DEPARTMENT OF ELECTRICAL ENGINEERING, 2006

PROGRESS THROUGH INNOVATIVE RESEARCH

University at Buffalo The State University of New York

Progress Perspective

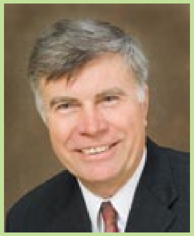
Progress and innovation are watchwords in UB's Department of Electrical Engineering (EE). The advances that are rapidly being made in a range of areas characterize the brilliant strides in research of a diverse faculty and student body.

EE has realized exceptional growth over the past year. Sponsored research expenditures increased more than 30 percent, journal publications are up 40 percent, PhD conferrals have advanced 40 percent, and the department faculty has increased in size and depth.

The pages of this booklet show an impressive body of work that is being achieved in the field of electrical engineering. UB EE is proud to be at the forefront of these advances.

A Department on the Rise

UB EE is evolving into a strong, interdisciplinary group of faculty who combine efforts in the areas of energy systems, nanoelectronics and nanophotonics, and communications and signal processing. They are developing solutions in intelligent sensing and regulatory systems that can enable monitoring and response at an unprecedented level.



The cumulative skills of talented faculty include the invention, fabrication, and characterization of novel nanoelectronic and nanophotonic devices, such as superconducting single-photon detectors, organic photonic devices, chemical detectors, and the development of components for high rep-rate, high-power, and pulsed-power applications. This broad experimental capability is supplemented by expertise in theoretical and numerical analysis and internationally recognized strength in communications and signal processing with sample highlights state-of-the-art short-data-record adaptive filtering procedures, optimal signature sets for code-division multiplexing, LDPC error correcting codes and decoding, and space-time coding for MIMO wireless communications.

During the past six years, EE has established an excellent reputation for collaboration with departments within the School of Engineering and Applied Sciences (SEAS) and other schools at UB. For example, EE faculty led a successful National Science Foundation Integrative Graduate Education and Research Traineeship (IGERT) in biophotonics that was funded in 2001. The IGERT program has continued to further enhance the multidisciplinary environment at UB by attracting excellent domestic students. These students have catalyzed the interdisciplinary activities at UB and the IGERT program has served as a model cross-disciplinary activity for UB.

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In the past two years, the department has hired five new faculty members, three of whom were hired via two grants from the New York State Office of Science, Technology and Academic Research (NYSTAR). The new faculty members are valuable additions to the area of nanoelectronics.

The department is an active participant in three of the strategic strengths outlined in the UB 2020 plan for the future. Strategic strengths are defined, in particular, as those multidisciplinary research and education areas that UB considers to be among its best opportunities for achieving significant academic prominence and recognition. The strategic strength in Integrated Nanostructured Systems (INS) is the one with the heaviest involvement of EE faculty. It is planned that the department will hire five faculty in the area of INS.

The substantial research activity of EE faculty is confirmed by the number of publications, by Masters and PhD students supported and graduated, and by the significant increase in research expenditures.

The research activity helps the department to improve undergraduate education. For example, EE established a new nanocharacterization laboratory for undergraduate students. This lab is equipped with three scanning tunneling microscopes and one atomic force microscope. This has developed into one of the best undergraduate labs in the country.

Each year, on average, 120 students obtain their BS degrees from EE.

We hope you find the UB EE information contained herein enlightening. More detailed information about the department can be found at www.ee.buffalo.edu/index.htm.

Vladimir Mitin
Chair, Department of Electrical Engineering

UB EE NEWS

New Faculty Members Enhance Department

Five new faculty members have significantly extended the depth of the department recently:

Jonathan Bird arrived as professor in fall 2004. His research is focused on the development of novel nanoelectronic devices that utilize quantum effects to achieve enhanced functionality. He received his doctorate in 1990 from the University of Sussex in the United Kingdom and has been a researcher at RIKEN (the Institute of Physical and Chemical Research), one of Japan's top national laboratories. Prior to arriving at UB, he had been an EE faculty member at Arizona State University. A fellow of the Institute of Physics, Bird has authored more than 150 peer-reviewed publications and coauthored the undergraduate text, *Electronic Materials and Devices*, (Academic Press, 2001). He is executive editor of *Journal of Physics: Condensed Matter*.

Aleksandr Verevkin joined as assistant professor in spring 2005, most recently having held a position as scientist at the University of Rochester. He holds a PhD in radiophysics from MSPU, Moscow, Russia. His research interests focus on the study and development of ultrafast superconductor and semiconductor single-photon detectors and their applications in nanophotonics and quantum information.

