Contents

Wireless hardware design ............. 2
WiCom group ........................... 4
Faculty ................................. 6
Research ............................... 9
Publications ......................... 12
Grants ................................. 16
Professional service/recognition .. 19
Undergraduate studies .............. 22
Graduate studies .................... 23
Advisory board ....................... 24
Contact information ................. 25
The Department of Electrical and Computer Engineering at Kansas State University reached its 111th year since electrical engineering began at K-State in 1899. The faculty continue to conduct very quality research while also maintaining our excellence in undergraduate education. Funding for our research programs continues to grow, with an approximate increase of 35% in 2010 over the previous year. Our faculty also remain effective in producing quality publications that exhibit their research results and contribute to the body of knowledge in their respective fields.

We have highlighted two different aspects of communications research and associated courses in this report. The wireless hardware projects led by Dr. William Kuhn have produced outstanding achievements in low power transceiver design for applications in space and other applications with power constraints. Research sponsors and collaborators include NASA, Sandia National Labs, Honeywell FM&T, and Peregrine Semiconductor. Graduates out of both groups have been highly sought after in both industry and academia. The WiCom group led by Dr. Bala Natarajan has conducted fundamental research on wireless communications and sensor networks. His team has led to some core technologies that are now incorporated in mobile communication standards, and their achievements in strategic deployment of sensors in a network are also noteworthy. The WiCom group receives funding from sponsors such as the from Department of Energy, Department of Defense, National Science Foundation, and the State of Kansas.

There are many other strengths in ECE that are evident within this report and from highlights in previous years. This includes the areas of biological computing, biomedical instrumentation and systems, complex networks, epidemic modeling, high speed computing architectures, power distribution systems, renewable energy, and smart grid. The faculty continue to grow in their roles on larger collaborative projects that are both multidisciplinary and multi-institutional.

Finally, I would like to briefly mention some of the recognition our faculty and students have received in the past year. Professor James DeVault received the Commerce Bank Outstanding Undergraduate Teaching Award, while Dr. Steve Warren was part of a large NASA project to measure the physiological characteristics of humans during low-gravity missions. Graduate student Sakshi Pahwa’s research on distributed generation, islanding, and cascading failures was selected as the winner in the State of Kansas Graduate Research Summit. Dr. Ruth Douglas Miller received DOE grants to develop a Small-Wind Turbine Test Center at Colby, KS as well as a project to develop and analyze wind energy resources at a regional site. Dr. Noel Schulz also served as the president-elect of the IEEE Power & Energy Society.

I hope you enjoy this snapshot of the research activities in our department for 2010. While it cannot capture all of the activities that are currently ongoing, additional information on our program can be found at our website, www.ece.ksu.edu. Please feel free to contact us if you would like to explore areas of collaboration or other common interests.

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Underpinning the wireless products we enjoy today is a vast array of research and development in radio hardware design conducted over the last century. For more than 30 years, KSU’s ECE department has provided students with outstanding laboratory experiences in the technologies involved. In addition to courses in the required mathematical theory (ECE 512 – Linear Systems Theory, ECE 557 – Electromagnetics, and ECE 660 – Communications Systems I), the department now offers three laboratory-oriented courses covering this “physical layer” of wireless systems: ECE 662 – Design of Communication Circuits, ECE 764 – Design of Microwave Circuits and ECE 765 – Digital Radio Hardware Design. In these courses, students design, build and test FM broadcast-band transmitters and receivers, antennas and radars operating at up to 10 GHz, and RF integrated circuits like those at the core of cell phone and wireless devices.

In conjunction with this course-level training, many participants join our communications research laboratory as seniors or graduate students where they research new technologies for future wireless products. In particular, the senior/graduate-level digital radio hardware design course (ECE 765) was created for just this reason. Originally developed through a National Science Foundation Career Award, the course begins with the basics of digital wireless systems and proceeds to the study of RF integrated circuit design and system-level performance issues. A central feature of the course is a class project in which students work in teams/companies to produce an integrated circuit design/product. For example, during the fall 2010 semester, the class project was the design of a fully-integrated 2.4 GHz digital radio transceiver for use in future lunar or outer-planetary exploration. The design was done in Peregrine Semiconductor’s latest 0.25um “GC” silicon-on-sapphire process and leveraged the departments existing “Mars Radio” transceiver design at 400 MHz as a foundation (www.ece.ksu.edu/research/mars). To accomplish this rather large task, stu-
Students worked in teams using modern electronic design automation tools including those donated to the department by Agilent Technologies and Cadence Design Systems.

As another example of combining research and education in ECE 765, prior-year students worked on technologies for variable band-pass filters—an enabling hardware technology for future cognitive radio products which must adapt to many different radio standards. Through the course project and related support from research sponsors, a series of students researched automatic tuning algorithms, associated IC designs and underlying high-quality-factor inductors spawning theses, conference and journal publications, and demonstration hardware such as that pictured below. The filter response plots demonstrate the technique of narrowing the bandwidth of a filter through active circuits and has been shown to operate reliably over a range of temperatures from 25°C to over 85°C.

