Adaptive IIR and Nonlinear Filters
Winser E. Alexander
Hampton University
$113,010
08/01/03 - 12/31/06
Adaptive systems play a major role in wireless communication systems to ensure the integrity of the data, e.g., equalizers, software radio, low bit-rate speech. This research project involves a study of optimization methods that not only adjust the parameters of a filter or controller but that can also adapt its computational structure. Optimization of a filter structure involves adapting the filter order, filter type i.e. FIR, IIR, or nonlinear, and the number of bits to represent the parameter values. The study considers the feasibility of using FPGAs for configurable adaptive IIR and nonlinear filters.

Laurie A. Williams, Mladen A. Vouk, Jason A. Osborne, Winser E. Alexander, Sarah B. Berenson
National Science Foundation
$812,587
07/15/03 - 06/30/08
We propose to conduct a meeting of principal investigators (PIs) and Co-PIs of the Information Technology Workforce program (ITWF). There are about 50 projects funded by the National Science Foundation (NSF) in the fiscal years 2000 – 2004 that are still current. One person, preferably the PI, from each of the 50 projects will be invited to attend the meeting. It is estimated that 70 PIs will attend the conference and will receive support for airfare, hotel, meals, and conference registration. In addition, two NSF representatives, 2 speakers, and 10 – 12 additional participants such as students helping with the conference and local PIs would also attend the meeting/meals.

Collaborative Protection & Control Schemes for Shipboard Electrical Systems
Mesut E. Baran
US Navy
$336,960
06/01/03 - 12/31/06
This work aims at development of new protection methods for Electrical Distribution Systems by adopting new intelligent agent paradigm.

Interfacing Distribution State Estimator with a Data Management Program
Mesut E. Baran
EnerNex Corporation
$7,533
02/15/07 - 06/30/07
The main goal of this project is to show the feasibility of interfacing a research grade analysis program with a commercial data management program such as OSIsoft-PI. The work involved in this project is for the PI to help the sponsor to develop a "wrapper" type interface for the BCSE program so that BCSE can obtain the data from the commercial data management software called OSIsoft-PI.

CAREER: Low Dimension Column III-Nitride (III-N) Metal Oxide Semiconductor (MOS) Structures for Terahertz and Gigascale Electronics
Douglas W. Barlage
National Science Foundation
$160,000
04/01/06 - 03/31/08
This work is designed to study a recently identified compatible oxide on the column III-Nitride (III-N) material system and to use this material system to address the scientific challenge of electronic devices suitable for gigascale integration as well as terahertz performance. The first research objective of this program proposal is to fully take advantage of a recent discovery of an oxide with the properties of an unpinned interface on the III-N semiconductor material system and produce a first of its kind Gallium Nitride (GaN) Metal Oxide Semiconductor Field Effect Transistor (MOSFET).

Materials Low Dimension GaN Field Effect Transistors
Douglas W. Barlage, Mark A. Johnson
Semiconductor Research Corp.
$300,000
08/01/04 - 07/31/06
This high-risk/high-payoff effort is intended to develop the heterogeneous integration of AlGaN/GaN quantum wire devices with silicon. The goal of this effort is to achieve a manufacturable process for quantum wire devices as a practical alternative to the currently envisioned carbon nanotube for the 8-12 year time horizon. As an initial step we will demonstrate a low threshold voltage GaN channel device in a fully depleted substrate MOS like configuration.

DURIP: Vibrating Sample Magnetometer for Characterization of Spin Electronic Devices
Nadia A. El-Masry, Salah M. Bedair
Army Research Office
$75,000
04/15/06 - 04/14/07
Magnetic characterizations of MnGaN films are important for the optimization of the growth conditions of magnetic devices. The characterization techniques used to measure the magnetic properties are the vibrating sample magnetometer (VSM) and super-conducting quantum interference device (SQUID). The VSM is versatile and can be used for room temperature electrical and optical control of ferromagnetism (FM). Our Goal for acquiring a high resolution VSM is (1) Characterization of memory cells. (2) Investigating the optical control of FM in DMS.
Strain and Quantum Dots Manipulation in Nitride Compounds for Opto-Electronic Devices
Salah M. Bedair, Nadia A. El-Masry
US Army
$355,000
10/01/04 - 09/30/07
For the past forty years, device processing has relied upon electric charge as state variables. Spin states (spin up and spin down) and controlled magnetic properties can offer an alternative that will lead to memory and logic devices that scale beyond CMOS in both density and power/operation. Our goal is to obtain a high resolution VSM with (1) characterization of P-i-n structures for memory applications and (2) investigating the optical control of FM in DMS Nitrides.

Carbon Nanostructures and Wide Bandgap Semiconductors for Vacuum Thermionic Energy Conversion
Robert J. Nemanich, Griff L. Bilbro, Robert F. Davis, Zlatko Sitar
University of California - San Cruz
$1,511,499
05/21/03 - 11/30/07
In this MURI project, researchers in thermionics (TI) at NC State University are working with researchers in thermoelectrics (TE) at other universities to develop direct energy converters that combine the higher efficiency of TI with the cooler operation of TE. At NCSU, we have focused on TI devices based on the ballistic transport of electrons across a micron-scale, high-vacuum interelectrode gap. We are now developing a perspective that includes TE converters based on the diffusion of electrons or holes across a semiconductor material.

Materials Processing and Characterization for a Thermionic Converter Based on Nanostructured Carbon Materials
Robert J. Nemanich, Griff L. Bilbro
Power Technology Services Co. (PTS)
$190,042
03/25/04 - 12/06/06
The goal of this project is to extend thermionic energy conversion technology to temperatures below 700 degrees centigrade by building on our previous research in low-temperature, low-field electron emission from carbon nanotubes, nanostructured carbon, and nanocrystalline diamond. Thermionic (TI) energy converters extract electrical power from electrons traversing a vacuum or plasma gap; they operate at higher temperatures and are more efficient than solid-state thermoelectric (TE) generators, but both are reliable, scalable, light weight, and can run for decades on nuclear fuel.

Architectures and Applications for Three-Dimensional Chip Multiprocessors
Gregory T. Byrd, William R. Davis
National Science Foundation
$300,000
05/15/07 - 04/30/10
This project will investigate multi-core architectures, advanced design tools, and highly-parallel applications to exploit three-dimensional integrated circuits (3D ICs) for significantly higher performance and reduced power, compared to traditional two-dimensional multi-core chips. The use of emerging 3D IC technology has primarily focused on shrinking existing designs, achieving shorter wire delays and lower power dissipation without scaling transistor size. This work concentrates on the next-higher level of abstraction: the best mechanisms to integrate multiple processing cores into a powerful parallel computing engine.

IPA Agreement with Asian Office of Aerospace Research & Development
Jim C Chang
US Air Force
$176,936
01/31/06 - 01/30/08
IPA Agreement - None required

Incremental Read-Aheads to Improve Throughput in Data-Intensive Applications
Rada Y. Chirkova
NCSU Center for Advanced Computing & Communication
$80,000
07/01/04 - 12/31/06
Modern information system architectures place applications in an application server and persistent objects in a relational database. In this setting, we consider the problem of improving application throughput; our proposed solution uses data prefetching to minimize the total data-access time of an application, in a manner that affects neither the application code nor the backend DBMS. Our methodology is based on analyzing and automatically merging SQL queries to produce query sequences with low total response time, in ways that exploit the application’s data-access patterns.

A Joint Exploratory Study on the Applicability of Networked Control Systems For Critical Multi-variable Systems
Mo-Yuen Chow
National Science Foundation
$8,591
08/15/06 - 07/31/07
The research group from the North Carolina State University, headed by Prof. Mo-Yuen Chow and the research team from Jadavpur University headed by Dr. Amitava Gupta, shall interact within the scope of this exploratory study with one doctoral student from each side to study the applicability of Networked Control Systems to complex industrial processes. The results of this exploratory study shall identify re-usable technology modules that can be used in the ongoing projects of both the collaborators and pave the way for a future joint R&D project.

Biologically Inspired Intelligent Fault Diagnosis for Power Distribution Systems
Mo-Yuen Chow
National Science Foundation
$156,000
05/15/03 - 12/31/07
This project will investigate and develop a Biologically Inspired Intelligent Fault Management System using Artificial Immune System (AIS) technologies on top of a Neural Network – Fuzzy Logic (NN-FZ) structure to actively manage power distribution system faults, including diagnosis, prog-
nosis, and data mining. This system would revolutionize the Fault Diagnosis process for power distribution systems, to significantly increase system reliability and reduce operation costs. The proposed activities and architectures are not only limited to power distribution system, but are also applicable to other industries such as communication networks and transportation system that are large scale nonlinear system with uncertain operating environments.

**Center of Excellence in the Area of Human and Robotic Structures Technologies for Lunar and Planetary Exploration**

National Institute of Aerospace
Unfunded
10/01/02 - 09/30/07

Center developed to perform research and development in the area of Human and Robotic Structures Technologies for Lunar and Planetary Exploration.

**Intelligent Human-Machine Interface & Control for Highly Automated Chemical Screening Processes**

David B. Kaber, Robert A. St. Amant, Mo-Yuen Chow
National Science Foundation
$798,132
10/01/04 - 09/30/07

The breakthrough information technology that we will develop through this ITR project is an intelligent/adaptive, human-machine interface to support the new role of screening process supervisors in safe and effective, distributed control of high time stress and high risk, automated chemical and toxicity testing. The development of this technology will be based on cognitive modeling of supervisory controller behaviors during actual chemical screening processes and model predictions of operator performance with different interactive information display design alternatives during the (model) design phase and during chemical process run-time.

**Advanced Memory Performance Inferencing Technologies**

Thomas M. Conte
Red Hat, Inc.
$76,601
07/01/05 - 06/30/07

Joint research activity in biotechnology, nano-technology and information systems is one illustration of fruitful interaction for a successful collaborative effort. To address the fast pace of research, and for a better means of communication among researchers, a forum of discussion where free flow of ideas is encouraged, is a solution. For an area like RTP which thrives on leading edge research, this interdisciplinary seminar series promises to inject a new platform of learning/research update by hosting Distinguished Speakers every three weeks. These will be web-cast, and broadcast over MBONE throughout the triangle and surrounding areas for maximal impact and benefit.

**Confidence in Computer Architecture Modeling and Simulation**

Thomas M. Conte
National Science Foundation
$150,940
09/15/05 - 08/31/08

Efficient, accurate fast simulation of computer architectures is critical to the microprocessor industry. Recent work on fast simulation of computer architectures present only empirical evidence of the models’ accuracy. This project will apply sampling theory properly. We will adapt sampling theory to predict confidence in reduced models. Architecture presents a unique situation for sampling theory, and new statistical techniques will be developed as needed in this project to rise to the occasion. The principal investigator will extend his students’ and his path breaking work a decade ago to the current computer architecture challenges.

**Membership in the Center for Embedded Systems Research (CEAR), Affiliate Member**

Thomas M. Conte
Red Hat, Inc.
$35,000
09/01/04 - 08/31/07

The Center for Embedded Systems Research is a multi-disciplinary research center funded in-part by industrial partners. The Center performs research in embedded systems, the systems that find their way into your car, your digital camera, your TV, your MP3 player, and a host of other applications. Only 1 in 10 computers have a monitor, keyboard and mouse. Most are hidden inside other items, and these systems have very tight and challenging design constraints. This proposal is for Center membership of one of our industrial partners.

**Signals Approaches to Computer Architecture Prediction Mechanisms**

Thomas M. Conte
National Science Foundation
$144,843
08/01/02 - 07/31/06

This research is focused on developing a new, symmetric framework for computer architecture prediction motivated by the signals approach to data analysis. The framework for this research uses styles of prediction in two dimensions: periodic vs. computational and local history vs. global history. This framework is built on top of the principles of discrete signal analysis. The initial focus of this new work will be on value prediction because it is the least well understood area. However, the framework and methodology are applicable to branch prediction, dependence prediction, etc.

**Techniques for Benchmark Characterization of the EEMBC Benchmark Set**

Thomas M. Conte
EEMBC
$38,663
05/01/06 - 04/30/07

Benchmarking is as much a science as an art and at times involves a leap of faith for its consumers. Project focuses on adding science to the art. Key ideas were first published in 1991 by Conte and Hwu. Benchmark characterization is the process of finding a set of unique characteristics to
classify benchmarks. Characteristics must have two properties: (1) be predictive of performance on wide variety of platforms, and (2) should allow benchmark consumers to find good proxies for own applications in benchmark set. This project will develop a set of benchmark characteristics to meet goals of BC.

Techniques for Improving Compiled Code for Embedded Superscalar Processor Pipelines

Thomas M. Conte
Qualcomm
$77,267
02/01/06 - 08/31/07

This project will extend an existing compiler infrastructure for code generation to enhance the parallelism present in embedded code. The focus will be on creating a code generator that is parametric, so that the pipeline can be described separately from the compiler, and presented to the compiler as a database. This will allow proprietary pipeline details to remain trade secrets. It will also permit the compiler to be used in future processor designs to pose "++ "what if" questions regarding pipeline structure.

Exploiting Multiple Antennas in Multiuser Wireless Networks

Huaiyu Dai, Brian L. Hughes
National Science Foundation
$355,293
07/01/05 - 06/30/08

This project deals with the joint analysis and design of physical and medium-access-control layer protocols for multiuser MIMO wireless networks. The overall aim of this work is to understand how PHY and MAC-layer protocols combine to determine overall network performance, and how these protocols can be jointly designed to optimize this performance. During this period, the following problems were studied: (1) Joint transmission by cooperative base stations in multiuser MIMO cellular downlinks with asynchronous interference; (2) Single-chip MIMO system design for CDMA applications; (3) Optimal transmit beamforming techniques for coupled MIMO systems; (4) Optimal receiver principles for receiver diversity systems with multiple antennas.

An Open-Source Framework For Developing and Distributing Design-Tool Expertise

William R. Davis
NCSU Center for Advanced Computing & Communication
$20,000
07/01/06 - 06/30/07

This work proposes a method called the Trained-Predictor Technique, which conveniently gathers design-tool usage statistics and uses them to measure the quality of a design flow.