Weifeng Su became assistant professor here in March 2005. He received his PhD in electrical engineering from the University of Delaware in 2002. From June 2002 to February 2005, he was a postdoctoral research associate with the Institute for System Research at the University of Maryland, College Park. His research interests span a broad range of areas—from signal processing to wireless communications and networking, including space-time coding and modulation for MIMO wireless communications, MIMO-OFDM systems, and ultra-wideband (UWB) communications.

Kwang W. Oh arrived as assistant professor in March 2006. After receiving his PhD from the University of Cincinnati in 2001, he worked as a technical staff member in the bio lab at Samsung Advanced Institute of Technology, Korea. His main research activity in his SMALLab (nanobioSensors and MicroActuators Learning Laboratory) is hybrid nano- and microtechnology, including sample-to-answer nano/microfluidic system; nanobiosensors and microactuators; world-to-chip interfacing and packaging; and single cell manipulation, sorting, and detection.

Yong-Kyu Yoon joined as assistant professor in August 2006. He received his PhD in electrical and computer engineering from the Georgia Institute of Technology in 2004, where he continued as a postdoctoral fellow until July 2006.

His research interests include developing 3-D MEMS technology, RF passive components and millimeter-wave antennas, electronic and MEMS packaging, and ferroelectric material study and its RF/optical applications.

EE Faculty and Student Honored

Department Chair **Vladimir Mitin** received the Sustained Achievement Award as part of the UB Exceptional Scholar Program in May 2005 in recognition of his Outstanding Achievements in Scholarly Activity.

In 2006, **Wayne Anderson** was the recipient of the Sustained Achievement Award, while **Albert Titus** was honored with a Young Investigator Award, also from the UB Exceptional Scholar Program.

Graduate student **Geno James** received a Best Student Paper Award at the IEEE Western New York Image Processing Workshop, Rochester, New York, in September 2005, for the paper "Performance of Practical Wyner-Ziv Video Codec under Flat-Fading Rayleigh Channel."

NYSTAR Awards Received by Bird and Mitin

The New York State Office of Science, Technology and Academic Research (NYSTAR) granted two $750,000 awards to the department. A faculty development award was granted to recruit **Jonathan Bird** as a professor in Electrical Engineering. Department Chair **Vladimir Mitin** also received a $750,000 NYSTAR award to conduct multidisciplinary research designed to develop and commercialize multifunctional nanosensors and sensor networks.

Bird's research involves the fabrication of novel nanoelectronic structures and the characterization of their electrical characteristics. He has been well funded by the National Science Foundation, the U.S. Department of Energy, and the Office of Naval Research in areas that include nanostructures, quantum dots, and semiconductor structures. Bird is working closely with faculty from several departments on interdisciplinary research at centers including the Center for Spin Effects and Quantum Information in Nanostructures.

Russell W. Bessette, MD, executive director of NYSTAR, said: "This award is important to Buffalo because Jonathan Bird will enhance the research being performed at two separate research centers at UB while moving this world-class institution further along in terms of its ability to perform critically important research in nanotechnology."

Mitin's award recognized him as a world-class research faculty member. The goal of his research is to enhance health care, especially for remote applications; to improve detection of contaminants; and to boost advances in quantum communication. The research will be concentrated in UB's Center on Hybrid Nanodevices and Systems, which integrates scientific and technological achievements in nanomaterials and electronics, with fundamental engineering research in the fields of public health care, environmental monitoring, and communication.

Research Review

Significant research activity within electrical engineering was driven by numerous peer-reviewed publications and by the 67 graduate students who were supported by fellowships and assistantships.

About 54 papers were published in refereed journals; one book and three book chapters were published; 12 invited and 30 contributed presentations were delivered at conferences, two patents were obtained, and several patent applications from the EE faculty are in process. Faculty publications have been cited in more than 10,000 research papers.

Last year's total research expenditures in the department, reported by SEAS, were $3.6 million. The research expenditures continue to grow at a fast pace. In the previous years they were: $3.1 million, $2.4 million, and $1.3 million. The eight earlier years averaged $1.4 million.

This year the department faculty obtained 16 new grants for a total of $2,056,146. Large grants received in recent years include:

W. J. Sarjeant and **J. L. Zirnheld,** "Power and Energy Management for System of Systems Architecture," U.S. Army Armament Research, 6/3/2004–6/3/2006, $1,082,981.