For wireless products of interest to NASA and related agencies, the department is also looking at performance of RF integrated circuits at extremely low temperatures. For example, it is characterizing the Peregrine Semiconductors GC process to temperatures of 50 Kelvin and below as a precursor to being able to design circuits that operate at liquid nitrogen temperatures, or which can work on the moons of Jupiter or Saturn without the need for power-consuming “warm boxes” typically used to house electronics in today’s space probes.

Through all of these activities, the ECE department is working to maintain our strong tradition in radio hardware design education and scholarship, and keep our graduates at the forefront of new developments.
Living in an untethered world where information access and exchange is ubiquitous, new applications and enabling technologies are fast emerging, stretching the boundaries of human imagination. This technological revolution has been fueled by research and development efforts across research institutions around the world and K-State is playing a critical role in this future. The WiCom group at Kansas State University, started in 2002 under the leadership of Dr. Bala Natarajan, has been engaged in state-of-the-art theoretical and applied research across a broad range of applications. Consistent research support from Department of Energy, Department of Defense, National Science Foundation, state of Kansas and industry partners has helped the group grow and advance research and development.

While core expertise of the group lies in statistical signal processing, stochastic modeling, optimization and control theory, the scope of their research is expansive. Over the past decade, researchers from the group have made significant contributions to the areas of wireless communication systems, sensor networks and signal/image processing systems. For example, Dr. Natarajan’s early work on carrier interferometry OFDM- and DFT-based coding in CDMA systems is now part of mobile technology standard — 3GPP Release 10 uplink specifications. A subset of recent research contributions across multiple areas are highlighted in this article.

**Wireless communication systems** can support higher data rates when using multiple antennas at the transmitter and receiver, and current channel state information is available at the transmitter. Recently, the WiCom group has focused on single-user and multi-user MIMO (multiple input multiple output) precoding strategies to improve capacity and performance of multi-antenna systems. Specifically, they have made fundamental contributions to the areas of limited feedback precoding and space time coding in MIMO systems. The idea behind limited feedback precoding is to send quantized channel information from the receiver to the transmitter to improve capacity. While precoding based on Grassmanian manifolds and other structured approaches have been proposed for limited feedback systems, the group has developed a new online trellis-search-based polyphase precoding strategy that (1) outperforms existing limited precoding methods in terms of ergodic capacity, (2) uses fewer number of feedback bits for a given performance constraint, (3) adapts to channel state changes and (4) has complexity that does not scale exponentially with MIMO dimensions.

Dr. Natarajan and his former graduate student Justin Dyer have a related patent currently pending approval. The MIMO precoding work was inspired by their earlier groundbreaking patented work on a trellis-based algorithm for custom designing spreading sequences*. This work was featured in multiple news venues and enables the design of complex spreading sequences with custom correlation properties for code division multiple access (CDMA)-based wireless systems. The core technology can also be used to design pulse compression codes for multi-beam radars for military applications. Other current active projects relate to cooperative MIMO, cognitive radio networks and application of residue number system (RNS) arithmetic in the design of (1) frequency hopping patterns (2) pilot pattern design for channel estimation and (3) space time coding in MIMO systems.

With advances in embedded processing, sensor-based detection, monitoring and tracking networks are becoming more common. Researchers in the WiCom group have been advancing the state of the art in distributed detection, estimation and energy-aware information processing, and fusion in sensor networks. For any sensor network-based automated surveillance operation to be...
successful, it is critical to have sensing resources strategically positioned to observe, interpret, react and maybe even predict events. In many practical scenarios, it is also expected that different zones within a surveillance area may have different probabilities of event detection (or false alarm) requirements. The operational objective in such surveillance systems is to optimize resources (number of sensors and the associated cost) and their deployment while guaranteeing a certain assured level of detection/false alarm performance.

If employing data or decision fusion across sensors to help in a surveillance effort is known in advance, how can sensors be optimally deployed to satisfy end user performance requirements? To address this question, WiCom group researchers have developed a novel approach for strategic sensor deployment based on optimal control theory principles. For the first time, unlike many heuristic approaches investigated earlier, the proposed approach provides a rigorous framework for sensor deployment. A control theoretic self-healing algorithm to deal with lost sensors in the detection network has also been developed. Currently, the group is working towards designing energy-aware cooperative estimation/tracking algorithms. The emphasis is on understanding how policies related to estimation load sharing among participating sensors impact the rate and power of transmissions. The goal is to quantify the tradeoff between lifetime of the network and the quality of estimates under different energy management policies.

In addition to fundamental research in wireless communication systems and sensor networks, students in the WiCom group are also engaged in applied research in smart grids, complex networks, and biomedical and image processing systems. These research efforts are in collaboration with a number of other faculty members within ECE: Drs. Pahwa, Miller, Das and Schulz (power systems); Dr. Scoglio (complex networks); Dr. Day (image processing); and Dr. Warren (biomedical systems). As many interesting challenges lie along boundaries of disciplines, these collaborative efforts have resulted in insights and solutions that are creating new design paradigms in the corresponding domains.