CAREER: Design Methodologies for Three-Dimensional Integrated Circuits

William R. Davis
National Science Foundation
$113,650
04/15/07 - 03/31/08

The goal of this 5-year project is to develop the fundamental design methodologies needed to make three-dimensional integrated circuits (3D ICs) a viable alternative to continued scaling of transistor gate lengths. The first objective is to develop the techniques needed to design 3D memories, clock-trees, and floor-plans. The second objective is to research methods for thermal verification. The third objective is to search for new computing applications with latency and power that cannot be achieved with traditional IC technology. This project will also improve engineering education by developing a free design kit for the latest integrated circuit technology.

CAREER: Software Thread Integration for Low-Through High-End Embedded Systems

Alexander G. Dean
National Science Foundation
$340,000
02/01/02 - 01/31/08

Software thread integration is a compiler technique enhances fine-grain concurrency of generic processors and increases a thread's instruction-level parallelism. The research simplifies the process of adding extremely fine-grain concurrency real-time tasks (primarily network support) to embedded systems while reducing development and unit costs, component count and overall device size and weight. The research also makes existing and future high-performance processors execute programs faster by using existing instruction-level parallelism resources more efficiently. This enables more sophisticated applications and improves execution performance and power consumption.

CSR--EHS Rapid Efficient Implementation of Communication Protocols for Embedded Systems

Alexander G. Dean, Mihail Sichitiu, Thomas G. Wolcott
National Science Foundation
$237,000
08/15/05 - 07/31/07

In this project we propose to develop methods, a toolbox and an associated communication framework to allow users to quickly implement software-based controllers for customized network communication protocols. More specifically, we will provide a complete networking stack featuring several options at each layer in the stack. Users will select specific protocol characteristics, and the tools of the framework will generate (and compile) the code that implements the specific protocol options for the desired application.

On Demand Testbed: Monitoring For Capacity Planning and Performance Optimization

Mihail Devetsikiotis, Ioannis Viniotis
NCSU Center for Advanced Computing & Communication
$40,000
07/01/06 - 06/30/07

Provisioning for on-demand, ubiquitous, high-speed networking services is a very challenging current issue. Performance monitoring is crucial for maintaining adequate quality of service and customer satisfaction, while maximizing resource utilization. Ensuring performance in an efficient manner requires advanced techniques of monitoring, data analysis, optimization and control. Our on-demand testbed will allow detailed and realistic experimentation at NC State,
in parallel with activities at IBM where the students are also spending time as interns. The award will fund research into the capacity planning and automation of monitoring tools by use of modeling, simulation, testbed emulation and on line optimization.

Performance and Testing of SIP Over Wireless Mesh Networks
Mihail Devetsikiotis, Mihail L. Sichitiu
Nortel Networks
$40,000
01/01/07 - 12/31/07
There seems to be agreement that the Session Initiation Protocol (SIP) will be at the core of the future Internet IP Multimedia Subsystem (IMS). Wireless mesh networks (WMNs) are a relatively new technology offering broadband mobile data communications at a fraction of the cost of conventional technologies. The main challenge we tackle in this project is evaluating and testing the performance of SIP in a WMN environment.

Adaptive Transmission and Channel Modeling for Frequency Hopping Communications
Alexandra Duel-Hallen, Hans D. Hallen
US Army
$220,000
06/20/05 - 12/19/07
Methods that improve the accuracy of the Long Range Fading Prediction for realistic Frequency Hopping Spread Spectrum systems are investigated, realistic channel modeling for peer-to-peer systems is enhanced, and adaptive transmission in the presence of partial band interference is explored.

ITR: Adaptive Signaling and MIMO Precoding for Rapidly Time Varying Fading Channels
Alexandra Duel-Hallen
National Science Foundation
$415,934
07/15/03 - 12/31/07
This project investigates feasibility of transmitter optimization for rapidly time varying fading channels encountered in wideband mobile radio communication systems. Adaptive transmission combined with long range fading prediction for frequency selective fading channels with antenna arrays is investigated. These methods are utilized in adaptive modulation and coding techniques for multicarrier and multiple antenna systems and in novel precoding methods and joint transmitter/receiver optimization techniques for Multiple Input Multiple Output (MIMO) wideband mobile radio systems. This research contributes to the development and realization of adaptive transmission and precoding methods that are essential in reliable high rate wireless communication.

Symbiosis of Micro-Robots for Advanced In-Space Operations
William W. Edmonson
University of Florida
$75,081
11/17/05 - 05/16/07
The use interval analysis to support the optimization required in many of the estimation and control algorithms to be implemented for cooperative momentum management and nonlinear image-based motion estimation and control. The use of interval analysis results in verifiable or reliable results. a reconfigurable computer system to execute the above algorithms in real time will be developed.

High Light Efficiency Liquid Crystal Microdisplay Systems
Michael James Escuti
Southeast TechInventures (STI)
$53,710
01/01/06 - 12/31/06
The goal of this project is to develop and begin commercialization of a break-through technology that enables polarization-independent LCDs in a partnership with industry (the technology-incubator Southeast TechInventures). We have so far been very successful at developing the proof-of-principle projection display, with a maximum contrast ratio of 600:1, switching speeds of ~2ms, operational voltage of between 5-20V, and low scattering. The result is an LCD with twice the brightness and comparable contrast. Even though only four months have passed, already several conference publications have resulted (SID, SPIE Optics & Photonics, & ILCC).

Liquid Crystal Polarization Gratings for Photonics Applications
Michael James Escuti
National Science Foundation
$122,933
09/01/06 - 08/31/07
The overall goal of this project is to investigate and apply a newly developed liquid crystal diffraction grating with broad applicability within many areas of photonics and optoelectronic devices due to its unique ability to manipulate light. In particular, a polarization-independent spatial-light-modulator and a hyperspectral polarimeter will be developed. Electromagnetic and elastic numerical simulation tools will be developed and published with an Open Source license. An outreach partnership with the NCSU Science House leads dozens of high school students in half-day, hands-on photonics projects. Two ECE students will complete a Research Experience for Undergraduates (REU) supplement.

Modular Laboratory Experiments on Organic Electronics and Liquid Crystal Displays for Undergraduates
Michael James Escuti
National Science Foundation
$154,410
01/01/07 - 01/31/09
The overall goal of this proposal is the development of a series of laboratory experiments for advanced undergraduate electrical engineering students that give hands-on experience with organic electronic materials and liquid crystal display technology. Inherently modular laboratory experiments are proposed for the fabrication and characterization of four devices: a single-pixel liquid crystal display (LCD), a polymer light-emitting-diode (pLED), a polymer field-effect-transistor (pFET), and an organic photo voltaics (OPV).
Thin Wide-Angle Beam Steerer That Operates in Transmission
Michael James Escuti
Boulder Nonlinear Systems
$23,207
10/24/06 - 04/02/07
The goal of this project is to fabricate polymer polarization gratings and support their integration in to a beam-steering device, an important function for free-space laser communications. This system will have the ability to direct a 633 nm laser into a set of discrete angles within +/- 60° in both horizontal and vertical directions.

Career: A Stochastic Approach to the Design of Communication Networks: An Alternative to Fluid Modeling
Do Young Eun
National Science Foundation
$144,673
03/01/06 - 02/29/08
The aim of this research is to understand the fundamental limitations of the fluid-based approach and of the deterministic optimization for large networks and then to develop a stochastic framework for large networks in which one can compute the performance metrics more accurately, while at the same time exploiting the simplicity caused by the interaction among many users, seeking to obtain new, efficient design guidelines and algorithms for a number of important networking problems including congestion control, network optimization, and peer-to-peer networks.

AC Coupled Interconnect for Low Power SpaceBorne Electronics
Paul D. Franzon, John Michael Wilson
US Air Force
$3,120,838
05/20/03 - 09/30/06
ACCI promises high-density, low-power chip I/O, sockets and connectors. In year 2, we demonstrated the feasibility of all the major technology elements in ACCI. The intent this year is to produce a complete transferable technology, including demonstration of issues related to laminate packaging, demonstration of a connector system, and improvement in our 3D IC concepts. In addition, we will design and deliver a board for a planned test in near earth orbit.

Behavioral Identification of Attack Signatures
Paul D. Franzon
Irvine Sensors Corporation
$30,000
09/15/06 - 03/15/07
NCSU will develop, implement and test a hardware-based solution for defending critical applications against network-based attacks.

Computer Aided Design For Digital Trust
Paul D. Franzon
Irvine Sensors Corporation
$45,000
02/01/07 - 12/31/08
NCSU will support Irvine Sensors in the development of CAD strategies to ensure that chip sets that can be secured from reverse engineering and tampering attacks

Development and Use of Sensors in Validating Aseptic Processing of Multiphase Foods
K. P. Sandeep, Paul D. Franzon, Josip Simunovic
US Dept. of Agriculture
$278,936
09/01/06 - 08/31/09
The overall objective of the current study is to develop a sensor that can be used to determine the location and internal temperature of food particles as they flow through the heating, holding, and cooling sections of an aseptic processing system.

Development of a Multi-Electro-Mechanical-System-Based (MEMS) Temperature Sensor to Determine Internal Temperatures Within Multiphase Food Products
K. P. Sandeep, Paul D. Franzon, Josip Simunovic
Ohio State University Research Foundation
$54,422
05/01/06 - 12/31/07
Researchers have been attempting to address the growing need in the food industry to monitor temperatures at various locations within food products (under batch and continuous flow conditions) to facilitate filing of a process with the FDA, to improve product quality, and enhance food safety measures. However, none of the currently available monitoring techniques meet the needs of the food industry. Thus, the current study will focus on developing a sensor to measure internal temperatures of particulates and tailoring it to meet the needs of the food industry.

DNA-Nanotube Assemblies for Molecular Electronics: DNA Directed Circuit Assembly
Paul D. Franzon
Duke University
$135,000
09/15/03 - 08/31/07
In collaboration with Duke University, determine circuit interconnect strategies using DNA scaffolds.

Multimode Interconnect
Paul D. Franzon
Semiconductor Research Corp.
$100,000
11/01/06 - 10/31/07
With higher core clock speeds, and the trend to multi-core, the demands on chip I/O are increasing rapidly. The key question is how to increase both the density and speed of chip I/O without increasing packaging costs. At high speeds, crosstalk issues typically dictate inter-pair spacings of four times the wire width in PCBs, and rich use of power and ground shields in connectors. In this research, we will investigate coding and circuit techniques that enable a group of signals to travel down a wire bundle, and potentially connectors and cable assemblies, without crosstalk.
System Packaging With AC Coupled Interconnect
Paul D. Franzon  
Irvine Sensors Corporation  
$100,000  
11/01/06 - 08/15/07
NCSU will design and implement a 3D Synthetic Aperture Radar Module.

System Technologies for AC Coupled Interconnect for Low Power SpaceBorne Electronics
Paul D. Franzon, Angus I. Kingon, John Michael Wilson  
US Air Force Research Laboratory (AFRL)  
$1,287,807  
09/25/06 - 09/24/07
ACCI promises high-density, low-power chip I/O, sockets and connectors. In year 05-06, we demonstrated the robustness of ACCI for capacitive and inductive connections. We also had extensive engagements with several technology transfer partners. The intent this year is to produce a complete transferable technology, including demonstration of issues related to laminate packaging, demonstration of a socket system and a connector system. In addition, we will complete the design and deliver a board for a planned test in near earth orbit.

Test Devices for Molecular Electronics Applications
Paul D. Franzon  
Virginia, University of  
$150,000  
05/11/06 - 11/10/07
Molecular electronics holds the promise of outscaling CMOS technology. However, the organic-inorganic interface is difficult to build. In this research, NCSU will determine approaches to building the inorganic portion of the system to permit fundamental studies in this interface.

Ultra High Density Computer Interconnect
Paul D. Franzon  
National Science Foundation  
$350,000  
09/01/02 - 08/31/07
We are determining new approaches to interconnect large systems at the system level. These approaches promise high density, low power and low cost.

Use of RFID Tags in Determining the Time-Temperature History Within a Product During Processing, Transportation, and Storage
K. P. Sandeep, Paul D. Franzon, Josip Simunovic  
Ohio State University Research Foundation  
$9,888  
11/01/06 - 05/31/07
Improving food quality, enhancing food safety, and aiding process filing with the FDA are three important areas of interest to the food industry. Accurate determination of the time-temperature history at the critical point in a system (slowest heating point) is necessary to accomplish this. We would like to make use of the RFID technology to capture and transmit internal temperatures of food particulates while they are being pumped through the heating, holding, and cooling sections of a continuous flow food processing system.

Advanced RF Transmitter Design for Deep Submicron CMOS
Kevin Gard  
Semiconductor Research Corp.  
$180,000  
06/01/04 - 05/31/07
The migration from SiGe HBT bipolar to CMOS based architectures requires a fundamental re-design of the radio architecture and innovative circuit designs. CMOS scaling from 130nm to 90nm and eventually to 45nm present new challenges for circuit design such as shrinking supply voltages and increased gate leakage. It is desirable to overcome these limitations by developing novel circuit designs which perform the same functions with comparable performance and yield as SiGe designs. This project will develop and design a linear radio transmitter integrated circuit with high performance and yield utilizing a state of the art CMOS technology.

High Efficiency 150W Widebandgap GaN Linear Amplifier with Digital Predistortion Linearization
Kevin Gard  
Nitronex Corporation  
$50,000  
09/01/06 - 03/06/07
Gallium Nitride (GaN) High Electron Mobility Transistors (HEMT) devices fabricated on silicon substrates offer a cost effective device technology for generating high power linear amplification at microwave frequencies. Application of digital predistortion (DPD) linearization to amplitude modulated signals significantly increases the power added efficiency (PAE) of a linear amplifier by correcting the nonlinear gain error of peak amplitude excursions resulting in less signal distortion at the output. Here we propose to develop and demonstrate DPD algorithms for increasing the PAE of a 150W GaN power amplifier with input signals with high PAR.

Expertiza: Reusable Learning Objects Through Active/Collaborative Learning and Peer Review
Edward F. Gehringer  
National Science Foundation  
$127,357  
01/01/06 - 12/31/07
The Expertiza platform is a divide-and-conquer approach to producing reusable learning objects through active-learning exercises. Students select from list of tasks to be performed, with several students selecting each task. Then they prepare their work and submit it to an electronic peer-review system. The work is then reviewed by other students, who offer comments to help the submitters improve their work. The best submissions for each task are then selected for use in later courses. This project is to study the educational benefits of the Expertiza approach, by measuring the improvements in student performance achieved when Expertiza is in use.