A. N. Cartwright and **P. N. Prasad,** "Nanomedicine," John R. Oishei Foundation, 7/1/04–6/30/07, $925,000.

P. N. Prasad, A. N. Cartwright, with R. Raffaelle, RIT, "Novel Flexible Plastic-Based Solar Cells," Air Force Office of Scientific Research, 5/1/06–04/30/09, $450,000.

V. Mitin, "Mobile Health and Environment Monitoring Systems," NYSTAR, 3/1/06–2/29/08, $750,000.

J. Bird, NYSTAR Faculty Development Grant, 9/1/04–8/31/06, $750,000.

J. Bird, "Quantum Coherence and its Manipulation in Coupled Quantum Dots," Department of Energy, 9/15/04–9/14/07, $337,311.

A.G. Markelz , S. J. Allen, G. Aizin, **J. Bird,** and L.G. Mourokh, "NIRT: Nanostructure Components for Terahertz Spectroscopy on a Chip," National Science Foundation, 7/1/06–6/30/10, $1,589,117.

F.V. Bright, **A. N. Cartwright,** V. Govindaraju, W.L. Hicks Jr., **A. H. Titus,** "Program in Odor-Based Screening," John R. Oishei Foundation, 3/06–2/08, $400,000.

S. Batalama and **D. Pados,** "(TCATS) Signature Waveform Design, Interference Suppression, and Data Authentication for Wireless Sensor Networks," Air Force Office of Scientific Research, 5/1/04–4/30/09, $381,070.

Areas of Faculty Research

A diverse range of activities is supported by industry and a variety of federal sources, including the National Science Foundation, the Department of Energy, the Army Research Office, and the Air Force Office of Scientific Research.

Nanoelectronics and Nanophotonics

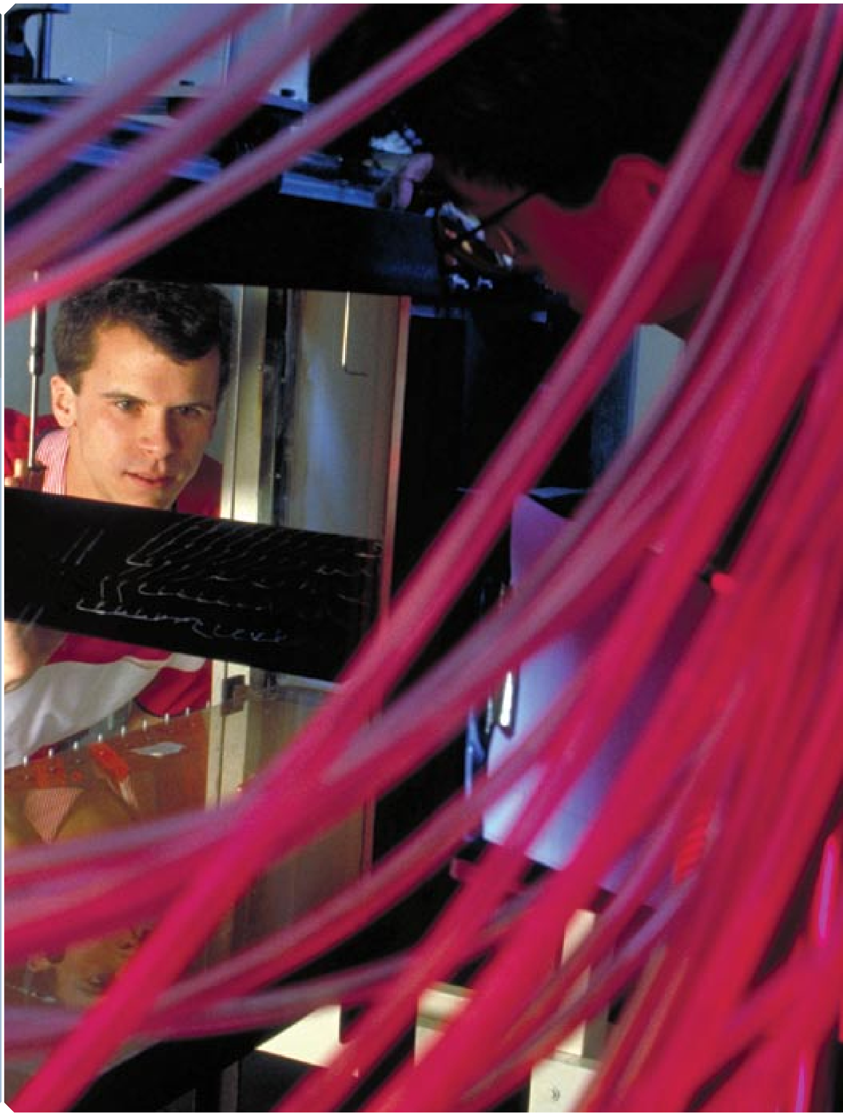
- Spin and electron-wave based approaches to quantum computing
- Nanomagnetoelectronics
- Solid-state THz spectroscopy
- Superconducting single-photon detection
- Synthesis and characterization of nanostructured semiconductors
- Modeling and simulation of carrier phenomena in nanoscale systems and devices
- CMOS sensors and analog circuits
- Nanoscale heat/energy transfer (nanophononics)