The success of WiCom research is a testament to the quality of graduate students who have been part of the group over the years. Twenty graduate students, six Ph.D. and 14 M.S., have graduated from the WiCom group. In addition to nearly 100 peer-reviewed journal and conference publications in the past nine years, and student paper awards in prestigious conferences, the WiCom group has also been home to an NSF graduate fellowship winner. The group currently has five Ph.D., three M.S. students and two undergraduate students engaged in a wide spectrum of research.

For more details on active research projects, related publications and graduate students, visit http://www.ece.ksu.edu/wicom.

Don Gruenbacher
Ph.D., Electrical Engineering, Kansas State University, 1994
M.S., Electrical Engineering, Kansas State University, 1991
B.S., Electrical Engineering, Kansas State University, 1989
Research: Communication networks, digital design, HDL synthesis and modeling,
error-control coding, intrusion detection
Teaching: Networking, digital design, stochastic processes

Satish Chandra
Ph.D., Electrical Engineering, Auburn University, 1984
M.S., Electrical Engineering, Auburn University, 1980
Research: Multimedia coding and communication over networks, multimedia
watermarking and security, biomedical signal and image processing
Teaching: Electric circuits and control, multimedia compression, computer design,
discrete-time and computer-control systems, digital image processing

Sanjoy Das
M.S., Ph.D., Computer Engineering, Louisiana State University, 1994
Research: Multi-agent system, machine learning, neural networks, evolutionary
computation, quantum computing, game theory, modeling and optimization
Teaching: Multi-agent systems, neural networks, computational intelligence, scientific
computing, computer design

Dwight Day
Ph.D., Electrical Engineering, Oklahoma State University, 1987
M.S., Electrical Engineering, Oklahoma State University, 1981
B.S., Electrical Engineering, Oklahoma State University, 1980
Research: Computer vision, pattern recognition, speech processing
Teaching: Digital computer design, computer interfacing, digital filtering, digital
signal processing, computer engineering methods, digital image processing

James E. DeVault
M.S.E., Electrical Engineering, The University of Michigan, 1977
M.S., Business Administration, Michigan Technological University, 1971
B.S., Electrical Engineering, Michigan Technological University, 1970
Research: Instrumentation, industrial control systems, mobile autonomous robotics
Teaching: Analog and digital electronics, instrumentation, control systems

John J. Devore
Ph.D., Engineering, Kansas State University, 1984
M.S., Computer Science, Kansas State University, 1973
B.S., Physics, Kansas State University, 1971
Research: Instrumentation, embedded systems, road smoothness testing
Teaching: Embedded systems, digital design, microcontroller programming

Stephen A. Dyer
Ph.D., Engineering, Kansas State University, 1977
M.S., Electrical Engineering, Kansas State University, 1974
B.S., Physics, Kansas State University, 1973
Research: Instrumentation and measurement, numerical methods, communication
theory, audio and electroacoustics, history of engineering
Teaching: Electronics, linear systems, audio engineering, rapid design
Will Hageman
- Ph.D., Optics, University of Central Florida, 2010
- M.S., Optics, University of Central Florida, 2008
- M.S., Electrical Engineering, Kansas State University, 2002
- M.S., Physics, Kansas State University, 2000
- B.S., Physics, Kansas State University, 1999
- Research: Solid-state lasers, fiber lasers, nonlinear optics, optical system design,
  thermo-optical modeling
- Teaching: Optoelectronics, lasers, electronics design lab, applied optics

William B. Kuhn
- Ph.D., Electrical Engineering, Virginia Polytechnic Institute and State University, 1996
- M.S., Electrical Engineering, Georgia Institute of Technology, 1982
- B.S., Electrical Engineering, Virginia Polytechnic Institute and State University, 1979
- Research: Analog/digital/RF circuit design, integrated circuit development, RF device
  technologies, wireless telecommunications systems design and implementations with
  emphasis on physical layer, renewable energy technology
- Teaching: Intro to electrical engineering, electronics, design of communication circuits,
  microwaves and antennas, IC design, digital radio hardware design

Ruth Douglas Miller
- Ph.D., Electrical Engineering, University of Rochester, 1990
- M.S., Electrical Engineering, University of Rochester, 1985
- B.S., Electrical Engineering, Lafayette College, 1984
- Research: Renewable energy (wind and photovoltaic applications), electromagnetic,
  bioelectromagnetics, health effects of electromagnetic fields, electronics
- Teaching: Introduction to electrical engineer, electronics engineering lab, electronics,
  electromagnetic theory, introduction to biomedical engineering, wind engineering,
  bioinstrumentation lab

Medhat M. Morcos
- Ph.D., Electrical Engineering, University of Waterloo, Ontario, Canada, 1984
- M.Sc., Electrical Engineering, Cairo University, Cairo, Egypt, 1978
- B.Sc., Electrical Engineering, Cairo University, Cairo, Egypt, 1966
- B.Sc., Military Science, Military Academy, Egypt, 1966
- Research: Power electronics, power systems, electric machines, high-voltage engineer
  ing, gaseous dielectrics, engineering education
- Teaching: Power electronics, control systems, energy conversion, power quality