Sangam+Facetop=World’s Best DPP Environment
Edward F. Gehringer  
NCSU Center for Advanced Computing & Communication  
$40,000  
01/01/06 - 12/31/06
We propose to create a state-of-the-art environment for distributed extreme programming by marrying the Sangam editor, developed at NCSU, with the FaceTop user interface, developed at UNC-CH. Combining Sangam and the FaceTop will produce an integrated tool that will be a quantum leap forward for distributed extreme programming and distributed agile development.

**Analytical Monitoring of Pharmaceutical Compliance**

Maysam Ghoavanloo  
Dow Chemical Co.  
$74,260  
01/01/06 - 12/31/07

Patients forget to take their medicine; they may think side effects outweigh benefits; they may not believe the diagnosis; they may not understand the directions correctly; they may not know enough about the side-effects; they may use too much; or they may view the medicine as too costly. The goal of this project is to develop a method to analytically determine whether a subject has been adhering to a pharmaceutical regimen especially when it is orally administered. The medication can be in the form of a pill or a capsule.

**Innovative Tools and Techniques for Robotic Heart Surgery**

Gregory D. Buckner, Denis R. Cormier, Edward Grant, Bryan W. Laffitte  
National Institutes of Health  
$1,336,792  
08/16/04 - 07/31/07

Under an NIH funded grant new instruments and surgical techniques for retraction and fixation to enhance the utility of MIRA systems is being researched. A particular area of focus relates to mitral valve replacement. We hope to significantly reduce the time required to tie surgical knots using MIRA systems, thereby reducing the time that a patient is supported on cardio-pulmonary bypass (CPB) to an unacceptable interval. Additionally, we are investigating how to develop a retractor capable of deployment and retrieval through a trocar without external intervention. The research is collaboration between NC State University and East Carolina University.

**MRI: Development of a Quantum Engineering Laboratory**

Alexej I. Smirnov, William C. Holton, Ki Wook Kim, Veena Misra  
National Science Foundation  
$1,116,256  
09/01/04 - 08/31/07

We are developing a unique cross-disciplinary tool for simultaneous millimeter-wave, magnetic resonance, and electrical experimental measurements (correlated spin and charge transport measurements) on arrays of single-electron quantum dots and other novel semiconductor materials in order to understand the fundamental quantum physics in such systems and to exploit the spin degree of freedom for a new generation of information and communication devices that are based on quantum principles. Our system will operate with 100 GHz microwave for magnetic resonance in magnetic field of 7T with the sample at 20 mK.

**Silicon Based Nanoscale Quantum Devices**

William C. Holton, Veena Misra, Alexej I. Smirnov  
National Science Foundation  
$240,000  
08/01/03 - 07/31/07

This proposal describes the progress made in our present NSF grant and proposes to continue our research to further investigate the properties of electrons trapped within quantum dots. We will fabricate additional devices, deriving the electrons from a two dimensional electron gas formed at the interface of Si/C heterostructures, and conduct low temperature electrical and magnetic-resonance measurements with our Quantum Engineering Laboratory. In addition to ESR array measurements, we will use on chip interconnect structures with a suitably interconnected quantum dot arrays to make low temperature dynamic measurements to determine the spin properties.

**10 MVA ETO-based STATCOM**

Alex Q. Huang  
Electric Power Research Institute  
$99,999  
09/15/06 - 12/31/07

The objectives of this Supplemental proposal is to obtain additional funding from EPRI so that NCSU can complete the development of a digital controller for a proposed ETO STATCOM. The proposed ETO STATCOM will be installed at a BPA wind farm to regulate the voltage.

**Advanced FACTS Controller Development Based on Emitter Turn-off Thyristor (ETO) and Cascaded Multilevel Converter (CMC)**

Alex Q. Huang  
Electric Power Research Institute  
$441,561  
10/04/04 - 12/31/06

NCSU is developing three key technologies that are suitable for applications in next generation Flexible AC Transmission (FACT). These are power devices based on emitter turn-off (ETO) thyristor, modular voltage source converter (VSC) based on ETO, and advanced digital control technologies. Initial focus is to apply these to a STATCOM configuration based on cascading a number of modular converters. In this project, initial focus is to finalize development of a 4.5 MVA STATCOM prototype and its testing in a laboratory setting. Next focus in the project is to develop a high power version of STATCOM system for a real utility application.

**Buck Boost Switching Converter for Dynamic Power Supply of a Radio Frequency Power Amplifier**

Alex Q. Huang  
RF Micro Devices  
$50,000  
11/15/05 - 05/15/07

Through this project, NCSU will investigate how to implement a high efficient and fast buck boost converter for dynamic power supply to a radio frequency power amplifier based on the polar modulation architecture. The proposed Buck-Boost converter will have a wide input voltage range of 2.7 V to 4.3 V and operate at 10 MHz.
Consortium of Advanced Power Electronics and Energy Storage-CAPES (within SPEC) Pool Agreement
Alex Q. Huang
NCSU Semiconductor Power Electronics Center (SPEC)
$1
07/01/06 - 12/31/10

CAPES provides efficient access to experienced university researchers in an array of relevant disciplines and geographically located across the U.S. Leading-edge research in cost-effective projects jointly developed by industry leaders and university experts. High quality education of future engineers needed to transform the electric power industry from a passive network to an actively managed electronics power system.

Design Optimization of Silicon Carbide Bipolar Junction Transistor
Alex Q. Huang
CREE Research, Inc.
$150,000
06/02/05 - 03/29/08

NCSU will study the class E amplifier based on SiC BJT and SiC MOSFET. This study will be based on finite element simulations as well as based on SPICE simulation using models extracted by NCSU. Power added efficiency will be analyzed. NCSU will continue the study of BJT degradation issues through testing, simulation and discussion with Cree. NCSU will study how to use SiC BJT or MOSFET to do power conversion at very high frequency (>100 MHz) using resonant topology.

Development of a 69 kV Class Solid State Current Limiter (SSCL)
Alex Q. Huang
Silicon Power Corporation
$99,993
12/01/06 - 11/30/08

Objective is to develop a Solid State Current Limiter (SSCL) to limit fault current issues and to take advantage of above benefits. The SSCL interrupts or limits fault current from new generation or transmission, reduces switching surges, and offers an environmentally benign alternative to circuit breakers. Silicon Power Corp. (SPCO), together with NCSU, has recently proposed to EPRI and DOE to develop, build and deliver a 69 kV/3000A transmission level SSCL that is extremely reliable as well as compact enough to be applied in urban transmission. Additionally, it must be maintainable by traditional utility personnel, and priced at a cost-effective level.

Development of a Scalable, Transportable Energy Storage System for Effective Integration of Renewable Energy Sources
Alex Q. Huang, Mesut E. Baran, Subhashish Bhattacharya
Bonneville Power Administration
$10,000
04/17/07 - 09/30/07

The objective is to develop a scalable, transportable energy storage devices based on emerging ETO Light Converter technology. Not only will we be able to demonstrate the performance advancement offered by the ETO Light Converter, but also demonstrate the reduced cost and improved reliability. The delivered energy storage device will solve practical problem at the identified wind farm location. The delivered unit can also be relocated to other BPA renewable energy locations to address the intermittent power issue such as those found in an ocean wave park. Rating of the unit can be scaled to higher level for future applications.

High Voltage SiC MOSFET/IGBT Development and Their Applications
Alex Q. Huang
CREE Research, Inc.
$275,500
11/21/05 - 05/31/07

Silicon carbide based high voltage (10 kV) devices have much superior performance than silicon devices at the same voltage rating. In this project, optimization of unipolar and bipolar devices at 10 kV level will be conducted to assist Cree’s development of these devices. Insertion opportunity and requirement of these devices in key defense and civilian applications will be studied and analyzed.

Interconnected Laboratory Scale FACTS Devices
Alex Q. Huang
University of Missouri-Rolla
$308,000
05/01/05 - 09/15/06

A modification of current contract to add an additional $8000 in tuition support.

Membership in Consortium for Advanced Power Electronics and Energy Storage (CAPES), Principal Member
Alex Q. Huang
ABB, Inc
$75,000
07/01/06 - 12/31/08

The Consortium for Advanced Power Electronics and Energy Storage (CAPES) is a government, utility company, equipment maker, university and national lab based consortium to leverage resources and expertise to develop and demonstrate key power electronics and energy storage technologies for transmission and distribution grids.

Membership in Consortium For Advanced Power Electronics and Energy Storage (CAPES), Principal Member In-kind
Alex Q. Huang
Progress Energy Carolinas
$1
01/01/07 - 12/31/08

The Consortium for Advanced Power Electronics and Energy Storage (CAPES) is a government, utility company, equipment maker, university and national lab based consortium to leverage resources and expertise to develop and demonstrate key power electronics and energy storage technologies for transmission and distribution grids.
The Power Management Consortium (PMC) is established as an industry and government sponsored consortium to conduct pre-competitive research in the areas of power management for future generations of microprocessors and battery powered portable systems. PMC research will explore novel power management solutions through architecture and topology modeling and hardware demonstration as well as delivering analog and mixed signal Integrated Circuit implementations to the proposed power management technologies.

Membership in Power Management Consortium (PMC), Associate Member
Alex Q. Huang
Intel Corp.
$30,000
01/01/06 - 12/31/08

Membership in Power Management Consortium (PMC), Associate Member
Alex Q. Huang
Fairchild Semiconductor
$30,000
09/01/05 - 12/31/08

Membership in Power Management Consortium (PMC), Associate Member
Alex Q. Huang
International Rectifier
$30,000
10/01/05 - 12/31/08

Membership in Power Management Consortium (PMC), Associate Member
Alex Q. Huang
Volterra Semiconductor
$30,000
01/01/06 - 12/31/08

Membership in Power Management Consortium (PMC), Principal Member
Alex Q. Huang
Vishay Siliconix, Inc. (subsidiary of Vishay)
$90,000
11/01/05 - 12/31/08

Next Generation Power Electronics Devices for Energy Storage Systems
Alex Q. Huang
University of Missouri-Rolla
$122,835
05/01/06 - 04/30/07

In 2006-2007, a new VSC converter based on Gen-4 ETO and advanced heatpipe cooling system will be developed and demonstrated. This will show significantly improved power density and reliability. As a major advancement of technology development, we will also concentrate on the development of a SiC ETO devices (Gen-6 ETO). This work will be partially supported by Cree. SiC ETO will be a futuristic devices for utility and energy storage applications, which can potentially push the voltage rating up to 15 kV or higher, and a frequency rating higher than 10 kHz.

Power Management Consortium-PMC (within SPEC) Pool Agreement
Alex Q. Huang
NCSU Semiconductor Power Electronics Center (SPEC)
$1
09/01/05 - 12/31/10

PMC is established as an industry and university consortium to conduct pre-competitive research in the areas of power management for future generations of microprocessors, cells phones and other battery powered systems. Research focus: battery powered systems; RF Power Management; computer power management; offline applications.

Losses and Degradation in Nanoscale Frequency Control Resonators
Gerald Iafrate, Andrey A Kiselev
Army Research Office
$50,000
10/01/06 - 06/30/07

The objective is to analyze fundamental physical limitations that arise in quality factor and noise figure occurring for low cost, integratable, NEMS solid state frequency control resonators as their dimensions approach the nanoscale and their operational frequency tends toward the low GHz range. The research considers non-equilibrium heat generation and redistribution processes from mechanical strain beyond the conventional heat diffusion and local temperature approximation, and develops scaling analysis, coupled with analytical and numerical modeling of phonon flow and heat distribution at the nanoscale.
redistribution in nanoscale resonators. A reliable approach
for the quantification of quality factor in presence of non-
diffusive phonon transport is developed.

**NIRT: Reduced Degree of Freedom Predictive Methods for Control and Design of Interfaces in Nanofeatured Systems**
*Donald W. Brenner, Marco B. Nardelli, Ron O. Scattergood, Mohammed A. Zikry, Gerald Iafrate*
National Science Foundation  
$1,980,275  
07/01/03 - 06/30/08

This research studies the quantum-mechanical behavior of nanocomponents embedded in a dissipative environment. An interacting harmonic oscillator and angular momentum oscillator are utilized to simulate the interaction of an electromagnetic field mode with an atom in an embedded micro or nano cavity to provide atomic transitions in absorption and emission; as the cavity boundaries are influenced by a surrounding environment, the cavity modes are perturbed thus influencing the transition characteristics. The objectives are to study the nanocomponent-environment interaction, and to provide adequate modeling capability for elucidating the robustness of the nanocomponent quantum characteristics due to the interaction with the environment.

**Physics at the Molecular Electronic Level**
*Gerald Iafrate*
US Army Research Laboratory (ARL)  
$60,000  
09/01/05 - 08/31/06

The objective of this research is to explore the basic principles, mechanisms, and limitations of electronic gain in molecular current carrying configurations, and to model molecular architectures that show promise for exhibiting electronic gain. Modeling methods are based on a modified Bardeen Transfer Hamiltonian (BTH) approach, and allow for the calculation of the current through a molecular configuration while the configuration interacts with an intermediate charge reservoir. The modified BTH method allows molecular arrangements and architectures to be modeled for gain capacity in a user friendly way to obtain “approximate” validation before more sophisticated modeling methods are employed.

**Quantum Analysis of a Microcavity-tuned Bloch Oscillator for Tunable Spontaneous Emission and Absorption of Terahertz Radiation**
*Gerald Iafrate*
Army Research Office  
$50,000  
08/31/06 - 05/30/07

The goals of the project are to (1) theoretically develop the basic quantum physical processes underlying the spontaneous emission and absorption of radiation during the time that the electron accelerates through the band under the influence of the constant external field. In addition, the offsetting effects of dephasing inhomogeneities such as interface roughness, impurities, phonons, will be treated by perturbation theory to assess their influence in degrading the optimal strength of the spontaneous emission; (2) study several different cavity/waveguide configurations to determine optimization of the Bloch radiator power enhancement, and to analyze the efficiency of power extraction from the cavity.