Communications

- Communications theory
- CDMA communications
- Cellular systems
- Multi-antenna communication systems
- Adaptive antenna array
- Coding and modulation techniques
- Estimation and detection
- Digital signal processing and video compression
- Radar and medical image processing
- Computationally efficient architectures and algorithms
- Wireless communications and networking
- Cooperative communications for wireless networks

Energy Systems

- Reliability and control of autonomous and/or supervised devices and systems, nano to mega scale size, that have been aged/stressed via a multitude of factors
- Investigation of electronic circuits, devices and systems for processing electrical power
- Interdisciplinary investigation of packaging power electronic circuits



All-Electrical Spin Readout and Its Effect on Quantum Computing

Quantum computing is an area of research that seeks to replace existing (classical) approaches to computing with new ones based on the foundations of quantum mechanics. Harnessing the unique features of quantum systems should allow for great improvements in computing speed, providing impact in such areas as secure communications, cryptography, and defense and homeland security.

Great effort in this area is currently being devoted to attempts to implement a scalable, solid-state based, quantum-mechanical bit, or qubit. In what is considered to be a particularly promising approach, the spin ("up" or "down") of the electron has been suggested as a convenient means to implement a qubit. While this idea is certainly attractive, it presents a number of critical challenges, perhaps the most demanding of which concerns developing approaches to "read out" (or detect) electron spin in an electrical measurement.

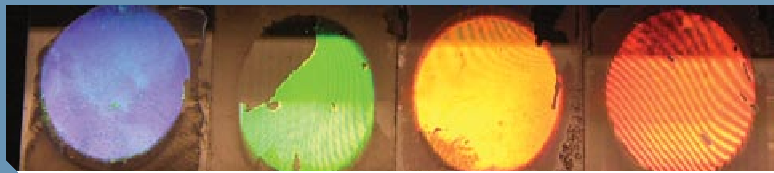
Jonathan Bird's group is currently addressing this problem, and has recently made significant progress in electrically detecting electron spins by trapping them in nanoscale semiconductor wires. It is hoped that this research, which is supported by the Department of Energy and NYSTAR, will ultimately contribute to the development of spin-based quantum computing.

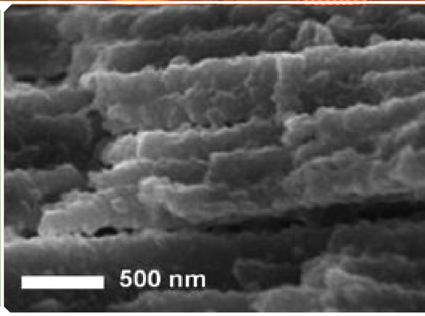
Porous Polymer Photonic Bandgap Structures for Sensing

Alexander Cartwright and Paras Prasad have recently pioneered a new method to produce highly reflective porous polymer photonic bandgap structures using holographic laser interferometry. In this work, photopolymerization is exploited to form high-contrast polymeric reflection gratings, whose precise periodicity (and reflectivity characteristics) is determined by the interference of two coherent laser beams. The strong reflection generated by these gratings is easily observable by eye in ambient light (see figure) and is a consequence of the periodic structure of the cross-linked polymer, as well as of the presence of nanoscale voids that form during subsequent processing.