Bala Natarajan
- Ph.D., Electrical Engineering, Colorado State University, 2002
- B.E., Electrical and Electronics Engineering, BITS Pilani, 1997
- Research: Estimation and detection/decision theory, communication systems and
  theory, wireless communications, optimization theory, sensor signal processing and
  networks
- Teaching: Communication systems, wireless communications estimation and detection
  theory, information theory

Anil Pahwa
- Ph.D., Electrical Engineering, Texas A & M University, 1983
- M.S., Electrical Engineering, University of Maine at Orono, 1979
- B.E., Electrical Engineering, Birla Institute of Technology and Science - Pilani, 1975
- Research: Power distribution system automation, reliability, analysis and design;
  intelligent computational methods for power systems
- Teaching: Power system analysis, design, protection; distribution system design and
  planning
Andrew Rys
Ph.D., Electrical Engineering, Texas Tech University, 1983
M.S./B.S., Electronics Engineering, Technical University of Wroclaw, Poland, 1978
Research: Solid-state electronics, design and processing of integrated circuits, characterization of III-V and wide band-gap II-N semiconductors, design of light detectors and sources
Teaching: Introduction to electrical engineering, electronics, optoelectronics, integrated circuit design, IC devices and processes, solid-state devices

Noel N. Schulz
Ph.D., Electrical Engineering, University of Minnesota, 1995, Minor: Computer Science
Research: Application of computers, including intelligent systems, to solve problems
Teaching: Power systems, energy conversion, application of computer programs to power engineering, application of intelligent systems to engineering problems, fundamentals of electrical circuits and technical communications in engineering

Caterina M. Scoglio
Dr. Eng., Electronics Engineering, “Sapienza” University of Rome, 1987
Research: Network science, computational epidemiology, complex networks, modeling and control of epidemics, dynamic networks
Teaching: Network science, computer networks, circuit theory, epidemic models

David L. Soldan
Ph.D., Engineering, Kansas State University, 1980
M.S., Electrical Engineering, Kansas State University, 1976
B.S., Electrical Engineering, Kansas State University, 1969
Research: Engineering education and accreditation, curriculum development, economic models for universities, first-year experiences
Teaching: Introductory logic design, digital systems design, computer architecture

Shelli Starrett
Ph.D., Electrical Power Engineering, Iowa State University, 1994
M.S., Electrical Power Engineering, University of Missouri - Rolla, 1990
B.S., Electrical Engineering, University of Missouri - Rolla, 1988
Research interests: Power system stability and control, voltage stability, applications of artificial intelligence to power systems, wide-area analysis, measurements and control, nonlinear simulations, innovations in engineering education, learning communities
Teaching: Energy conversion, power devices, power laboratory, power system protection, power seminar, advanced systems theory

Steve Warren
Ph.D., Electrical Engineering, The University of Texas at Austin, 1994
M.S., Electrical Engineering, Kansas State University, 1991
B.S., Electrical Engineering, Kansas State University, 1989
Research: Biomedicine, home care, light-based biomedical instrumentation, student learning, telemedicine, numerical analysis and simulation
Teaching: Circuit theory, linear systems, introduction to biomedical engineering, computer graphics, theory and techniques of bioinstrumentation, bioinstrumentation design laboratory, computer engineering methods for analysis, simulation and design
Researchers at Kansas State University include the following:

- Research projects harvest wind power for the benefit of themselves, their children and the state. Research projects are to educate electrical engineers on the basics of wind energy for the people of Kansas who want to build and test complete radios and radar systems at VHF through microwave frequencies. This gives our graduates practical, hands-on experience necessary for this field of engineering. Our research efforts have been primarily focused on design of transceivers in integrated circuit form, with special emphasis on the modeling and application of high-Q spiral inductors and performance of semiconductor processes. Students and faculty connected with the CCL have experience with standard bulk-CMOS, silicon-on-insulator (soi) and silicon-on-sapphire (SOS), and GaAs integrated circuit processes. Designs are created with tools from both Agilent and Cadence and are tested at the board and chip levels with industry-caliber measurement equipment and probing stations.

- Examples of research and development work are our Mars microtransceiver recently developed in collaboration with NASA’s jet propulsion laboratory. This three-year project resulted in a complete RFIC chipset for future missions to the planet Mars. Please see http://www.ece.ksu.edu/research/mars/ for additional information.

The Kansas Wind Applications Center

The Kansas Wind Applications Center missions are to educate electrical engineers on the basics of wind energy, and to be a source of information on wind energy for the people of Kansas who want to harvest wind power for the benefit of themselves, their children and the state. Research projects include the following:

- Siting of small wind turbines, including means of assessing surface roughness and turbulence;

- Networking of distributed generation sources for reliability, especially in islanded conditions; and

- Development of curricula for use in K-12 and informal educational settings, such as 4-H, focusing on topics of energy and sustainability.

The WAC also runs the Wind for Schools program in which small wind turbines are installed at K-12 schools throughout Kansas for educational purposes. Undergraduate students assist with school selection, communications and siting. The WAC coordinates a variety of industry donors to accomplish the installations with minimal costs to the schools and enhanced cooperation with electric utilities. Through 2009, seven turbines had been installed at Kansas schools. The Wind Applications Center is funded by the Department of Energy under its Wind Powering America program.

