Communication Network,
S. Haas, D.W. Petr. Technical Report TISL-10920-21, May 1996.

A Measurement-Based CAC Strategy for ATM Networks,
K. Liu, D.W. Petr. Technical Report TISL-11230-01, Oct. 1996.

An Overview of the Rapidly Deployable Radio Network Proof of Concept System ,
B. Ewy, C. Sparks, S. Shanmugan, J. Evans, G. Prescott. Technical Report TISL-10920-16, Apr. 1996.

Radar Thickness Measurements Over the Northern Part of the Greenland Ice Sheet,
T. Chuah, S. Gogineni, C. Allen, B. Wohletz. RSL Technical Report 10470-3, Apr. 1996.

Radar Thickness Measurements Over the Southern Part of the Greenland Ice Sheet,
T. Chuah, S. Gogineni, C. Allen, B. Wohletz. RSL Technical Report 10470-2, Apr. 1996.

Rapidly Deployable Radio Networks,
K.S. Shanmugan. Semi-Annual Progress Report, Technical Report TISL-10920-19, July 1996.

Rapidly Deployable Radio Network (RDRN) Link Budget,
V.K. Paulrajan, J.A. Roberts. TISL Technical Report 10920-18, May 1996.

Rapidly Deployable Radio Network: Proof of Concept System,
B. Ewy, C. Sparks, K.S. Shanmugan, J. Evans, G. Prescott. TISL Technical Report TISL-10920-16, Apr. 1996.

Rapidly Deployable Radio Networks - Network Architecture,
S. Bush, S. Jagannath, R. Sanchez, J. Evans, V. Frost, S. Shanmugan. Technical Report TISL-10920-09, Apr. 1996.

Steel Bridge Exterior Girder Response to Concrete Deck Placement Loads,
R. Zhao, W.M.K. Roddis. SL Report 96-4, The University of Kansas Center for Research, Inc., Nov. 1996.

Subjective Test of Voice Transmission Over ATM Networks,
G. Huang, D.W. Petr. Technical Report TISL-10610-05, Oct. 1996.

Targeting Expert Systems for Bridge Engineering,
H.G. Melhem, A. Moran, W.M.K. Roddis, J. Bocox. Report No. K-TRAN: KU/KSU-95-8, Final Report, Kansas Department of Transportation, Topeka, KS, Feb.1996.

1995

Beamform MATLAB Code,
S.M. Haas, D.W. Petr. Technical Report TISL-10920-03, Jan. 1995.

BONeS TCP Primitive Module Validation,
V.S. Frost, G.Y. Lazarou. Technical Report TISL-10980-6, June 1995.

Bounded Delay for Weighted Round Robin with Burst Crediting,
K. Mezger, D.W. Petr. Technical Report TISL-10230-08, May 1995.

Bounded Delay for Weighted Round Robin,
K. Mezger, D.W. Petr. Technical Report TISL-10230-07, May 1995.

The Burst Crediting Concept,
K. Mezger, D.W. Petr. Technical Report TISL-10230-06, May 1995.

The Burst Crediting Concept,
K. Mezger, D.W. Petr. Technical Report TISL-10230-06, May 1995.

Calculation of Leaf Area Index and Other Canopy Indices from Gap Fraction: A Manual for the LAICALC Software,
P.M. Rich, J. Chen, S.J. Sulatycki, R. Vashisht, W.S. Wachspress. Kansas Applied Remote Sensing Program Open File Report, University of Kansas, Lawrence, KS, 1995.

A Consistent Labeling Algorithm for the Frequency/Code Assignments in a Rapidly Deployable Radio Network (RDRN),
S.M. Haas, D.W. Petr. Technical Report TISL-10920-04, Jan. 1995.

Electromagnetic Induction Research Issues: Magnetic Dipoles and SQUID Technologies,
C.T. Allen, N.A. Rehoie. RSL Technical Report 11740-1, Sept. 1995.

Measurement of a Multimedia Distance Learning Application Using ATM Network Service,
R. Smischny, D.W. Petr, V.S. Frost. Technical Report TISL-10230-11, Nov. 1995.

Modeling Topographic Influences on Solar Radiation: A Manual for the SOLARFLUX Model,
P.M. Rich, W.A. Hetrick, S.C. Saving. Los Alamos National Laboratory Report LA-12989-M, 1995.

Performance and Traffic Measurement Scenarios for the AAI Network,
L.A. DaSilva, H. Zhu, V.S. Frost, J.B. Evans, D. Niehaus, D.W. Petr. TISL Technical Report TISL-10980-3, 1995.

Performance and Traffic Measurement Techniques for the AAI Network,
H. Zhu, V.S. Frost, J.B. Evans, D. Niehaus, D. Petr. Technical Report TISL-10980-2, Feb. 1995.

Rapidly Deployable Radio Network: Semi-Annual Technical Report,
K.S. Shanmugan, V.S. Frost, J.B. Evans, G. Prescott, R. Plumb, D.W. Petr. TISL Technical Report TISL-10920-09, June 1995.

Research Experiences for Undergraduates: Information Systems Engineering at the University of Kansas,
J.A. Roberts. 1995 Program Report, TR-10190-3, Department of Electrical Engineering and Computer Science, The University of Kansas Center for Research, Inc., Aug. 1995.

Research Experiences for Undergraduates: Information Systems Engineering at the University of Kansas,
J.A. Roberts. 1994 Program Report, TR-10190-2, Department of Electrical Engineering and Computer Science, The University of Kansas Center for Research, Inc., Jan. 17, 1995.

Research on Gigabit Gateways: Final Report,
V.S. Frost, J.B. Evans, D.W. Petr, D. Niehaus, G.J. Minden. Technical Report TISL-9770-34, Aug. 1995.

Research on Gigabit Gateways: Quarterly Report,
V.S. Frost, J.B. Evans, D.W. Petr, D. Niehaus. Technical Report TISL-9770-33, July 1995.

Research on Gigabit Gateways: Quarterly Report,
V.S. Frost, J.B. Evans, D.W. Petr, D. Niehaus. Technical Report TISL-9770-32, Apr. 1995.

Research on Gigabit Gateways: Quarterly Report,
V.S. Frost, J.B. Evans, D.W. Petr, D. Niehaus. Technical Report TISL-9770-31, Jan. 1995.

Sprint Directory Hierarchy,
K. Mezger, D.W. Petr. Technical Report TISL-10230-09, May 1995.

Sprint Voice Transport Over ATM Network,
K. Nguyen, D.W. Petr, J.B. Evans, V.S. Frost. Technical Report TISL-10610-4, July 1995.

Trace Traffic Integration into Model-Driven Simulations,
K. Mezger, D.W. Petr. Technical Report TISL-10230-10, May 1995.

Voice Transport via ATM Networks: Subjective Testing Results,
V.S. Frost, M. Mischler, D.W. Petr. Technical Report TISL-10610-3, Mar. 1995.