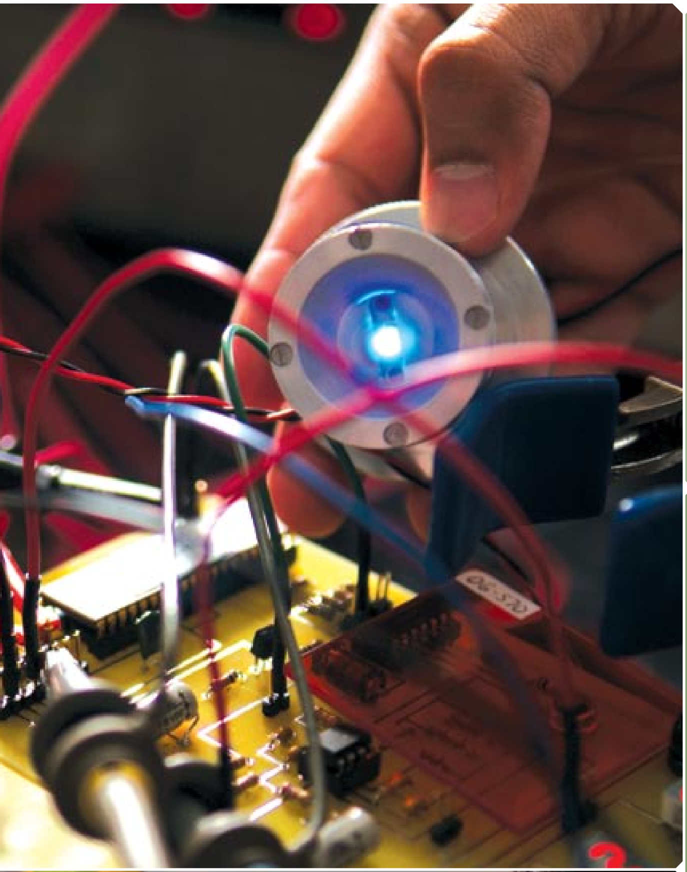
In other work, Cartwright and Prasad have shown how chemical modification can be used to vary this nanoscale porous structure, thereby allowing for the creation of a variety of functional porous periodic polymeric structures. It is hoped that these polymeric structures will ultimately provide a new broad platform for the development of a variety of low-cost (chemical, thermal, pressure, strain, etc.) sensors.

This work is the result of an active collaboration between UB and Wright Patterson Air Force Base in Dayton, Ohio, and was funded under the Air Force Defense University Research Initiative on Nanotechnology focusing on polymeric nanophotonics and nanoelectronics. The work has been reported in *Applied Physics Letters*, *Advanced Materials*, *IEEE Sensors Journal*, and was featured in the June 2005 issue of the *Photonics Spectra* magazine.





The **right** figure shows a scanning-electron microscope image of one of the polymeric nanoscale grating structures fabricated by Cartwright and Prasad. The **top** figure shows the reflection observed from grating samples with different grating spacing.



Superconducting Single-Photon and Photon Number-Resolved Counters

The research of Aleksandr Verevkin focuses in part on the development of state-of-the-art superconducting single-photon counters, suitable for use in photon number-resolved mode with timing resolution in the picosecond range. These detectors can be easily coupled with standard fiber-optical cable and, with proper readout electronics, function as a single-photon counter with negligibly low dark counts and extremely fast response.

Such detectors are urgently needed for ultrafast and long-distance optical communications, remote sensing, biophotonics, and quantum information processing.

Artificial Visual Systems on Silicon CMOS

Vision is a broad area of research that spans many disciplines, including electrical engineering. Research in Albert Titus's group focuses on studying the visual systems (eyes) of animals and creating artificial visual systems on silicon CMOS integrated circuits (similar to computer chips found in almost every electronic device). One example of this is a system that can determine relative depth (distance) of objects based on their motion.

Using biologically inspired principles, they are able to show that by accelerating the viewer (the velocity sensor chip), all ambiguity about the relative depths of objects can be removed. By using CMOS chips to perform these functions, the resulting system can be low power, low cost, and very small – characteristics that make these ideal for autonomous robots exploring distant planets.

Other work in Titus's group is focused on developing a range of sensor systems that can measure oxygen concentrations, pH, and changes in glucose levels. Through multidisciplinary research, they are able to address all of the issues in the design of such sensors. As an example, Titus has combined custom-designed integrated circuits (chips) that can detect light and process data with chemical sensor elements that emit light. These chemical sensors emit selectively to different concentrations of the chemical being sensed. The combination of these technologies can lead to low-power, low-cost, portable sensor systems.

III Pictured **above** is a CMOS chip, developed in Albert Titus's group **(below),** that can be used to determine the velocity of a moving object.

Novel Coding Technique for MIMO Wireless Systems

As new emerging broadband applications demand reliable wireless communication at higher and higher data rates, new transmission and reception technologies need to be developed to meet this demand. Evolving wireless standards, such as the mobile WiMax (IEEE 802.16e), WLAN, and IEEE 802.11n standard, are likely to employ multiple transmit and receive antennas with OFDM modulation for increased spectral efficiency. Consequently, the development of coding methods and signal processing techniques that can fully exploit the potential of multi-antenna OFDM systems will make a serious impact on the direction.