---

**CACC Membership Pool Agreement**
*Dennis H. Kekas*
NCSU Center for Advanced Computing & Communication  
$1  
07/01/06 - 06/30/10

**Membership in CACC**
*Dennis H. Kekas, Mladen A. Vouk*
Cisco Systems, Inc.  
$450,000  
07/01/00 - 06/30/09

Cisco Systems is extending membership in CACC through June 30, 2009.

**Membership in CACC**
*Dennis H. Kekas, Mladen A. Vouk*
Ericsson, Inc.  
$360,000  
07/01/00 - 06/30/09

The Center for Advanced Computing and Communication (CACC) is a membership-based industry/university cooperative research center co-located at North Carolina State University and Duke University. Expertise in the center is focused in the areas of information security, business intelligence, software engineering, extreme programming, networking, wireless technologies, autonomic computing, power visualization, business analytics, sensor-based systems, and display technologies. The CACC research goal is to create concepts, methods and tools for use in the analysis, design and implementation of advanced computer and communication systems.

**Membership in CACC**
*Dennis H. Kekas, Mladen A. Vouk*
Tekelec  
$300,000  
07/01/04 - 06/30/10

The Center for Advanced Computing and Communication (CACC) is a membership-based industry/university cooperative research center at North Carolina State University. Expertise in the center is focused in the areas of information security, business intelligence, software engineering, extreme programming, networking, wireless technologies, autonomic computing, power visualization, business analytics, sensor-based systems, and display technologies. The CACC research goal is to create concepts, methods and tools for use in the analysis, design and implementation of advanced computer and communication systems. Our mission is to carry out basic and applied research on fundamental problems with both industrial and academic relevance, to transfer these results to our members, and to provide our students with a unique and challenging educational opportunity.

**Membership in CACC**
*Dennis H. Kekas, Mladen A. Vouk*
MCNC-RDI  
$80,000  
07/01/03 - 06/30/07

MCNC agrees to continue associate level membership in CACC through June 30, 2007.
Membership in CACC, Affiliate Member

Dennis H. Kekas
Qimonda North America Corp.
$60,000
07/01/05 - 06/30/08

The Center for Advanced Computing and Communication (CACC) is a membership-based industry/university cooperative research center co-located at North Carolina State University and Duke University. North Carolina State University was selected by the National Science Foundation in 1981 as a site for an industry/university cooperative research center in communications and signal processing. The center was named the Center for Communications and Signal Processing until 1994 when a second center site at Duke University was added. Expertise in the center is focused in the areas of information security, business intelligence, software engineering, extreme programming, networking, wireless technologies, autonomic computing, power visualization, business analytics, sensor-based systems, and display technologies. The CACC research goal is to create concepts, methods and tools for use in the analysis, design and implementation of advanced computer and communication systems. Our mission is to carry out basic and applied research on fundamental problems with both industrial and academic relevance, to transfer these results to our members, and to provide our students with a unique and challenging educational opportunity.

NSF Partnership in the Center for Advanced Computing and Communication

Dennis H. Kekas, Mladen A. Vouk, Laurie A. Williams
National Science Foundation
$683,340
09/15/99 - 08/31/07

The purpose of this budget is to MIPR funds through NSF to CACC. Funds requested are those to be paid by National Security Agency (NSA) for continuing support of NSA CACC enhancement project 522836 under direction of Laurie Williams.

Request for Support for the International Conference on Information and Communications Security (ICICS 2006)

Dennis H. Kekas
National Science Foundation
$5,000
09/15/06 - 08/31/07

The International Conference on Information and Communications Security will be held in December 2006 in the Research Triangle of North Carolina. This is a well-established security conference being held for the first time in North America. Support from NSF is sought to broaden participation, particularly of students, provide improved access for researchers to the latest research results, and to promote the development and dissemination of solutions to some of the nation’s pressing security needs in the computing and communications areas.

Carrier Spin Dynamics and Device Applications in Carbon Nanotube

Ki Wook Kim, Marco B. Nardelli
National Science Foundation
$239,979
09/01/06 - 08/31/09

The objective of this research is to explore spin dependent properties of the carriers in carbon nanotubes and their potential device applications. The approach is based on the theory and numerical (ab initio) modeling of carrier spin relaxation and transport dynamics in carbon nanotubes. Specific concepts/structures leading to a novel class of spintronics devices is also pursued beyond the current scaling limit.

MARCO Center on Functional Engineered Nano Architectonics (FENA)

Ki Wook Kim
University of California
$356,789
09/01/03 - 04/30/07

As a member of the MARCO team led by UCLA, the main aim of this effort is to develop theoretical models capable of simulating nanostructures based primarily on semiconductors and to investigate their characteristics comprehensively. Particularly, fundamental limitations and optimum design guidelines are examined for various novel nanoscale devices and the new paradigm of information processing/storage is explored. The focus is on the devices that can be integrated with the CMOS.

Novel Non-Volatile Memory Devices Based on Magnetic Semiconductor Nanostructures for Terabit Integration

Ki Wook Kim
Army Research Office
$127,770
07/01/06 - 12/31/07

This program explores novel spin memory devices that utilize carrier spin-dependent interactions in magnetic semiconductor nanostructures. It is aimed at demonstrating the viability of non-volatile memory concepts that can be highly scalable, can have extremely low power dissipation, and can be readily merged with the CMOS platform. The primary focus of the effort is on the concepts utilizing electrical control of the magnetism, i.e., the phenomena based on the electrically induced magnetic phase transition and magnetization reversal. A theoretical investigation is pursued by developing physical understanding of the related phenomena, followed by the device modeling for optimum structure design.

Novel Polymer Structures for Optical Sources and Detectors for Intra Chip Interconnects

Mohamed O. Abolfotoh, Robert M. Kolbas
Georgia Institute of Technology
$398,085
09/01/03 - 08/31/06

Radically new optical sources and detectors are required for compatibility with deep-submicron electronics. Polymers as ordered thin films or as single molecular strands hold great promise for intra-chip optical interconnects. Our strategy is to achieve the three functionalities of optical emission, optical detection and optical modulation through the use of simple polymer systems. These polymer systems are characterized by unique electrical, optical and dielectric properties that can be tuned over a wide range by controlling the polymer morphology and the polymer molecular structure. Another great advantage of this approach is the compatibility of polymers with silicon materials and processing technology.
A Test Bed for Range Imaging and 3D Object Measurement and Exploitation

Hamid Krim
US Air Force-Office of Scientific Research (AFOSR)
$51,107
06/01/06 - 05/31/07

We propose a test bed which jointly exploits the range measurement capabilities of Laser Scanners together with those of Structured Light Imaging to characterize and model 3D targets and construct a comprehensive database. This will help us how to combat data drop outs and the influence of noise induced by ambient lighting and motion. This experimental test bed will be key in analyzing, testing and stressing numerous existing algorithms and those we have recently developed in the course of our AFOSR funded research. This will also play a key role in educating undergraduate as well as graduate students.

Bio-inspired Invariants: Target Representation and Classification towards Scene Understanding

Hamid Krim
US Navy-Office Of Naval Research
$95,580
05/15/06 - 09/30/09

At the center of cognition, lies understanding brain functionality which remains a hot topic of research to address the slow progress in machine-based image understanding. Biological systems (e.g. one may recognize an object despite some occlusion and/or additive noise) have increasingly attracted more researchers as a rich source of inspiration, which has led to investigations of smaller and potentially simpler biological entities. The goal in this effort is to exploit biologically inspired invariants in objects to develop a methodology to efficiently and accurately represent 2/3D objects as weighted-graphs for classification and recognition problems as is crucially important in scene understanding applications.

Graphs and Homology in 3D Object Classification

Hamid Krim
US Air Force
$294,386
03/01/04 - 02/28/07

The purpose of this research is to conduct multidiscipline and technology integration research and evaluation of several technology areas to achieve better fundamental understanding as well as to the initializations of these technologies. Some of these areas have been addressed traditionally by a single discipline research, such as electronics, communications and networks, and some others are multidisciplinary in nature and technology integration is the key, such as nanotechnology, biotechnology and modeling and simulation.

Graphs and Homology in 3D Object Classification

Hamid Krim
US Air Force-Office of Scientific Research (AFOSR)
$91,533
01/15/07 - 11/30/07

The fully automatic target recognition problem has been hampered by its multi-disciplinary nature whose challenge emanates from intertwined complexities. Topological features of an object together with its finer geometrical features were sought to provide a parsimonious graphical model which is well adapted for classification and recognition.

Information Systems and Interdisciplinary Research Seminar Series

Hamid Krim
Army Research Office
$31,332
01/01/06 - 12/31/08

Joint research activity in biotechnology, nano-technology and information systems is one illustration of fruitful interaction for a successful collaborative effort. To address the fast pace of research, and for a better means of communication among researchers, a forum of discussion where free flow of ideas is encouraged, is a solution. For an area like RTP which thrives on leading edge research, this interdisciplinary seminar series promises to inject a new platform of learning/research update by hosting Distinguished Speakers every three weeks. These will be web-cast, and broadcast over MBONE throughout the triangle and surrounding areas for maximal impact and benefit.

Workshop Proposal: New Directions in Complex Data Analysis for Emerging Applications

Hamid Krim
US Air Force-Office of Scientific Research (AFOSR)
$39,960
05/15/07 - 12/14/07

Difficult challenges arise in many applications where the curse of dimensionality very quickly becomes a limiting issue, starting with 3D bodies to other processes lying in higher dimensions but yet associated with common characteristics which may be used to advantage. One such example, relevant in security applications is the characteristic space where human face data lie. A workshop serving as a forum of discussions and debate for defining new directions in research of novel mathematical tools is proposed.

A High-Density Microelectronic Tissue for Imaging: Electromagnetic and Thermal Effects

Gianluca Lazzi
US Dept. of Energy
$585,548
12/15/03 - 12/14/07

The overall goal of this project is to develop novel quasi-static and time-domain bioelectromagnetic and biothermal modeling methods that will ultimately lead to a complete characterization of the electromagnetic and thermal impact of a retinal prosthesis on the human body. The focus is on the characterization of the current spread in retinal layers due to an array of stimulating electrodes, with the goal of understanding the effect of electrode shape and size on the induced currents on ganglion and bipolar cell layers as well as the thermal impact of the electrical stimulation on the delicate neural layers.
Biomimetic Electronic Systems (BIMS): Electrical and Electromagnetic Interactions
Gianluca Lazzi
Southern California, University of
$233,264
09/01/04 - 08/31/07
In this project we will investigate thermal effects (models and methods) of bioimplantable devices developed in the ERC at the University of Southern California.

CAREER: Advanced Bioelectromagnetics for Wireless Biomedical Devices
Gianluca Lazzi
National Science Foundation
$387,000
03/01/01 - 02/28/07
This supplement requests funds to support an undergraduate student to work on the development of a high resolution human body model that will be used in the PI’s laboratory.

ITR: A New Class of Vector-Sensing Antennas for Wireless Communications
Gianluca Lazzi, Brian L. Hughes
National Science Foundation
$357,906
07/15/03 - 06/30/07
This is a REU supplement request to support one undergraduate student to work on the current NSF award “A New Class of Vector Sensing Antennas for Wireless Communications.” The student will be focusing on the antenna design component.

Multi-Functional Engineered Fabrics for Tarps
Behnam Pourdeyhimi, Gianluca Lazzi
US Army
$240,000
09/25/06 - 09/30/07
Tarps are deployed to cover structures from the environment and may have the ability to reduce the visual and thermal signature of the structure. The use of materials and supplies that are lightweight, energy efficient and durable under extreme weather conditions would be desirable. This proposal addresses the development of lightweight, novel materials for use as tarps with a specific signature management strategy. This is a proposal for the research, development, test and evaluation of innovative nonwoven fabric structures that incorporate a dipole antenna signature management strategy.

Protocol Driven Studies to Measure Absorbed Radiofrequency, Microwave and Millimeter Wave Energy: Computational Electromagnetic
Gianluca Lazzi
Henry M. Jackson Foundation
$100,000
01/01/07 - 09/28/07
Investigate adaptation of ADI-FDTD code and Impedance code currently available at North Carolina State University to modeling human electromuscular incapacitation (HEMI) exposures. The goal is to develop a code capable of running these high-resolution anatomical models with reasonable turnaround times.

IPA Agreement with NSF
Leda Lunardi
National Science Foundation
$341,900
06/06/05 - 07/31/07
This is an IPA Agreement between Leda Lunardi and NSF. The Amount requested consists of the salary and benefits that will be paid by NSF and NC State. Attached are documents supporting this submission Continuation of IPA at NSF

North Carolina Photonics Initiative Phase II
Leda Lunardi
UNC - Office of the President (GA)
$58,000
04/21/04 - 06/30/07
In Phase IV we intend to complete the tasks necessary to continue to grow, promote and institutionalize the Carolinas Photonics Cluster. As we organize ourselves through an inter-institutional agreement into effectively one distributed collaborative campus, the rewards for our faculty and students and even more so, our industry partners, will be considerable. We are at a point in time where there is willingness on the part of the campuses involved to invest in the resources, time and energy needed to accomplish this important multi-institutional activity. Coordinated educational programs and complementary research facilities simplifies the Consortium’s engagement with the broader industry driven Cluster.

Molecular Information Storage
Jonathan S. Lindsey, Raymond E. Fornes, Veena Misra, John S. Strenkowski
Zettacore, Inc
$2,437,078
01/01/02 - 12/31/07
Molecules will be developed for use at the counterelectrode as required for molecular information storage. Additional molecules will be prepared for use at the working electrode. Compounds will be synthesized in the PI’s laboratory, and then sent to Prof. David F. Bocian at UC Riverside for characterization. Selected compounds will be sent to Prof. Veena Misra at NCSU for evaluation in nanodevices.