Kansas State Epicenter

Kansas State University’s EPICENTER – Center for Complex Network Approach to Epidemiological, Biological, and Sociological Modeling and Simulation - is directed by Dr. Caterina Scoglio, associate professor of electrical and computer engineering, and Dr. Morgan Scott, professor of epidemiology in veterinary medicine. One of the main goals of EPICENTER is to provide policymakers with real-time, flexible modeling tools to curtail epidemiological outbreaks, whether it occurs in humans, animals, plants or computers. The most important aspect is use of a complex networks approach for the analysis of problems relating to multiple disciplines such as agriculture, veterinary science, biology, medicine, social sciences and engineering.

Highlights of the key areas under K-State EPICENTER are as follows:

- Network-based modeling for epidemics. These projects are concerned with the study and implementation of mathematical models of epidemic spreading in a realistic environment with individual-based models and meta-population models. Work on models for specific contagious diseases such as foot and mouth disease and Rift Valley fever are in progress.

- Agent-based epidemiological simulator for rural communities. The aim of this project is to design agent-based simulation software for a set of representative infectious diseases in a rural community to detect the conditions under which an epidemic would spread or die out, as well as to determine the direction and
speed if it spreads. These results will be used to derive and analyze optimized policies and guidelines for containment and prevention of infectious diseases.

- Modeling of interconnections among human behavior and epidemic spreading. Human behaviors play a crucial role in how an epidemic spreads in a social society. Despite extensive studies on how human beings perceive a disease and the behavior they show in response, not many results have been reported on how human behavior would actually affect the epidemic spread. The goal in this study is to provide interconnected models for epidemic spread and individual behaviors, followed by simulation and analysis of the models.

- Network partitioning for mitigation of epidemics. One of the considered mitigation strategies to control and reduce epidemic spreading is quarantine. When contacts are represented by a network, quarantine can be determined using network partitioning algorithms. We are developing network partitioning algorithms, designed to be a simple, efficient method to partition a network into possible quarantine sections. Our algorithm, called Bloom, grows partitions and then allows the individuals to decide which partition they feel most comfortable in. We have implemented the first algorithm and done some initial testing on classical clustering graphs.

**Sunflower Networking Group (SNG)**

http://www.ece.ksu.edu/sunflower_wiki

Our goals are to conduct theoretical research in emerging areas, as well as to apply optimal networking solutions through simulations, to current and future realistic problems. General areas of interest include network science, network robustness, networking protocols, architecture, modeling and analysis, security and network metrics. Three main topics of focus are as follows:

- Characterization and control of complex networks. Projects based on this topic are concerned with the study of multiple statistical metrics and performance indices for complex networks. Specific projects under this category include quantifying the robustness of complex networks with respect to epidemic spreading using SIS and SIR models and mitigation strategies using optimal control, analysis of cascading failures in power grid networks with mitigation strategies including use of distributed sources and islanding, efficient techniques for modularity and cluster detection in complex networks, and study of weighted networks.

- GpENI—enabling network innovation at K-State. The Great Plains Environment for Network Innovation (GpENI) is a regional network between the University of Kansas (KU), Kansas State University (K-State), University of Nebraska – Lincoln (UNL), and University of Missouri – Kansas City, within the Great Plains Network. Global Environment for Network Innovation (GENI) is a global, programmable testbed which provides experimenters the ability to deploy innovative ideas in real-time. SNG administers the core GpENI testbed, an aggregate of GENI that realizes programability at all seven layers of the protocol stack through PlanetLab, VINI and DCN (dynamic circuit network). Furthermore, SNG has enabled K-State to become the 13th openflow campus among other schools including Georgia Institute of Technology, Stanford and Rutgers. This opportunity allows researchers at K-State, and also researchers around the world, the opportunity to conduct network research in domains such as security, mobility, energy management, access control and traffic management.

- Peer-to-Peer networks. Peer-to-Peer (P2P) networking is a distributed application architecture which generates more than 50% traffic in the current Internet. Different from traditional client-server architecture, each peer is both a service consumer and a service provider in P2P networks. P2P technologies can be used to improve system performance, scalability and robustness; therefore they are popular in file-sharing, video streaming, web caching, etc. The goal of this project is to design architectures and protocols to enhance the efficiency of P2P systems.