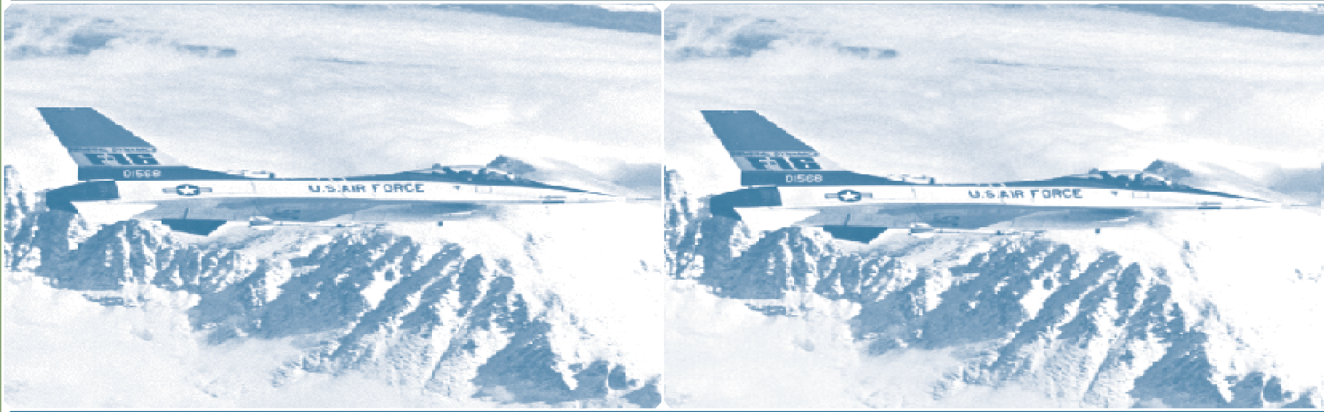
Weifeng Su's group has invented a space-frequency code design method for MIMO-OFDM systems that can guarantee reliable data transmissions at high data rates in broadband wireless communications. This is the first coding scheme to guarantee both full rate and full diversity in such communications. Reported in the July 2005 issue of *IEEE Transactions on Wireless Communications,* this technology has potential applications in the design of the next generation of broadband wireless communication systems.

Optimal Signature Design for Spread-Spectrum Steganography

Dimitrios Pados and Stella Batalama have recently developed a new method to redefine state of the art of transform-domain spread-spectrum steganographic technology via signature design optimization.

In this work, host adaptive signatures were embedded in linearly processed host data in which adaptive signatures were designed to maximize embedding capacity and minimize host distortion. The proposed signature design can guarantee maximum signal-to-interference plus noise ratio (SINR) message recovery and minimum bit error rate (BER) message recovery.

This work results from an active collaboration with Michael Medley at Air Force Research Laboratory, Rome, New York.



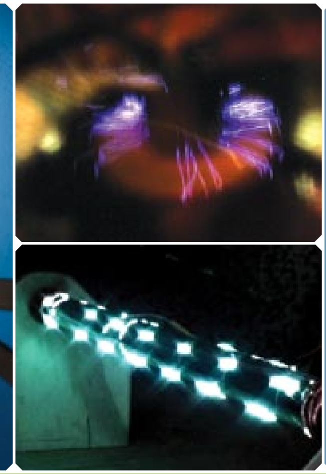
Left Original 512x512 host image. **Right** Host with 4kbit hidden message and white Gaussian noise (proposed signature embedding in 8x8 block-DCT linearly processed data, sig. length 63, distortion 20dB, noise variance 3dB).

Short-Data-Record Adaptive Filtering

It is challenging to design adaptive receivers based on limited data records. Recently, Stella Batalama and Dimitrios Pados proposed a novel design algorithm—the auxiliary-vector (AV)—which is able to generate a sequence of linear filters/receivers based on a short data record.

The obtained AV filters have several favorable properties: 1) the algorithm involves only computationally simple recursions (no matrix inversion and decomposition); 2) the sequence of filters reliably converges to the minimum-mean square error solution; and 3) the proposed data-record-based criteria allow the selection of an AV estimator according to appropriate output variance rules.

This algorithm may find significant applications in high-dimension adaptive signal processing with data records of limited size. It has been applied to design adaptive robust receivers for multi-user wireless communications with rapidly changing communication environments. The main results have been published in *IEEE Transactions on Communications* and *IEEE Transactions on Signal Processing.*



The **top** image shows uncontrolled, nonuniform surface flashover that indicates the electrical failure of an electrical component. In the **bottom** image, controlled, uniform flashover is used to initiate the next stage in a given process.