New Concepts and Substrates for Ultrathin Body Devices
Angus I. Kingon, Jon-Paul Maria, Veena Misra
Semiconductor Research Corp.
$540,000
10/01/03 - 09/30/06
Current routes to SOI and SOI devices present a major scaling challenge if SOI is to be utilized for 65nm to 22 nm technology nodes. This activity is focused on the development of a new route to silicon-on-insulator through the use of an epitaxial oxide template layer. The oxide template is ‘floated’ above the Si wafer through the growth of an underlying amorphous SiO2 layer. Several key process and material constraints are removed if one uses the same or related epitaxial oxides for SOI devices. The technology will provide a platform for new ultra thin body silicon on insulator devices.
**Novel Approaches for Integration of Vertical Silicon Nanoelectronics**

Veena Misra  
National Science Foundation  
$400,000  
02/01/01 - 01/31/08  

This proposal will investigate novel approaches in the integration of vertical CMOS devices. This integration offers low temperature compatibility since high-K gatestack formation in vertical devices can be performed after the source/drain regions are defined, thus avoiding any high temperature exposure. This offers tremendous opportunity for achieving ultimate CMOS performance.

**Porphyrin-based Molecular Memories**

Jonathan S. Lindsey, Veena Misra  
University of California  
$300,000  
06/29/05 - 09/30/06  

Abstract New porphyrin-based charge storage materials will be synthesized, including porphyrin monomers, dyads, and triple-decker sandwich coordination compounds. Novel approaches for development of charge-transfer layers also will be investigated. Molecular-based charge-storage materials will be incorporated into a variety of novel nanodevice designs in the Misra lab. Material samples will be delivered from the Lindsey lab to collaborators (David Bocian, UC Riverside; Veena Misra, NCSU ECE) on a regular basis for physical studies. The collaborative effort of the three groups will lead to new insights in molecular information storage. The Misra and Lindsey labs will split the funds allocated to our labs.

**Scalable Strained Silicon MOSFET Technology with Advanced Gatestack Materials**

Veena Misra, Mehmet C. Ozturk  
National Science Foundation  
$270,000  
07/01/03 - 06/30/07  

The goal of this project is to evaluate alternative high-K dielectrics and metal electrodes on strained silicon devices. The impact of varying strain levels in the silicon will be evaluated on the interfacial properties, mobility and reliability of the gatestacks.

**Defining the Boundaries of Free Space Underwater Communications**

John F. Muth  
National Science Foundation  
$100,000  
01/01/07 - 12/31/07  

Graduate Student Supplement to existing NSF Grant for Rebecca Scott

**Integrated Pumping of III-V Nitride Materials for Novel Optical Device and System Applications Including Chemical**

John F. Muth  
US Army  
$170,000  
09/05/03 - 10/15/06  

Integrated optoelectronic devices using GaN and novel substrates to form chemical and biological sensors.
Investigation of the Fundamental Properties of Amorphous and Crystalline Oxide Semiconductors.

John F. Muth
Army Research Office
$89,999
03/21/06 - 05/31/07

The purpose of this project is to investigate a new class of novel semiconducting oxide materials. Some interesting properties of these materials is that they have an electron mobility that is an order of magnitude faster than amorphous silicon, and they are transparent to visible light. This opens up the possibility of transparent electronics for displays and other applications.

Micromachined Chemical Sensor

John F. Muth
Naval Research Laboratory
$444,998
08/15/05 - 08/15/08

The need to be able to detect chemical or explosive agents has grown greatly in importance in recent years. Present sensor systems require the sensor and readout to be at the location of the agent. The ability to remotely interrogate sensors from a distance would be advantageous. This proposal involves the fabrication of micromachined sensors that will be sensitive to chemicals and can be read out by a laser from a distance.

Photonic Devices for Underwater Communications

John F. Muth
US Navy
$543,912
05/01/03 - 12/31/06

Radio waves do not penetrate ocean water, and acoustic signals have relatively low bandwidth for communicating large amounts of data. Blue and Green light emitting diodes and lasers provide one possible means of forming short range high bandwidth communication systems that will work in ocean water. This project investigates novel optical devices that will enable underwater optical communication systems for unmanned underwater vehicles and underwater networks.

National Nanotechnology Infrastructure Network - Triangle National Lithography Center

Carlton M. Osburn
Cornell University
Unfunded
03/04/07 - 02/28/09

The Triangle National Lithography Center (TNLC), is a joint venture of NC State and UNC-Chapel Hill, whose centerpiece is a state-of-the-art, 193 nm optical lithography scanner for rapid turnaround time and high volume patterning. Automated wafer tracks are used for resist processing. The tool can “print” 80 nm isolated features, and resist trimming can be used to produce even smaller features. The scanner is housed in Class 100 facilities within the NCSU Nanofabrication Facility (NNF) which provides: reactive ion etching, film deposition, thermal processing, diffusion, chemical mechanical polishing, cleaning, and characterization tools. The TNLC is an affiliate of the National Nanotechnology Infrastructure Network (NNIN) and, along with the NNF, is open to all researchers.

A Novel Laboratory Based Introduction to Electrical and Computer Engineering for Sophomores

Mehmet C. Ozturk
National Science Foundation
$304,643
02/01/02 - 08/31/06

The goal of this program is to develop a novel, introductory course for electrical and computer engineering sophomores. The course is centered around a hardware laboratory with traditional bench-top measurement equipment and new laboratory hardware specifically designed and constructed for the new experiments. The course begins with fundamental concepts and moves onto different specialization areas supported by motivating experiments based on real-life applications. The new laboratory hardware allows the students to work on these applications at an introductory level. Another component of this program is the Virtual Laboratory in the form of Java applets.

Recessed SiGe and SiC Source/Drain Engineering For Future CMOS Technologies Employing Uniaxial Channel Stress For Channel Mobility Enhancement

Mehmet C. Ozturk, Veena Misra
Semiconductor Research Corp.
$128,000
07/01/06 - 06/30/07

In this work, we explore methods to form low-resistivity source/drain junctions and contacts for CMOS technology nodes down to 22 nm. The work is performed in two parallel tracks. In the first track, we explore selective epitaxy of SiC alloys in recessed source/drain regions with the objective of inducing tensile stress for electron mobility enhancement. In the second track, we explore novel contact formation schemes to both p+ SiGe and n+ SiC source/drain junctions in order to reduce the contact resistivity of these contacts down to 10-9 ohm-cm2 to limit the series resistance to a small fraction of the channel resistance.

REU Site: Research Experiences For Undergraduates in the Department of Electrical and Computer Engineering at North Carolina State University

Mehmet C. Ozturk, Mihail Devetsikiotis
National Science Foundation
$89,693
03/01/07 - 02/29/08

Funds are requested to create a site for research experiences for rising seniors in Electrical and Computer Engineering. Ten students from different institutions will be sponsored every summer for a period of 10 weeks. The students will work on independent research projects with the mentoring ECE faculty and learn about research performed in different ECE specialization areas. The students will be exposed to various elements of academic life including ethics, diversity and forming collegial relationships.

Strained Si MOSFETs with Silicon-Germanium Source/Drain Junctions: An Alternative Path to Strain Engineering in Nanoscale

Mehmet C. Ozturk, Veena Misra
Semiconductor Research Corp.
$300,000
10/01/03 - 09/30/06

The purpose of this project is that they have a electron mobility that is an order of magnitude faster than amorphous silicon, and they are transparent to visible light. This opens up the possibility of transparent electronics for displays and other applications.
The goal of this project is to evaluate novel routes in introducing strain in nanoscale MOSFETs. Strained silicon devices formed directly on oxide is one of the goals of this project.

**Thermoelectric Cooling Technology Utilizing Silicon Nanowires**

* Mehmet C. Ozturk, Veena Misra  
* Orobridge Inc.  
* $60,000  
* 01/01/06 - 05/31/07

As technological complexity continues to increase, thermal energy management becomes more crucial. Cooling electronic or mechanical systems have centered on fluid heat exchange and only recently have had solid state cooling devices, using the Peltier effect, been deployed in limited applications. Proposed research will develop manufacturing processes to fabricate silicon nanowires to be used in novel thermoelectric cooling devices. Nanowires will be applied to a variety of architectures including a new device developed by Orobridge Inc. Technology is not only compatible with silicon integrated circuit manufacturing but also promises significant enhancements in thermoelectric cooling power over that possible with commercially available coolers.

**CAREER: Cooperative Redundant Threads**

* Eric Rotenberg  
* National Science Foundation  
* $300,000  
* 03/01/01 - 02/28/07

Redundant execution is proposed for speeding up sequential programs on single-chip multiprocessors. The new method is called slipstream, a term borrowed from car racing in which two cars collaborate aerodynamically to speed up both cars. A slipstream processor finishes two redundant copies of the program sooner than a conventional processor finishes a single copy. Redundant execution is also transparently leveraged for fault tolerance with no additional support. Finally, slipstream is implementable on multithreaded processors without fundamentally reorganizing their architecture. The project explores novel uses of single-chip multiprocessors and simultaneous multithreading processors.

**Control-Flow Processors**

* Eric Rotenberg  
* National Science Foundation  
* $175,000  
* 09/01/04 - 08/31/07

An architecture is presented that unifies fine-grain control-flow and data-flow dependences in the context of contemporary superscalar processors, preserving highly streamlined mechanisms of superscalar processors while endowing them with dataflow properties. Future independent instructions are fetched, executed, and locally finalized, their results propagated and corresponding resources freed, and their cumulative effects sustained regardless of prior unresolved branch mispredictions. Branch mispredictions no longer serialize execution, leaving exceptions and finite resources as the only remaining serializing constraints in the system. The proposed approach promises to overcome one of the remaining grand-challenge problems in scaling processor performance.

**Static-Power-Efficient Caches**

* Eric Rotenberg  
* Texas Instruments  
* $38,000  
* 05/16/06 - 08/15/07

There are three research thrusts: (1) Continue our research on static-power-efficient caches. (2) Begin exploratory research on logic-process embedded dynamic random access memory (DRAM) trends. (3) Apply our research on Retention-Aware Placement in DRAM (RAPID) to a real system, such as an ultra-low-power wireless sensor network node.

**The Phase Based Behavior of Objects: Enabling a New Generation of Microarchitecture**

* Eric Rotenberg  
* Semiconductor Research Corp.  
* $100,000  
* 04/01/07 - 03/31/08

Processor performance is no longer scaling well, due to technology issues and lack of a compelling theme to drive a new generation of microarchitecture innovation. While the multi-core theme is important, ordinary software cannot be accelerated by multiple cores in conventional ways. A new approach is proposed for significantly expanding the execution scope of the processor. The idea is to capture the influence of a running program’s objects on the program as a whole. As there are many objects, the approach works hand-in-hand with the deep computation and memory capacity of future multi-core substrates.


* Eric Rotenberg, Frank Mueller  
* National Science Foundation  
* $275,000  
* 08/15/03 - 07/31/07

We propose a radically new solution to the problem of building safe real-time systems from unsafe components. Our approach features a reconfigurable pipeline with two modes – a primary mode that is unsafe but energy-efficient and a backup mode that is safe but energy-inefficient. The dual-mode pipeline enables the unrestricted yet safe use of contemporary processors in real-time systems, resolving a long-standing problem in this domain.

**Development of Highly-Sensitive HgCdTe Detectors and Large-Format Focal Plane Arrays for Space-Based Imaging Applications in the 2-14 um Infrared Region and Beyond**

* Jan F. Schetzina, Mark A. Johnson  
* US Missile Defense Agency  
* $200,000  
* 09/30/05 - 09/29/08

The increased threat to the U.S. associated with international terrorism will require development of large numbers of sensitive detectors to protect against biological and chemical attacks. Enhanced photo detectors and digital imagers in ultraviolet, visible, and infrared are also needed for both tactical and strategic DoD and MDA applications. This project will employ new epitaxial growth methods for CdTe, along with CdZnTe, and CdSeTe lattice-matched to HgCdTe, in order to achieve the required reduction in HgCdTe device dislocations. This work also represents enabling technol-
A hyperspectral imager produces an image with a hundred or more spectral measurements at each pixel. A multispectral imager on the other hand may sample the spectrum in only three to ten bands. This work will show how to use the hyperspectral data to its fullest advantage to detect and classify a target, then, using that information, design a lower dimensional multispectral system that can perform the same task using fewer resources that can be implemented on a smaller platform.

**NetS-NBD: Measurement-Based Mobility Modeling for MANETs**

Mihail L. Sichitiu, Injong Rhee  
National Science Foundation  
$154,123  
08/15/06 - 07/31/07  

The goal of this project is to develop and evaluate a hybrid mobility model that is relatively easy to generate and, at the same time, produces realistic mobility traces, that in turn, result in meaningful simulation results for MANET simulations. The proposed model has the desirable characteristics that it is customizable to match any scenario (e.g., busses in a city, students in a campus, or zebras in a herd), while allowing the users to vary key parameters (number of nodes, density, etc.).

**OSPF Extensions for MANETs**

Mihail L. Sichitiu  
NCSU Center for Advanced Computing & Communication  
$80,000  
07/01/05 - 06/30/07  

During the past year, there has been significant effort and progress in IETF's workgroups toward improving OSPF's performance in mobile ad-hoc networks (MANETs). However, despite the progress in IETF and the previous CACC project, the current solutions are far from optimal. In this project we propose two improvements aimed at increasing OSPF's efficiency in MANETs. In particular we propose an adjacency formation algorithm and an area management scheme, expected to significantly increase OSPF's efficiency in MANETs. We will also consider the effects of multi-topology routing on the adjacency and area management algorithms.

**SGER-Predictable Mobile Ad-Hoc Networks**

Mihail L. Sichitiu  
National Science Foundation  
$50,000  
10/01/05 - 03/31/07  

In this project we propose a set of protocols that exploit the predictability of the node movements to improve the performance of MANETs (reliability, delay, capacity, etc.). The proposed protocols operate at media access control (MAC) and network (routing and forwarding) layers. The protocols are aimed at increasing the network scalability and reliability.

**On-the-fly Scene-dependent ATR**

Wesley E. Snyder, Siamak Khorram  
US Air Force-Office of Scientific Research (AFOSR)  
$110,000  
02/15/07 - 11/30/07  

A hyperspectral imager produces an image with a hundred or more spectral measurements at each pixel. A multispectral imager on the other hand may sample the spectrum in only three to ten bands. This work will show how to use the hyperspectral data to its fullest advantage to detect and classify a target, then, using that information, design a lower dimensional multispectral system that can perform the same task using fewer resources that can be implemented on a smaller platform.