**Medical Component Design Laboratory (MCDL)**

Steve Warren directs the KSU ECE Medical Component Design Laboratory (MCDL), housed in Rathbone Hall. The primary mission of the MCDL is to support work in interoperable component design for medical systems: plug-and-play hardware/software elements that can be assembled rapidly to create care systems matched to patient needs. Interoperability standards, wireless devices, wearable sensors, and light-based devices play important roles in this research, which targets physiologic monitoring for humans and animals. Quality of life issues (e.g., successful aging and technology applications for the disabled) are important drivers for the pervasive care environments addressed by these projects. This laboratory also plays an important role in engineering
education via the delivery of research products into the classroom and grant-sponsored research that focuses on how students learn and how students transfer and retain knowledge over multiple semesters. Primary collaborators in 2010 included Heartspring (Wichita, Kan.), East Carolina University, the KSU Department of Computing & Information Sciences, the KSU Department of Anatomy & Physiology, the KSU Electronics Design Laboratory, the KSU Mathematics Department, the KSU Physics Department, the KSU Kinesiology Department, the U.S. Food and Drug Administration, and the University of Pennsylvania. Project funding was received from the National Science Foundation (CCLI/TUES, CNS, CRI, & REESE), NASA and the KSU Targeted Excellence program.

Influence of Environmental Factors on Outages in Electricity Distribution Systems

Environmental factors such as lightning, wind, tree, and squirrels cause a majority of outages in distribution systems. Their effects follow random processes with higher probability of outages under worse conditions. Understanding effects of environmental variables is important for utilities to increase reliability of electricity distribution systems. The National Science Foundation is providing funding to Dr. Anil Pahwa and Dr. Sanjoy Das to investigate these effects. Due to the complex nature of interaction of these factors with distribution systems, modeling becomes difficult. In this project, we are investigating regression, neural networks, wavelet decomposition and Bayesian models to study effects of environmental variables on distribution systems. For example, to study the influence of lightning and wind, we have used non-linear regression models with maximum daily wind gust and sum of lightning strokes in a day as inputs and outages as outputs. Applying these models to five years of data (2005-2009) obtained for service territories of Manhattan, Lawrence and Topeka show that the model with linear relationship for lightning and quadratic relationship for wind to outages gives the best performance. Future research will focus on exponential regression models, neural networks and Bayesian models.

Community Wind

Wind generation has received significant attention over the past decade, but most of the focus has been on large wind farms. The focus of this project, supported by the U.S. Department of Energy, is to investigate the feasibility of owning a wind generator by electricity distribution co-operative. Dr. Anil Pahwa and a graduate student are using the hourly load data of a co-operative in western Kansas and weather data for this research.
Sanjoy Das


Stephen A. Dyer


Don Gruenbacher


William Hageman


William Kuhn


Ruth Douglas Miller

Bala Natarajan

Anil Pahwa
Publications

**Noel N. Schulz**


**Caterina M. Scoglio**

Steve Warren


David L. Soldan


Shelli Starrett

Sanjoy Das
- PI, Development of ECE 840 as a Distance Education Course, K-State DCE, ($5,000).

William Kuhn
- PI, “Phase V Research and Development at Kansas State University,” Sandia National Laboratory, ($85,095), December 2010 – September 2011.

Ruth Douglas Miller
Bala Natarajan


Anil Pahwa


Andrew Rys


Noel N. Schulz


Caterina M. Scoglio

David L. Soldan
- PI, “Reconnecting Chemical Engineering Students with the Physical World,” $82,509, Larry Glasgow, PI, submitted to NSF CCLI Phase I program. $82,509. Fifty percent each to ECE and ChE. Funded January 1, 2009 to December 31, 2010.

Shelli Starrett
Sanjoy Das
- Associate Editor, International Journal of Power and Energy Conversion
- Advisory Board Member and Special Sessions Program Chair, International Conference on Swarm, Evolutionary and Memetic Computing (SEMCCO), India
- IEEE Transactions on SMC(B), SMC(C), Information Sciences, Applied Soft Computing
- Member, College of Engineering Math Liaison, Diversity, and Academic Standards committees.

James E. DeVault
- 2010 Commerce Bank Undergraduate Teaching Award
- Member, Electrical and Computer Engineering Department Committee on Planning (DCOP)
- Senior Member, IEEE
- Member, ASEE

Stephen A. Dyer
- Fellow, IEEE
- Chair, Awards Committee, IEEE Instrumentation and Measurement Society
- Co-Chair, Organization Committee, IEEE Instrumentation and Measurement Society
- Member, Long-Range Planning Committee, IEEE Instrumentation and Measurement Society
- Member, Nominations and Appointments Committee, IEEE Instrumentation and Measurement Society
- Member, Management Committee, IEEE Instrumentation and Measurement Society
- Member, Finance Committee, IEEE Instrumentation and Measurement Society
■ Member, Fellows Identification Committee, IEEE Instrumentation and Measurement Society
■ Member, Administrative Committee, IEEE Nanotechnology Council
■ Member, Editorial Board, IEEE Instrumentation & Measurement Magazine
■ Member, 2010 International Instrumentation and Measurement Technology Conference (I2MTC/2010) Technical Program Committee
■ Member, 2011 International Instrumentation and Measurement Technology Conference (I2MTC/2011) Technical Program Committee
■ Corresponding Member, IEEE Technical Activities Board (TAB) Strategic Planning Committee
■ Referee, Ministero dell’Istruzione, dell’Università e della Ricerca, Direzione Generale della Ricerca
■ Reviewer, IEEE TRANSACTIONS ON COMMUNICATIONS
■ Reviewer, Thermochimica Acta
■ Reviewer, IEEE Instrumentation & Measurement Magazine
■ Invited speaker, “Ethics in Engineering,” Rowan University
■ Member, Executive Team, K-State Center for the Advancement of Entrepreneurship
■ Presented 2009 IEEE Instrumentation and Measurement Society’s Career Excellence Award,
■ IEEE I&M awards ceremony, Austin, Texas, May 2010