High-Voltage Engineering Focus in Energy Systems Research

The Energy Systems Institute (ESI) is led by Jim Sarjeant, James Clerk Maxwell General Dynamics Chair Professor in Energy Systems, and focuses on high-voltage engineering, pulsed power conditioning, insulation coordination, and more recently, research on energy systems ranging from milliwatts to multi-megawatts. His team addresses the effect that aging has on a wide spectrum of electronic components and subsystems in real-world environments.

The ESI is currently working on the development of an ultra-low electrical energy plasma initiation source for pulsed power applications. By precisely controlling the quantity and location of the energy discharge, a novel, more efficient electrostatic discharge (ESD) resistant initiation mechanism can be produced. The benefits of this technology include the preservation of human life and conservation of the environment.

With the advancement of pulsed power components and applications, the need for higher voltage standoff has increased immensely. Sarjeant and his team are working with local industry to understand flashover generation and inhibition for complex insulation structures and environments by treating existing insulating substrates to try and enhance their insulation properties. One of the benefits of this research is increased miniaturization of both military and consumer electronics. Several department faculty are involved in the efforts of the ESI, including Jennifer Zirnheld, deputy director, and Mohammed Safiuddin and Douglas Hopkins.

UB EE RESEARCH HIGHLIGHTS

Effective Thermal Control in Nanodevices and Nanomaterials

Rapid improvements in the synthesis and processing of novel materials with structure on nanometer-length scales have created a demand for nanomaterials and nanodevices with controllable kinetics of electrons and phonons. In a series of high-level publications, Andrei Sergeev and Vladimir Mitin have shown that the consistent quantum description of the electron-phonon energy transfer and transport phenomena should comprehensively consider the interference phenomena and take into account electron screening specific for nanostructures.

The electron-phonon kinetics is investigated in 0-D Arrays (quantum dots, nanofluids); Quasi-1D and 1D-Multi-Channel Structures (carbon multi-walled nanotubes; metallic, superconducting and semiconducting nanowires; metallic clusters; organic conductors), and 2D-structures (heterostructures, ultrathin metallic films). The quantum kinetics developed is based on the Feynman-Keldysh diagrammatic technique.

By providing the needed fundamental and technological bases, this research program develops effective ways to control the electron-phonon energy transfer, which, in turn, gives a strong impact to the development of advanced nanodevices, such as energy converters, transducers, refrigerators, calorimeters, detectors, and counters of single quanta.

UB EE PROGRAMS

Undergraduate Program

The EE undergraduate program provides the scope of knowledge and training for employment in the field and also forms the basis for further study at the graduate level. The curriculum emphasizes the fields of electronics and information engineering.

UB's undergraduate program leads to the bachelor of science in electrical engineering (BS) degree. The BS program is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET). In addition, the combined degree for the bachelor of science in electrical engineering and master of business administration can be obtained by the students. The total number of undergraduate students is about 450.

The first two years of undergraduate curriculum emphasize physical sciences and mathematics. In the third year, the emphasis is on physical electronics, electronic circuits, electromagnetic theory, applied mathematics, and the design of analog and digital circuits. Up to this point, the technical content consists of required courses. The fourth year is largely elective and is devoted to broadening the background, reinforcing lab skills, and studying design concepts. By choosing technical electives, students may concentrate in physical electronics, circuits, signal processing, or related studies. Students with computer engineering interests may concentrate on the design of computers and their interface devices and networks through courses available in the Department of Computer Science and Engineering.

Special undergraduate degree programs are offered under electrical engineering auspices in cooperation with the Department of Computer Science and Engineering, the Department of Mathematics, and the Department of Physics.

Companies that have hired our graduates include Cisco, Hewlett Packard, Intel, AMD, IBM, Ford, General Electric, General Motors, Lockheed Martin, Lucent Technologies, Moog, Micron, Motorola, Nokia, Qualcomm, Rockwell, Sun Microsystems, and Texas Instruments. Our alumni also have established companies, such as Atto Technology and MTI, and have joined the faculty in many universities.

Graduate Program

We are a highly interdisciplinary department. We build on a solid foundation of physical sciences, a broad knowledge of engineering techniques, and an understanding of how technologies can help us to shape the future. Our primary mission is to educate students at all levels. We offer the breadth of education and depth of training necessary to make our graduates successful in their professional careers. Our faculty engages in a long-standing tradition of excellent teaching, innovative research, and valuable public service activities; our department staff is devoted to helping students succeed.

Our research programs are diversified and receive long-term support from the university, the State of New York, federal agencies, and industry. The total number of graduate students is about 230. We currently have 24 full-time faculty members. We offer MS, MEng, and PhD programs with specialization and research in communications and signal processing; microelectronics, photonics, and materials; and energy systems.