**CAREER: Intelligently Managing the Memory Hierarchy of Future High Performance Servers**

Yan Solihin  
National Science Foundation  
$316,564  
03/01/04 - 02/29/08  

Continuing trends in chip integration will soon lead to on-Chip Massive Multi Processors (CMMP) for high-performance servers in the multi-billion transistor chip era. A unique feature of CMMP is that there will be a large number of threads, up to hundreds of them, simultaneously competing for shared resources such as caches and off-chip bandwidth. This presents unprecedented new challenges in designing the memory hierarchy of CMMP, such as inter-thread cache conflicts, off-chip bandwidth bottleneck, and costly context switches. To tackle the challenges, fine-grain thread-aware resource management of caches, off-chip bandwidth, and the main memory is proposed.

**Collaborative Research: General-Purpose Memory Tagging for Reliable, Secure, and Fast Computing**

Yan Solihin  
National Science Foundation  
$24,047  
09/01/06 - 08/31/09  

In a computer system, much of the power budget, execution time and hardware and software complexity is devoted to managing and maintaining memory-related meta-data. Advanced support for software reliability, security, and performance requires large amounts of memory-related meta-data. A general-purpose, customizable memory tagging mechanism and architecture can provide meta-data management and manipulation support that can be programmed to implement only the needed enhancements. The proposed mechanism will utilize an Processor in Memory (PIM) technology, where a simple processor is integrated in or near the memory chips, which runs software tag handlers that manage memory tags.

**Collaborative Research: Software and Hardware Support for Efficient Monitoring of Program Behavior**

Yan Solihin  
National Science Foundation  
$150,000  
09/01/06 - 08/31/09  

Today's software systems run on a number of platforms and environments and are increasingly dynamic in nature. It is becoming difficult to assess the performance of a software system without considering the context in which it will run. Therefore, the analysis of software behavior is shifting from a purely in-house activity to live runs analysis. This shift has spurred much interest in runtime monitoring. Unfortunately, existing approaches to runtime monitoring are ad-hoc and layer-specific. The goal of this research is to define a general approach to efficient runtime monitoring of software that leverages software and hardware capabilities synergistically.
Practical Lockfree Shared Data Structures:CACC Enhancement project

Yan Solihin
Tekelec
$65,046
11/01/05 - 12/31/06

“Lockfree” shared data structures can reduce contention between threads and processes for accessing shared data such as lists, maps, etc. The project is to survey the state-of-the-art, determine and extend the state-of-the-art as required, and design and/or implement practical implementations of the algorithms for Intel processors.

Providing and Maximizing Quality of Service in Utility Computing Servers

Yan Solihin
National Science Foundation
$319,925
09/01/04 - 08/31/07

This work proposes new run-time, operating system, and performance modeling techniques that enable Quality of Service (QoS) through providing performance guarantee and contention minimization for user jobs in future utility computing servers. Utility computing servers will likely simultaneously run many user jobs with varying performance guarantee requirements. Many important applications, such as transaction processing, weather prediction, and real-time applications, require execution time guarantee. In addition, trends in server architecture design suggest deep memory hierarchy where lower level memory hierarchy will be highly shared by a large number of processors. Guaranteeing performance as such is a new and serious challenge.

Electromagnetic Modeling Tools for Three Dimensional Integrated Circuits

Michael B. Steer, William R. Davis, Paul D. Franzon
Parametric Technology Corporation (PTC)
$1,400,000
07/05/04 - 04/12/08

The central aim of this proposal is development of a workflow that supports three dimensional integrated circuit (3DIC) design and, with minimal change, will support module design. Work will address partitioning of high performance functions among individual integrated circuits in the 3DIC stack, reuse of the existing integrated circuit design infrastructure, and the critical thermal environment in 3DICs. The project requires good thermal modeling and thermally-oriented design.

Mixed-Signal Interposer Design & Fabrication

Michael B. Steer, Angus I. Kingon, Jon-Paul Maria, Paul D. Franzon
Purdue University
$743,534
06/19/02 - 02/27/07

Integrated a technology set for mixed signal passive elements.

Multifunctional Adaptive Radio, Radar and Sensors

Michael B. Steer
US Army
$6,000,000
05/01/01 - 01/31/07

Advanced enabling technologies and system concepts are addresses that will lead to revolutionary innovations in multifunctional, adaptive radio, radar and sensors. Mid-range and long-range visions of advanced EM sensors are considered, and these are used to determine functional needs. Advanced RF architectural development and technology integration are explored.

Optimum Waveform Design for Electromagnetic Disruption and Probing of Remote Devices

Michael B. Steer
Army Research Office
$594,060
11/01/06 - 10/31/08

Waveforms will be designed to examine the characteristics of wireless devices. A wireless device consists of an antenna, frequency-dependent circuitry, and a nonlinear device. Identification is dependent on the ability to generate a large signal at the nonlinear device. Waveforms will be explored and validated that exploit radio frequency characteristics of antennas and circuitry.

Standoff Inverse Analysis and Manipulation of Electronic System

Michael B. Steer
Army Research Office
$2,525,639
07/01/05 - 01/31/08

We propose a program to probe, locate, and identify wireless electronic circuits using electromagnetic probing. We have crafted a program that will contribute to the required fundamental understanding of the phenomena involved through theoretical developments; and we will engage in experimental and modeling-based phenomenological investigations. In particular we will develop high power, wideband passive circuits will low passive intermodulation performance.

Ultra-Wideband Impulse Radio for Tactical Military Communications

J. K. Townsend
US Army
$219,000
08/20/03 - 08/19/07

The requirements of tactical communications have some important differences when compared to commercial radio and include coverytness, survivability, rapid deployment and low power in an ad-hoc, peer-to-peer environment. Some of the operational covert characteristics of SINGARS, for example, are implicit in UWB with added advantage of a very dynamic data throughput used for simultaneous voice and data. We propose to investigate ultra-wideband technology with emphasis on the tactical military mission. Our approach will be to leverage our existing experience in impulse radio. Our investigation will provide the theoretical and practical foundation for the potential of UWB in the tactical environment.

IMPATT-mode AlGaN/GaN mm-Wave HFETs

Robert J. Trew
SVT Associates
$65,000
10/03/06 - 10/02/07
This research is directed towards investigation of a novel IMPATT mode of operation of AlGaN/GaN high voltage HFET’s. Novel device structures are investigated using a physics-based large signal RF simulator and simulated results are compared to experimental data obtained from industrial collaborators. The simulator is used to provide design guidance, as well as to investigate physical operational details.

**Label-Free THz-Optoelectronic Sensing of Ultra-Low Concentration of Genetic Sequences: Theoretical Treatment**

Robert J. Trew, Carl T. Kelley, Peiji Zhao  
US Army  
$785,561  
08/01/04 - 01/31/09

The operation of bio-electronic devices is investigated for label-free THz optoelectronic sensing of single or a few DNA molecules. Issues investigated include: 1) THz photoconduction of the probe ssDNA, 2) Vibration spectra of probe ssDNA and hybridized dsDNA, 3). Simulation of the THz-photocurrent characteristics of the proposed device. A common feature of the biomolecular detection techniques is that known DNA molecules are used as the detector probes. Research on conductive characteristics of DNA molecules shows that single DNA molecules exhibit behaviors closely related to the sequence of the base pairs of the molecules, including metallic, semiconductor, and insulator behaviors.

**mm-Wave AlGaN/GaN HFET’s**

Robert J. Trew  
US Army  
$568,159  
06/09/03 - 06/08/07

We have discovered new phenomena in nitride devices that may result in the use of these devices as very high frequency (mm-wave to THz) sources. These new RF channel breakdown and transit-time phenomena introduce negative resistance behavior into the conducting channel, increasing the gain at high frequencies and permit gain at frequencies well above the normal cutoff frequency for the device. Also, our work has expanded to investigation of molecular electronics, with application at THz frequencies and we have established fundamental simulation capability that provides the basis to investigate the potential of the molecular devices for use at THz frequencies.

**Physics-Based Device Modeling**

Robert J. Trew  
Northrop Grumman  
$120,000  
05/20/05 - 02/01/08

Not required

**Proposal for Defense University Research Instrumentation Program**

Carl T. Kelley, Robert J. Trew  
Army Research Office  
$260,000  
05/01/06 - 04/30/07

This is a revised budget for an ARO proposal entitled “Proposal for Defense University Research Instrumentation Program.” We plan to purchase 53 dual-Xeon compute nodes with Myrinet interconnect for use in two ARO supported projects in nano-molecular electronics.

**SGER: Systems for Novel Energy Conversion**

Robert J. Trew  
National Science Foundation  
$58,964  
07/01/05 - 12/31/06

The proposed research is directed towards investigation of novel systems that can serve as sources of energy, analogous to photovoltaic solar cells systems. If successfully developed, these new devices could provide the basis to construct systems that would be used as energy sources for mobile and other equipment that traditionally operate on battery power. These systems would find widespread application throughout society and would be sources for low-cost electrical power since they would consume natural background thermal radiation as fuel.

**The Millimeter-Wave Initiative for Nitride Electronics**

Robert J. Trew  
Santa Barbara, University of California  
$129,167  
04/01/05 - 03/31/10

This investigation will make use of a series of advanced physics-based device models that have been previously developed. These models will be modified and enhanced with appropriate physical phenomena that will permit accurate simulation of realistic HFET device performance. The models will be used to determine optimized device designs for mm-wave operation. Physical effects to be investigated include channel charge transport models that properly account for interface scattering and velocity vector dispersion, space-charge and high current density effects in the source-gate region, channel current non-confinement effects, and breakdown and transit-time phenomena introduce negative resistance behavior into the conducting channel, increasing the gain at high frequencies and permit gain at frequencies well above the normal cutoff frequency for the device. Also, our work has expanded to investigation of molecular electronics, with application at THz frequencies and we have established fundamental simulation capability that provides the basis to investigate the potential of the molecular devices for use at THz frequencies.

**IP Triple and Quadruple Play Services: Modeling and Design**

Harry G. Perros, Ioannis Viniotis  
NCSU Center for Advanced Computing & Communication  
$40,000  
07/01/06 - 06/30/07

The “Triple” and “Quadruple play” are part of the cable and telecom industry’s strategy to offer new networking services. The dimensioning of such services (i.e., figuring out how many users are connected to an access concentrator, how many devices from a hierarchy level to aggregate to the next level) has a significant impact on the competitive pricing of the services. The objective of this project is to develop traffic models for evaluating the statistical multiplexing gains possible under the presence of the traffic mix dictated by such plays. Such models can aid network engineers in properly dimensioning networking gear.
CAREER: A Unified Study of Resilience-to-Failure in Multihop Wireless Networks

Wenye Wang
National Science Foundation
$80,000
03/01/06 - 02/28/07

Multihop wireless networks can offer a wide variety of important applications that could have a substantial impact throughout society as mobile devices become more and more critical to our day-to-day lives. However, the infrastructure of such networks is vulnerable to many types of network dynamics such as node mobility, potential attacks, and misbehavior. This research aims to develop models and algorithms for a deeper understanding of multihop networks when multiple failures are present.

Distributed Inter-System Authentication Mechanisms for Seamless Roaming in Multi-Network Environments

Wenye Wang
University of Florida
$163,178
10/01/03 - 09/30/06

Allowing users to roam seamlessly between multiple types of networks creates problems for network security. Current registration techniques assume a centralized authentication authority, which is not suitable for the distributed, multi-network environment, and also leaves the new authentication and security issues unresolved. This research addresses the problem of inter-system authentication in multi-network environments. Specifically, there are three issues to be investigated: design and architectural dimensioning of an inter-system authentication agent; design of a passport and visa mechanism to issue permissions (or service denials) to roaming users; and development of an inter-system registration protocol based on the passport/visa system.

Time and Data Sensitive Wireless Networked Control Systems

Wenye Wang, Mo-Yuen Chow
National Science Foundation
$239,967
09/01/05 - 08/31/08

The project focuses on the integration of networked control and wireless communication technologies for real-time, remote monitoring and control. This research plan concerns not only the development of data-sensitive control systems, it also studies the design of transport algorithms and computing models which play an important role in facilitating real-time control based on wireless sensing and networking. By integrating a middleware-based approach to compensate for random network delay, we will apply our solutions to time-sensitive, feedback control systems in a case study for motion tracking and control.

Magneto-Transports in Interband Resonant Tunneling Diodes (I-RTDs) and Dilute Magnetic Semiconductor (DMS) 1-RTDs

Peiji Zhao
Army Research Office
$84,899
05/01/07 - 04/30/08

This research seeks to develop multi-band models for understanding of basic transport physics of I-RTDs when subjected to magnetic fields and when composed of diluted magnetically-ordered type II superlattices. The objectives of this research are: (1) to calculate the resonant conduction-band current and interband Zener tunneling current; and (2) to study the nanoscale feedback dynamic processes arising from interband tunneling and its accompanied space charge accumulation. Therefore, these investigations will develop new models and execute simulations to analyze and engineer specific DMS device configurations suitable for a two-phase charging-discharging THz oscillator and explore other possible applications such as spintronics.