Don Gruenbacher
■ Co-Chair, Energy Track, Big 12 Engineering Consortium
■ Reviewer, IEEE Vehicular Technology Conference

William Kuhn
■ Chair, Course and Curriculum Committee.
■ Member, Department Committee on Planning
■ Advisor, Honors Program
■ Advisor, Amateur Radio Club.
■ Advisor, Electronics Club
■ Advisor, Robotics Competition Club
■ Senior Member, IEEE
■ Life Member, Microwave Theory and Techniques Society

Ruth Douglas Miller
■ Member, Kansas Wind Working Group.

Medhat M. Morcos
■ Associate Editor, Electric Power Components and Systems.
■ Member, Executive Committee of the North American Power Symposium.

Bala Natarajan
■ Senior Member, IEEE (2008-current).
■ Member, IEEE Vehicular Technology society (2002-current)
■ Member, IEEE Technical Committee on Cognitive Networks (TCCN) (2006-current).
■ Member, IEEE Technical Committee on Wireless Communications (2006 – current)
■ Member, ASEE (2002-current).
■ Member, HKN (2007 – current)
■ Journal Reviewer, IEEE Communications Letters
■ Journal Reviewer, IEEE Transactions on Communications
■ Journal Reviewer, IEEE Transactions on Wireless Communications
■ Journal Reviewer, IEEE Transactions on Vehicular Technology
■ Journal Reviewer, IEEE Transactions on systems, man and cybernetics
■ Session Chair, IEEE Globecom 2010, Miami
■ Session Co-Chair, Wireless Telecommunications Symposium, Tampa, Fla., 2010
■ Program Committee Member, IEEE Global Telecommunications Conference (GlobeCom ) 2010
■ Program Committee Member, IEEE International Conference on Communications (ICC) 2010
■ Program Committee Member, IEEE Vehicular Technology Conference (VTC) 2010
Anil Pahwa
- Guest Editor, IEEE Transactions on Smart Grid
- Editor, IEEE Transactions on Power Systems
- Vice Chair and Technical Committee Paper Coordinator, Power and Energy Education Committee
- Member, Fellows Working Group, Power and Energy Education Committee
- Vice Chair and Technical Committee Paper Coordinator, Power System Planning and Implementation (PSPI) Committee
- Steering Committee, Power Systems Conference and Exposition
- Member, Technical Advisory Committee for International DistribuTech Conference and Exposition
- Member, Editorial Board of Electric Power Components and Systems
- Member, Editorial Board of International Journal of Emerging Power Systems
- Session Chair, DistribuTECH Conference and Expo, Tampa, March 2010
- Session Chair, IEEE PES T&D Conference and Expo, New Orleans, April 2010
- Session Chair, PMAPS, Singapore, June 2010
- Session Chair, IEEE PES General Meeting, Minneapolis, July 2010
- WESP Making a Difference Award
- Faculty Advisor, HKN (up to August 2010) (Beta Kappa Chapter won 2009-10 HKN Outstanding Chapter Award)
- KSU Faculty Senator

Andrew Rys
- Member, IEEE Electron Device Society (EDS)
- Coordinator, ECE Graduate Program
- Member, Graduate ECE Course and Curriculum Committee
- Member, Physics – Engineering Liaison Committee

Noel N. Schulz
- Kansas State First Lady
- Development and university promotion activities through President’s Office
- Chair, K-State Women of K-State Leadership Committee
- Advisory Board, Virginia Tech Department of Engineering Education
- Chair, ASEE Board of Directors and Professional Interest Council IV
- President-Elect, IEEE Power & Energy Society (PES) Governing Board and Executive Committee
- Board Member, Friends of McCain Auditorium and Friends of the Beach Museum
- Senior Member, IEEE
- Member, Society of Women Engineers
- Reviewer, IEEE PES Transactions and Conference Proceedings

Caterina M. Scoglio
- Associate Coordinator, DHS Center of Excellence for Emerging and Zoonotic Animal Diseases
- Chair, Technical Program Committee, IFIP Networking 2011, Valencia, Spain
- Member, Editorial board, Computer Network Elsevier journal
- Member, Editorial board, ISRN Communications journal, Hindawi Publishing Corporation
- Co-Organizer and Keynote Speaker, “Robustness of Complex Networks” Delft workshop, Nov. 2010
- Guest Editor, International Journal of Artificial Life Research, special issue “Modeling and mitigating the spread of disease”
- Member, Technical Program Committee for ITC2011
- Reviewer, Elsevier Journals and IEEE Transactions
- Invited Speaker, Bio-Defense Symposium organized by Hudson-Alpha Institute for Biotechnology, 2010