The department conferred 10 PhD degrees, 78 MS degrees, seven MEng degrees, and 108 BS degrees during the 2004–05 academic year.

UB EE FACULTY

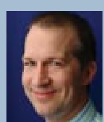
Wayne A. Anderson, Professor

Research: Semiconductors, Thin films, Photovoltaics and thin film transistors, Defect spectroscopy

Stella N. Batalama, Associate Professor

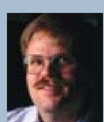
Research: Wireless communications, Detection and estimation, Adaptive signal processing

Jonathan P. Bird, Professor



Research: Nanoelectronics, Nanomaterials characterization

Alexander N. Cartwright, Professor



Research: Semiconductor quantum dots, Hybrid inorganic/organic materials and devices, Biological and chemical sensors, Nanophotonics and nanoelectronics

Ping-Chin Cheng, Professor

Research: Confocal microscopy, Biomedical imaging, X-ray microscopy, Microtomography, Lithography

Kasra Etemadi, Associate Professor

Research: Arc technology, Plasma chemistry, Emission spectroscopy

Adly T. Fam, Professor

Research: Systems theory, Digital signal processing, Digital control

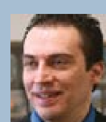
Donald D. Givone, Professor

Research: Switching circuit theory, Automata theory, Digital systems

Raj K. Kaul, Professor

Research: Fractal phenomena, Wave propagation in periodic structures and wavelets, Elasticity and piezoelectricity

Lisimachos Paul Kondi, Assistant Professor



Research: Multimedia communications and signal processing, Image and video compression, Wireless communications, Image restoration and super-resolution

Pao-Lo Liu, Professor

Research: Computational photonics, Photonic band gap materials and devices, Quantum information processing

Vladimir Mitin, Professor and Chair

Research: Nanoelectronic, Microelectronic and optoelectronic devices and materials, Nanophononics, Photodetectors, Terahertz generators and detectors

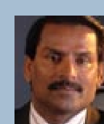
Kwang W. Oh, Assistant Professor

Research: BioMEMS, Lab-on-a-chip, Microfluidics, Nanobiosensors, Microactuators, World-to-chip interfacing and packaging, Single cell manipulation

Dimitrios A. Pados, Associate Professor

Research: Communication theory and systems, Coding and sequences, Adaptive signal processing

Paras N. Prasad, Professor



Research: Nonlinear optics, Nanophotonics, Biophotonics

W. J. Sarjeant, James Clerk Maxwell General Dynamics Chair Professor

Research: Aging in complex insulation systems, Power conditioning and generation, High power electronics, Mobile and mobility power

David T. Shaw, Professor

Research: Carbon nanotubes, High temperature superconductivity, Thin films, Plasma dynamics, Aerosol mechanics

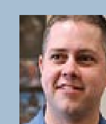
Mehrdad Soumekh, Professor

Research: Signal and image processing, Medical and radar imaging, Inverse scattering

Weifeng Su, Assistant Professor

Research: Wireless communications and networking, MIMO systems and space-time coding, Cooperative communications for wireless networks

Albert H. Titus, Assistant Professor



Research: Analog VLSI design, Neural networks, Electronic routing and packaging design, Electron beam lithography, Sensors, Optoelectronics

Aleksandr Verevkin, Assistant Professor

Research: Superconductor and semiconductor single-photon detectors, Quantum cryptography, Ultrafast magnetooptics

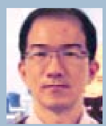
James J. Whalen, Professor

Research: Electromagnetic compatibility, Microwaves, Semiconductor electronics

Chu R. Wie, Professor

Research: Semiconductor devices, radiation effect, X-ray analysis of semiconductor materials, Semiconductor nanodevice visual simulation

Yong-Kyu Yoon, Assistant Professor



Research: 3-D MEMS technology, RF passive components and millimeter-wave antennas, Electronic and MEMS packaging, Temperature sensors, Bio/microfluidic systems for the lab-on-a-chip

Adjunct, Emeritus, Part-Time and Research Faculty

Cemal Basaran
Adjunct Professor

Venugopal Govindaraju
Adjunct Professor

Wilson Greatbatch
Research Professor

Douglas C. Hopkins
Research Associate Professor

Venkat Krovi
Adjunct Assistant Professor

Andrea Markelz
Adjunct Associate Professor

Bruce McCombe
Adjunct Professor

Russ Miller
Adjunct Professor

Chunming Qiao
Adjunct Professor

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