ELECTRICAL AND COMPUTER ENGINEERING FACULTY

S. Thomas Alexander, Associate Professor of Electrical and Computer Engineering (919-515-5127); PhD Electrical Engineering, NC State University, 1982. Adaptive signal processing and adaptive systems analysis, including the investigation of roundoff and finite precision arithmetic effects for adaptive algorithms; applications include echo cancellation for long distance, telephony and adaptive channel equalization for modern and multipath communications environments. [sta@eos.ncsu.edu]

Winser E. Alexander, Professor of Electrical and Computer Engineering (919-515-5190); PhD Electrical Engineering, University of New Mexico, 1974. Multidimensional digital signal processing and the development of concepts, algorithms, and special purpose computer architectures for digital signal and image processing; research has included the development of a special purpose architecture for the real-time implementation of spatial domain digital filters for image processing and the design of a single chip processor to implement this architecture. [winser@eos.ncsu.edu]

B. Jayant Baliga, Distinguished University Professor of Electrical and Computer Engineering; Director, Power Semiconductor Research Center (and Founding Director) (919-515-6169); PhD Electrical Engineering, Rensselaer Polytechnic Institute, 1974. Physics/modeling of semiconductor devices, semiconductor materials/processing technology, power semiconductor devices and power integrated circuits are at the center of Dr. Baliga’s research. [bjbaliga@eos.ncsu.edu]

Mesut E. Baran, Associate Professor of Electrical and Computer Engineering (919-515-5081); PhD Electrical and Computer Engineering, University of California, Berkeley, 1988. Application of computer control and system analysis techniques for analysis, planning, operation and control of electric power systems at generation, transmission and distribution levels. [baran@eos.ncsu.edu]

Douglas W. Barlag, Assistant Professor of Electrical and Computer Engineering (919-513-3018); PhD Electrical Engineering, University of Illinois-Urbana Champaign, 1997. His research concentrates on novel electronic device characterization and design that is focused on transistor amplifiers and sources for high power millimeter wave electronics. A secondary focus is the limits of low-power digital electronics. [dwbarlag@eos.ncsu.edu]
Salah M. Bedair, Professor of Electrical and Computer Engineering (919-515-5204); PhD Engineering Science, University of California, Berkeley, 1969 Semiconductor materials and devices, including new novel techniques such as atomic layer epitaxy, laser assisted deposition, MOCVD and MBE; devices such as superlattice optical sources, modulation doped field effect transistors, heterojunction bipolar transistors, solar cells and the integration of optical and microwave devices are in progress. [bedair@eos.ncsu.edu]

Subhashish Bhattacharya, Assistant Professor of Electrical and Computer Engineering (919-513-7972); PhD University of Wisconsin – Madison, 2003. Development of FACTS (Flexible AC Transmission Systems) controllers and power electronics converters, high power device characterization, Strategies for clean and reliable utility interface of “polluting” loads in electric distribution systems – such as active filters, Interface and control of renewable and distributed energy sources in electric power grid, System applications of emerging power semiconductor devices such as high voltage SiC based turn-off switches. [sbhattacharya@necs.edu]

Griff L. Bilbro, Professor of Electrical and Computer Engineering (919-515-5101); PhD University of Illinois at Urbana, 1977 Developing global optimization algorithms for communications and signal processing, modeling electron devices in silicon carbide and diamond, and implementing nonlinear algorithms in analog integrated circuits. [griff_bilbro@ncsu.edu]

Nivedita Biswas, Research Assistant Professor of Electrical and Computer Engineering (919-513-7364); PhD Stevens Institute of Technology, 2002. Research on Metal Gates for CMOS application and Interface Engineering for GaAs substrates for CMOS application. [nbiswas@eos.ncsu.edu]

James J. Brickley, Jr., Teaching Associate Professor and Associate Department Head, Electrical and Computer Engineering (919-515-5089); PhD Biomedical Engineering, University of Virginia, 1979 Distributed real-time control systems and microprocessor-based biomedical devices and systems. [jjb@eos.ncsu.edu]

Gregory T. Byrd, Associate Professor of Electrical and Computer Engineering (919-513-2508); PhD Electrical Engineering, Stanford University, 1998 Communication mechanisms for parallel computer systems. Other interests include computer architecture and high-performance network security. [gbyrd@eos.ncsu.edu]

Jim Chang, Research Professor of Electrical and Computer Engineering (919-515-7359); PhD Theoretical and Applied Mechanics, Cornell University, 1971. Research in the unlimited frontier of macro-, meso-, micro- and nano- mechanics and materials. [jchang@eos.ncsu.edu]

Mo-Yuen Chow, Professor of Electrical and Computer Engineering (919-515-7360); PhD Electrical Engineering, Cornell University, 1987 Current research projects related to the application of control, computational intelligence, and network technology to modeling fault diagnosis and control. [chow@eos.ncsu.edu]

Thomas M. Conte, Professor of Electrical and Computer Engineering, Director of the Center for Embedded Systems Research (919-515-5067); PhD Electrical Engineering, University of Illinois, Urbana-Champaign, 1992. Computer architecture, processor design, and compiler optimization, embedded computer systems are the focus of his research. [conte@eos.ncsu.edu]

Huaiyu Dai, Assistant Professor of Electrical and Computer Engineering (919-513-0299); PhD Electrical Engineering, Princeton University, 2002. Current research projects relate to communication systems and networks, advanced signal processing for digital communications, and communication and information theory. [huaiyu_dai@nsu.edu]

Rhett Davis, Assistant Professor of Electrical and Computer Engineering (919-515-5857); PhD Electrical Engineering, University of California at Berkeley, 2002. Dr. Davis’ research focuses on increasing productivity in VLSI design methodologies. His systems interests include signal-processing and protocols for wireless and wired networks. [rhett_davis@ncsu.edu]

Alexander G. Dean, Associate Professor of Electrical and Computer Engineering (919-513-4021); PhD Electrical Engineering, Carnegie Mellon University, 2000. Dean’s research centers on helping people design embedded systems efficiently using standard microprocessors and drawing on computer architecture, compilation methods and real-time systems. [agdean@eos.ncsu.edu]

Mihail Devetsikiotis, Professor of Electrical and Computer Engineering (919-515-5253); PhD Electrical Engineering, NC State University, 1993. Research interests are in the areas of high-speed networking modeling, performance evaluation and efficient simulation; and optimization techniques applied to the analysis and design of communication systems. [mdevets@eos.ncsu.edu]

Alexandra Duel-Hallen, Professor of Electrical and Computer Engineering (919-515-7352); PhD Electrical Engineering, Cornell University, 1987. Digital communication systems. Specific studies include detection methods for fading multipath channels and intersymbol interference channels; applications include cellular mobile radio, voiceband communications and magnetic recording. [sasha@eos.ncsu.edu]

William Edmonson, Associate Professor of Electrical and Computer Engineering (919-515-5151); PhD Electrical Engineering, North Carolina State University, 1990. Research area is global optimization and validation for adaptive, biological and signal processing systems and reconfigurable computing for small satellites and ground based vehicles. [wwedmons@ncsu.edu]

Michael J. Escuti, Assistant Professor of Electrical and Computer Engineering (919-513-7363); PhD in Electrical Engineering, Brown University, RI, 2002; Nanoelectronics and Photonics: current research projects lie in the diverse fields of liquid crystal displays, photons, biophotonics, organic electronics, and switchable diffractive optical elements. [mjscuti@ncsu.edu]

Do Young Eun, Assistant Professor of Electrical and Computer Engineering (919-513-7406); PhD Electrical Engineering, Purdue University, 2003. Dr. Eun’s research centers around telecommunication networks, performance analysis of large networked systems, queuing networks, and ad-hoc sensor networks. [dyeun@eos.ncsu.edu]

Paul D. Franzon, Professor of Electrical and Computer Engineering (919-515-7351); PhD Electrical Engineering, University of Adelaide, South Australia, 1989. Microelectronics system and circuit design; design methodologies and
CAD tools for high speed multichip modules, printed circuit boards and VLSI chips; design and application of Micro-Electro Mechanical Systems (MEMS, or ‘micromachines’). [paulf@ncsu.edu]

Kevin Gard, William J. Pratt Assistant Professor, Assistant Professor of Electrical and Computer Engineering (919-53-7366); PhD Electrical Engineering, University of California at San Diego, 2003. Dr. Gard’s areas of research include design of radio frequency integrated circuits (RFIC) for wireless communication systems, and the study of analysis techniques for modulated waveforms passed through nonlinear circuits. [kevin_gard@ncsu.edu]

Edward F. Gehringer, Associate Professor of Electrical and Computer Engineering and Computer Science (919-515-2066); PhD Computer Science, Purdue University, 1979. Object-oriented software systems, performance studies, architectural support for persistence and very large address spaces; parallel processing interests include supporting shared memory on distributed-memory machines. [efg@ncsu.edu]

Maysam Ghovanloo, Assistant Professor of Electrical and Computer Engineering (919-513-1923); PhD Electrical Engineering, University of Michigan, 2004; Analog, RF and Mixed Mode to include Analog Circuits, Digital Circuits, and VLSI are his primary research interests. Additionally, his interests include Computer Architecture and Systems including VLSI System Design / ASIC Design Methods. [mghovanloo@ncsu.edu]

Tildon H. Glisson, Professor Emeritus of Electrical and Computer Engineering (919-515-1666); PhD Electrical Engineering, Southern Methodist University, 1968. Monte-Carlo methods applied to high-field transport in materials and devices, self-consistent simulation of transport in devices, and signal processing and system simulation. [glisson@eos.ncsu.edu]

Alfred J. Goetze, Professor Emeritus of Electrical and Computer Engineering (919-515-7359); PhD Electrical Engineering, Duke University, 1967. Electromechanical energy conversion in electric power systems and computer control of SCR motor drives are at the center of Dr. Goetze’s research. [ajgoetze@eos.ncsu.edu]

Christal Gordon, Lecturer of Electrical and Computer Engineering (919-515-7347); MS Electrical Engineering, Georgia Institute of Technology, Atlanta, GA, 2000. Main research areas are bio-inspired circuits for emulating neuronal circuitry, bio-interfacing circuits for neuroprosthetics, and bio-inspired low power systems for use in consumer electronics. [cgordon@eos.ncsu.edu]

John J. Grainger, Professor of Electrical and Computer Engineering (919-515-5202); PhD Electrical Engineering, University of Wisconsin, 1968. Co-founder and President of the Electric Power Research Center (EPRI) led its program of research in planning, design, operation, and automation of electric power transmission and distribution systems. [jjag@eas.ncsu.edu]

Edward Grant, Professor of Electrical and Computer Engineering; Director of the Center for Robotics and Intelligent Machines of Electrical and Computer Engineering (919-515-7354); PhD Computer Science, University of Strathclyde, Glasgow, 1999. Knowledge based control systems working with robots and their systems. [egraft@eas.ncsu.edu]

Barton J. Greene, PE, Lecturer and Director of ECE Design Center, Electrical and Computer Engineering (919-515-8740); MS Electrical Engineering, Purdue University, 1985. Instruct students in product design and development methodologies and techniques. Mentor students in: systems design, analog circuit design, digital circuit design, microcontroller applications, power systems, wireless communications, electro-mechanical components, testing methods and software development. [bjgreen@eos.ncsu.edu]

John R. Hauser, Distinguished Professor of Electronic Devices and Materials and Professor of Electrical and Computer Engineering (515-7350); PhD Electrical Engineering, Duke University, 1964. Research centers on semiconductor material properties, the physics of semiconductor devices, fabrication of devices and integrated circuits and the measurement and characterization of semiconductor device and IC parameters. Recent research activities include (a) semiconductor device theory and modeling and (b) single-wafer, in-situ processing techniques and approaches for silicon integrated circuits. [hauser@eos.ncsu.edu]

William C. Holton, Visiting Research Professor of Electrical and Computer Engineering (919-515-5246); PhD Physics, University of Illinois, 1960. Quantum computing, charge transport phenomena in condensed matter (including magnet materials), mathematical methods, modeling and nuclear magnetic resonance. [holton@eos.ncsu.edu]

Alex Q. Huang, Alcoa Professor of Electrical and Computer Engineering (919-513-7387); PhD Cambridge University in the United Kingdom, 1992; Research Interests Include: Power Electronics and Power Systems including Power Semiconductor Devices, Power Systems Analog, RF and Mixed Mode including Analog Circuits. Other interests include Nanoelectronics and Photonics including Device Simulation and Modeling, III - V Materials and Devices, Silicon Devices and Fabrication. [aqhuang@ncsu.edu]

Brian L. Hughes, Professor of Electrical and Computer Engineering (919-513-1798); PhD Electrical Engineering, University of Maryland, 1985. Digital communication, information theory and coding, and statistical signal processing with applications to wireless data networks are Dr. Hughes’ research areas. Recent projects have focused on space-time coding and modulation for high-rate wireless communication, and channel modeling and signal detection in the presence of multi-user interference. [blhughes@eos.ncsu.edu]

Gerald J. Iafrate, Professor of Electrical and Computer Engineering (919-513-2310); PhD Physics, Polytechnic Institute of Brooklyn, 1970. His research focuses on Quantum transport in nanostructures such as resonant tunneling diodes and quantum dots and quantum dissipation with emphasis on ratchet-like transport phenomena and non-equilibrium processes in nanosystems. [gjiafrate@ncsu.edu]

Ilki Kim, Research Assistant Professor of Electrical and Computer Engineering (919-515-6174); PhD Physics, University of Stuttgart, Germany, 2000. His research focuses on quantum controllability of quantum networks and its relation to quantum computing, as well as research in understanding the underlying quantum principles of interacting atomic systems relevant to quantum information technology as they pertain to such forefront areas as quantum computation and error coding. Examines basic properties of nanometer components, studying the interaction of such components with dissipative material environments in order to discern the loss
of nanocomponent integrity and robustness with material scalability; which is central to the field of nanotechnology. [ikim4@eosc.ncsu.edu]

Ki Wook Kim, Professor of Electrical and Computer Engineering (919-515-5229); PhD Electrical Engineering, University of Illinois-Urbana, 1988. Semiconductor physics and modeling of electronic and optoelectronic devices, carrier transport in bulk and heterostructures, low dimensional effects, quantum transports theory, and Monte Carlo simulation. [kwk@eos.ncsu.edu]

Andrey A. Kiselev, Research Assistant Professor (919-515-5080); PhD Physics and Mathematics, A.F. Ioffe Physico-Technical Institute, St. Petersburg, Russia, 1994. Dr. Kiselev’s area of research is theory of photon, electron, phonon, and exciton states in low-dimensional systems; effects of stress, confinement and external fields, quantum beats; hopping, spin effects and spintronics, de-coherence and relaxation. [kiselev@eos.ncsu.edu]

Robert M. Kolbas, Professor of Electrical and Computer Engineering (919-515-7350); PhD Physics, University of Illinois, Urbana-Champaign, 1979. Optical properties of semiconductor materials and devices, semiconductor quantum well lasers and light emitters, wide bandgap semiconductors, femtosecond spectroscopy, molecular beam epitaxy, integrated optoelectronic circuits, and photonic materials and devices. [kolbas@eos.ncsu.edu]

Hamid H. Krim, Associate Professor of Electrical and Computer Engineering (919-513-2270); PhD Electrical Engineering, Northeastern University, 1991. Vision, information and signal theory, statistics/probability and mathematical modeling with applications to real world problems. [akh@eos.ncsu.edu]