David L. Soldan
- Chair, ECE Assessment Committee
- Member, College Program Assessment Coordination Committee
- Member, College Assessment Review Committee
- Member, KSU Faculty Senate
- Member, Faculty Senate Committee on University Planning
- Trustee, KSU Amateur Radio Club
- Member, ABET Engineering Accreditation Commission (EAC)
- Member, EAC Executive Committee
- Chair, EAC Training Committee
- Member, ABET Accreditation Council Training Committee
- Support Facilitator, ABET Program Evaluator Candidate Training
- Co-Chair, Eta Kappa Nu, C. Holmes MacDonald Award Committee
- Member, Eta Kappa Nu, Outstanding ECE Student Award Committee
- Chair, ECEDHA ABET Workshop Committee
- Reviewer, National Science Foundation
- Reviewer, IEEE Transactions on Education

Shelli Starrett
- Chair, ECE Academic Standards and Advising Committee
- Reviewer, IEEE-Power and Energy Society publications

Steve Warren
- Member, Heartspring Board of Trustees, Wichita, Kan.
- Academic program consultant, East Carolina University, General Engineering Department
- National Instruments myDAQ Beta Program
- Member, K-State Olathe Innovation Campus Faculty Advisory Council
- Member, Kansas State University Goldwater Nominating Committee
- Member, Kansas State University Internal Review Board (Human Subjects Research)
- Director, KSU Student Chapter of the IEEE Engineering in Medicine and Biology Society
- IEEE 11073 Personal Health Devices Working Group
- Member, Institute of Electrical and Electronics Engineers
- Member, American Society for Engineering Education
The department of electrical and computer engineering offers B.S. degrees in both electrical engineering and computer engineering. Areas of specialization associated with each degree are as follows:

- Electrical engineering
  - bioengineering, communications and signal processing, digital electronics, integrated circuits and devices, power systems
- Computer engineering
  - architecture and design, embedded systems, multimedia and networking

Various opportunities exist for students to become involved in both organizational activities as well as undergraduate research. Student organizations and clubs within the department include Robotics, Engineering in Medicine and Biological Systems (EMBS), Amateur Radio, IEEE and Eta Kappa Nu (HKN). Many undergraduate students also actively participate in research projects, which include the following:

- Department of Energy-sponsored Wind for Schools program at K-State ECE utilizes many undergraduate students to help place small wind turbines at K-12 educational facilities throughout the state. Undergraduate students assist with school selection, communications and siting.
- Industry-sponsored Electrical Power Affiliates Program supports multiple research projects which involve undergraduates in power-related research. Project titles supporting undergraduates include “Intelligent Dispatch of Small Wind and Solar Generators,” “Survey and Assessment of Different High-Performance and Low-Cost Control Strategies for Wind Turbines,” “Mapping Voltage Stability Vulnerabilities” and “Increasing the Robustness of the Power Grid through Distributed Solar and Wind Generation.”
- Various mathematical models in epidemic modeling and their corresponding software implementation were realized by an undergraduate research student in the EPICENTER group.
- An energy harvesting radio was developed for remote sensing applications.
- Undergraduates were involved in development of the K-State UHF micro-transceiver with frequency-hopping, spread-spectrum capabilities.
Our graduate programs have an excellent base of students utilized in the various research activities listed. From local students raised in Kansas to our international students from countries such as Egypt, Poland, St. Lucia, China and India, our students are bright and hard working. They are often recognized for their accomplishments with national scholarships and best paper awards.

The department offers a master of science in electrical engineering and participates in the College of Engineering doctor of philosophy program. Several areas of specialization are available at the graduate level. At the master’s level there are three options: thesis, report and coursework only. All require a minimum of 30 hours of credit. The Ph.D. program requires 60 hours beyond the master’s, including original research of sufficient quality and importance to merit publication in a referred journal.

Research is conducted in many different areas of electrical and computer engineering including networking, communications theory and hardware design, image processing, VLSI device and circuit development, power systems, embedded systems and medical device design. Opportunities for graduate research assistant appointments are available on a competitive basis to highly qualified students with good prior background in the specific technologies involved in externally funded grants. Opportunities for graduate teaching assistant positions are also available to students with good interpersonal as well as technical skills needed in interacting with the undergraduate student body.

The department is located in Rathbone Hall. This 100,000-square-foot facility has been designed to provide an excellent academic environment with numerous well-equipped instructional and research laboratories including the communications lab, signal processing lab, integrated systems lab, microcomputer lab, digital systems lab, networking lab, medical component design lab, energy systems lab and solid-state electronics lab. State-of-the-art software packages and corresponding computing facilities are available for students to

For additional information, please contact:

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Department of Electrical and Computer Engineering
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E-mail: grad@ece.ksu.edu
Web: http://www.eece.ksu.edu/
The purpose of the ECE Advisory Council shall be—

- To take a leadership role in encouraging department alumni and friends to provide service and financial support to the department.
- To provide a connection among ECE faculty, students, and the organizations represented by council members.
- To provide advice about ECE research and degree programs.

David Abrams
Sr. Vice President and Director of Power Delivery
Energy Division
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Glen Fountain
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Don Gruenbacher, Ph.D.
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