Gianluca Lazzi, Professor of Electrical and Computer Engineering (919-513-3685); Dr. Eng. Electronic Engineering, University of Rome, 1994; PhD Electrical Engineering, University of Utah, 1998. His research areas are: Wireless communications, safety assessments for human exposure to electromagnetic fields, medical applications of electromagnetic energy and numerical techniques. [lazzi@eos.ncsu.edu]

Michael A. Littlejohn, Professor Emeritus of Electrical and Computer Engineering (828-251-6944); PhD Electrical Engineering, NC State University, 1967. III-V compound semiconductor materials and devices, hot electron transport in semiconductors, ultra-small device modeling and quantum transport, ion implantation and radiation damage in semiconductors, defects in semiconductors, thin films and oxide films on semiconductors, and integrated electronics. [mlittlejohn@unca.edu]

Xun Liu, Assistant Professor of Electrical and Computer Engineering (919-513-7076); PhD Electrical Engineering, University of Michigan-Ann Arbor, 2003. Research area is electronic design automation including timing optimization, power estimation and optimization for VLSI circuit and system designs. [xunliu@ncsu.edu]

Leda Lunardi, Professor of Electrical and Computer Engineering (919-513-7362); PhD Electrical Engineering, Cornell University, 1985. Area of expertise/research interests lie in devices for communication systems, nanofabrication, sensors and MEMS. [leda_lunardi@ncsu.edu]

Nino A. Masnari, Distinguished Professor of Electrical and Computer Engineering; Dean of the College of Engineering (919-515-2311); PhD Electrical Engineering, University of Michigan, 1964. Semiconductor materials and processing technology, high-speed devices, novel heterojunction devices, field effect transistors, magnetic sensors, and microwave electronics. [masnari@eos.ncsu.edu]

Thomas K. Miller III, Professor of Electrical and Computer Engineering; Vice Provost for Distance Education and Learning Technology Applications, NC State University (919-513-3358); PhD Biomedical Engineering and Mathematics, 1980; University of North Carolina at Chapel Hill. Microprocessor architectures, interactive multimedia network engineering education, technologies for distance education, and technology entrepreneurship. [tkm@ncsu.edu]

James W. Mink, Visiting Professor of Electrical and Computer Engineering (919-513-1803); PhD Electrical Engineering, University of Wisconsin, 1964. Microwave and millimeter wave devices and systems with his current interest focused upon fundamental understanding of quasi-optical techniques for power combining and system development. [jwm@eos.ncsu.edu]

Veena Misra, Professor of Electrical and Computer Engineering (919-515-7356); PhD Electrical Engineering, North Carolina State University, 1995. Solid State devices, sub-micron MOSFET scaling, CMOS process integration, advanced gate dielectrics, fabrication and characterization of thin films, chemical vapor deposition and high vacuum technology. [vmsra@eos.ncsu.edu]

John Muth, Associate Professor of Electrical and Computer Engineering (919-513-2982); PhD Physics, NC State University, 1998. Optical characterization of materials, fabrication of optoelectronic devices; developing optical communications and photonics courses with hands on laboratories are the focus of Dr. Muth’s research. [muth@unity.ncsu.edu]

H. Troy Nagle, Professor of Electrical and Computer Engineering, Department Head of the Bio-Medical Engineering Department (919-515-3578); PhD Electrical Engineering, Auburn University, 1968; Doctor of Medicine, University of Miami, 1981. Application of analog and digital electronics, design for testability, and microelectronics and micro fluidic fabrication technologies to the design and implementation of medical devices; specific areas of interest are medical instruments, implantable devices, microelectrode arrays and biosensors; application areas include interfacing to the central nervous system, prostheses, and sensors for genomics research. [nagle@eos.ncsu.edu]

Arne A. Nilsson, Professor of Electrical and Computer Engineering; Technical Director of the Center for Advanced Computing and Communications (919-515-5130); PhD Telecommunication Systems (Teknologisk Doktor), Lund University of Technology, Sweden, 1976. Routing and flow control in computer networks, performance modeling of local area networks, computer communication synthesis and analysis, performance modeling of computer systems, medical image networking, and packet radio architectures. [nilsson@eos.ncsu.edu]

J.B. O’Neal, Jr., Professor Emeritus of Electrical and Computer Engineering (919-515-5128); PhD Electrical Engineering, University of Florida, 1963. His research centers around communication theory and systems; encoding analog...
signals into digital form, data transmission over power lines, distribution line carrier systems, telecommunications and engineering education. [oneal@eos.ncsu.edu]

Carlton M. Osburn, Professor of Electrical and Computer Engineering and the Director of the Advanced Electronic Materials Processing Center (919-515-5153); PhD Electrical Engineering, Purdue University, 1970. Submicron silicon CMOS technology, including manufacturing technology studies, silicided shallow junctions, insulator reliability, process integration, lithography, reactive ion etching and interconnection metallurgy; microsensor technology and fabrication. [osburn@eos.ncsu.edu]

Hatice Ö. Öztürk, Teaching Associate Professor of Electrical and Computer Engineering (919-515-6328); PhD Electrical Engineering, NC State University, 1991. Gender and Science; Women in Engineering and Engineering Education are the topics of her research in the Women in Engineering Board of SUCCEED (Southeastern Universities and Colleges Coalition in Engineering Education); [hoo@eos.ncsu.edu]

Mehmet C. Öztürk, Professor of Electrical and Computer Engineering (919-515-5245); PhD Electrical and Computer Engineering, NC State University, 1988. Advanced process development for Si based microelectronics; emphasis on rapid thermal chemical vapor deposition of silicon epitaxial layers and metals for deep submicron transistors, and MOS drain and channel engineering with emphasis on ultra-clean low temperature single wafer manufacturing. [mco@eos.ncsu.edu]

Sarah A. Rajala, Professor of Electrical and Computer Engineering; Associate Dean, Research and Graduate Programs, College of Engineering (919-515-3939); PhD Electrical Engineering, Rice University, 1979. Analysis and processing of images and video with application to the areas of color imaging, image coding/compression, and motion estimation; further research includes developing new approaches for engineering education. [sar@eos.ncsu.edu]

Arnold Reisman, Professor Emeritus of Electrical and Computer Engineering (919-515-5156); PhD Physical Chemistry, The Polytechnic Institute of Brooklyn, 1958. Materials science and process technology of electronic materials; currently involved in examining process induced radiation damage phenomena, selective area chemical vapor deposition, plasma assisted oxidation, nitridization, and film deposition processes for controlled stress applications. [reisman@eos.ncsu.edu]

Donald Rhodes, Named Professor Emeritus of Electrical and Computer Engineering (919-515-5206); PhD in Electrical Engineering, Ohio State University, 1953. Antenna and propagation, spheroidal functions, and pulse synchronization processes are Dr. Rhode’s main areas of research.

Eric Rotenberg, Associate Professor of Electrical and Computer Engineering (919-513-2822); PhD Computer Science, University of Wisconsin-Madison, 1999. High-performance computer architecture with emphasis on new processor paradigms for exploiting instruction-level parallelism, advanced compilers and micro-architectures that effectively leverage the enormous transistor budgets of forthcoming chip technologies. [ericro@eos.ncsu.edu]

Suleyman Sair, Assistant Professor of Electrical and Computer Engineering (919-513-7386); PhD Electrical Engineering, University of California, San Diego, 2003. Dr. Sair’s research interests are in the broad area of computer architecture. His current research is on high performance, yet complexity effective processor and memory system designs. [ssair@eos.ncsu.edu]

Jan F. Schetzina, Professor of Electrical and Computer Engineering (919-515-5233); PhD Physics, Penn State University, 1969. His area of research lies in the development of optoelectronic materials and devices based on compound semiconductors. [jan_schetzina@ncsu.edu]

Mihail Sichitiu, Assistant Professor of Electrical and Computer Engineering (919-515-7348); PhD Electrical Engineering, University of Notre Dame, 2001. Adhoc networking and distributed sensor networks with a special interest in (QOS) routing, GPS-less localization, clock synchronization and mesh networks are the concentration for his research. [mlsichit@eos.ncsu.edu]

Robert E. Singleton, Research Professor of Electrical and Computer Engineering; PhD Engineering Sciences, California Institute of Technology, 1964. Basic research strategy planning and management; fluid mechanics and simulation methodologies; research proposal development and promotion; engineering sciences applications and technology transfer are Dr. Singleton’s areas of expertise.

Wesley E. Snyder, Professor and Associate Department Head of Electrical and Computer Engineering (919-515-5114); PhD Electrical Engineering, University of Illinois, 1975. Dr. Snyder’s research interests are machine vision, digital systems, pattern recognition and medical image processing. [wes@eos.ncsu.edu]

Yan Solihin, Assistant Professor of Electrical and Computer Engineering (919-513-2965); PhD Electrical Engineering, University of Illinois at Urbana-Champaign, 2002. Area of research focuses on reliable and high performance computer architecture. [solihin@eos.ncsu.edu]

Michael B. Steer, Professor of Electrical and Computer Engineering (919-515-5191); PhD Electrical Engineering, University of Queensland, Australia, 1983. RF and microwave system architecture; multifunctional adaptive RF circuits and systems; computer aided engineering and design of mixed-signal (RF/analog/digital) embedded systems; technology integration; signal integrity; computer aided design of nonlinear analog circuits, simulation of nonlinear circuits, simulation of nonlinear microwave circuits; microwave and millimeter-wave quasi-optical systems; and microwave and laser power transmission from space. [mbs@eos.ncsu.edu]

Cecilia Townsend, Lecturer and Undergraduate Coordinator, Electrical and Computer Engineering (919-515-5087); MS Electrical Engineering, University of Kansas, 1987. Teaching and advising undergraduate students; instructional topics include introductory level linear circuits, linear systems, and nonlinear devices. [cwrt@eos.ncsu.edu]

J. Keith Townsend, Professor of Electrical and Computer Engineering (919-515-7353); PhD Electrical Engineering, University of Kansas, 1988. Computer-aided modeling, analysis, and design of communications systems; communications theory, digital signal processing, and random signal theory are his areas of research. [jkt@eos.ncsu.edu]

Robert J. Trew, Department Head, Alton and Mildred Lancaster Professor of Electrical and Computer Engineering (919-515-7350); PhD Electrical Engineering, University of Michigan, 1975. Trew’s research focuses on solid state
microwave devices, circuits, and components; nanotechnology, microwave, mm-wave, and THz technology. [trew@ncsu.edu]

**H. Joel Trussell**, Director of Graduate Programs, Professor of Electrical and Computer Engineering (919-515-5126); PhD Electrical Engineering, University of New Mexico, 1976. Estimation theory, signal and image restoration and reconstruction, and new mathematical techniques applied to signal processing; specific applications include color measurement and reproduction, image restoration, point spread function determination and improved signal measurement. [hjt@eos.ncsu.edu]

**Ioannis Viniotis**, Associate Professor of Electrical and Computer Engineering (919-515-5148); PhD Electrical Engineering, University of Maryland, 1988. Analysis and control of high-speed communication networks, with special emphasis on quality of service control; areas of application include Broadband Integrated Services Digital Networks, sharing of computer resources, routing, flow control and channel access in communication networks. [candice@eos.ncsu.edu]

**Stephen J. Walsh**, Teaching Associate Professor of Electrical and Computer Engineering (919-513-4639); P.E., PhD Electrical Engineering, Duke University, 1994. Dr. Walsh’s focus is in ultra low power, clock-less, embedded DSP system architectures for use in portable and wearable embedded computing markets. [sjwalsh@eos.ncsu.edu]

**Wenye Wang**, Assistant Professor of Electrical and Computer Engineering (919-513-2549); PhD Electrical Engineering, Georgia Institute for Technology, 2002. Dr. Wang’s primary area of research is mobile computing, resource allocation, access control in single- and multi-hop wireless networks. [wwang@eos.ncsu.edu]

**Mark W. White**, Associate Professor of Electrical and Computer Engineering (919-515-7349); PhD Electrical Engineering, University of California, Berkeley, 1978. Non-linear adaptive signal processing algorithms that can be implemented using massively parallel architectures (e.g., neural networks); speech processing for cochlear implants and hearing aids; modeling and measurement of auditory responses to electrical stimulation, and related psycho-physical measurements and models of implant recipient performance. [mark_white@ncsu.edu ]

**John M. Wilson**, Research Assistant Professor of Electrical and Computer Engineering (919-513-7365); PhD, Electrical Engineering, North Carolina State University, 2003. Analog, RF and Mixed Mode including Analog Circuits, Digital Circuits, VLSI.

**Jimmie J. Wortman**, Professor Emeritus of Electrical and Computer Engineering (919-515-5255); PhD Electrical Engineering, Duke University, 1965. Solid-state semiconductor technology with emphasis on semiconductor devices. Development of processes and technology for fabricating advanced devices including chemical vapor deposition of semiconductors and insulators, rapid thermal processing and process measurement; device research on bipolar and CMOS transistors with an emphasis on ultra-small dimensions. [jjw@eos.ncsu.edu]

**D. Ginger Yu**, Teaching Associate Professor of Electrical and Computer Engineering (919-513-2653); PhD Electrical Engineering – Solid State, University of California-Santa Barbara, 1997. Semiconductor processing in clean room environment; establishing and evaluating processes for submicron and nanostructure devices. [dgyu@eos.ncsu.edu]

**Peiji Zhao**, Research Assistant Professor of Electrical and Computer Engineering (919-515-3984); PhD Condensed Matter Physics and Computational Physics, Stevens Institute of Technology, Hoboken, NJ, 2000. Research interests lie in nonequilibrium quantum transport in semiconductors and semiconductor hetero-structure systems; bio-molecular device (DNA) physics, computational molecular device physics; femtosecond optoelectronic device physics and optical and electric characteristics of semiconductor low-dimensional solid state systems. [pzhao@ncsu.edu]

---

**CONTACT INFORMATION**

For more information about the Department of Electrical and Computer Engineering at NC State University, visit the department’s website:

www.ece.ncsu.edu/

or contact the head of the department:

Dr. Robert J. Trew
Department of Electrical and Computer Engineering
Room 3098 Engineering Building II
Campus Box 7911
NC State University
Raleigh, NC 27695-7243
email: trew@ncsu.edu
phone: (919) 515-7350
fax: (919) 515-5523