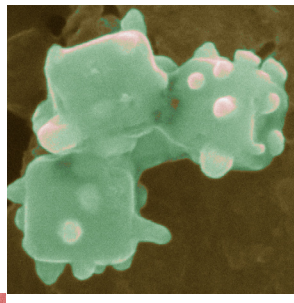
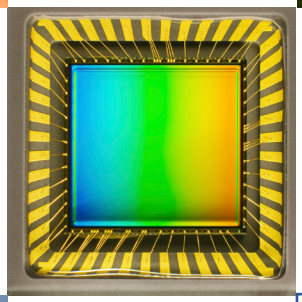
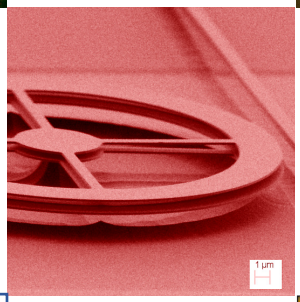
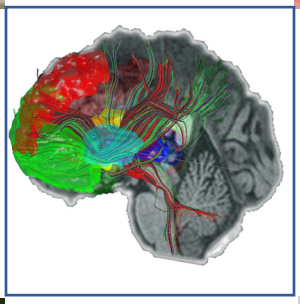
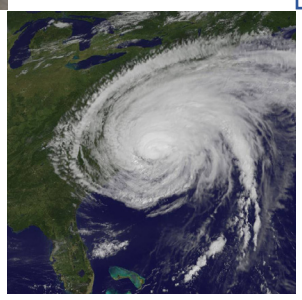
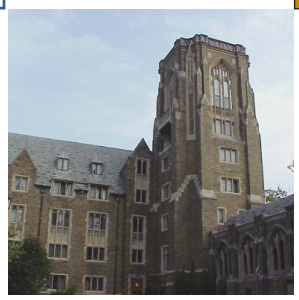
Center for Emerging & Innovative Sciences

Annual Report 2010-2011





Photograph Credits

Image of Hurricane Irene taken by one of ITT Geospatial Systems' cameras supplied to the NASA/NOAA GEOS project, courtesy of Robert Fiete, Chief Technologist – ITT Geospatial Systems

Silicon Nitride for Integrated Photonics; Principal Investigator Michal Lipson; Users Alexander Gondarenko and Gustavo Wiederhecker; Figure, Suspended silicon nitride double ring cavity coupled to a waveguide. Research performed at the Cornell NanoScale Science & Technology Facility (CNF).

Scanning Electron Microscope image of silver halide particles (original magnification=170KX) Brian McIntyre-URnano

Results from tractography based on diffusion tensor imaging (DTI), which illustrate connections between the deep neuronal structures and cortical areas that are involved in selecting, manipulating, and monitoring of information (dorsolateral frontal cortex, DLFC), and that are playing a role in making analytical judgment (lateral orbitofrontal cortex, LOFC). These connections were found to be compromised in patients with Parkinson's disease. Tong Zhu and Jianhui Zhong, URMC Department of Imaging Sciences

Managing Editors

Cathy Adams, Kristine Long

Production Assistant

Alyssa Smudzin

Annual Report 2010-2011

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Director's Message

The past year has been one of continued evolution at CEIS with the naming of a new Director and Associate Director. We are fortunate to have Cathy Adams, our Center Business Manager and Kristine Long, the Center's Administrative Assistant, as well as our student Office Assistants whose dedication and expertise has kept the business of the Center running smoothly during this busy transition year.

The mission of CEIS – to generate economic growth through technology transfer – has never been more important to the Finger Lakes region and the state as a whole. Large corporations continue to cut back on internal R&D as global competition erodes profits. As a result, industry is increasingly looking toward academia as a source of innovation. At the same time, more federal funding agencies are requiring universities to include industrial participation in research they fund, as the economy dominates budget discussions in Washington. Industry - university collaboration is now becoming essential.

As is the custom each year this annual report contains a summary of some of our accomplishments in the past year, a listing of our Industry Partners and a directory of Center Principal Investigators describing their research and technology interests. We are pleased to report this year that the economic impact of CEIS is once again on the rise. Our documented economic impact in the past year is up nearly 70% from the previous year - to $35 million including the creation or retention of 68 jobs in the region. We hope to continue this trend as new Center initiatives begin to have an impact.

A continuing Center priority is to encourage new projects and partnerships. One way to do this is our new STAR (Short Term Applied Research) program for which proposals are accepted at any time throughout the year. STAR awards provide 1:1 matching funds up to $5000 for collaborative projects with either a Science & Technology or Business Development focus. Projects may be proposed either by faculty members or directly by companies; in the latter case we will work with the company to identify a University collaborator. We are very grateful to Dr. William McKenna, our Center Business Innovation Consultant, for his work in creating the STAR program. We are also doing more to encourage industry – university collaboration by holding industrial seminars and panel discussions on campus and expanding the scope of our annual technology showcase to include non-CEIS sponsored research.

In closing we would like to thank the staff at NYSTAR and all of our industry partners and university PIs for making the past year successful and all of us at CEIS look forward to even greater accomplishments in the coming year.

Mark F. Bocko, Director

Paul Ballentine, Associate Director

Economic Impact—from CEIS Innovations

Since its inception, CEIS has continually strived to develop industrial relationships and fund collaborative research projects that maximize the return on the State's investments. In the past five years, CEIS has had a steady track record of providing economic impact to New York State. Successful technology transfer by CEIS has made a record total impact on the regional economy of nearly $405 million—increased jobs, growing revenue, cost savings, acquired funding, and capital improvements.

Despite the unsteady 2010-2011 economy, CEIS managed to achieve an annual economic impact of $35 million. We helped to create 25.5 new jobs and retain 42 jobs in New York State as a direct result of CEIS projects. In 2010-2011, CEIS partnered with 34 companies in New York State, of which 22 reported they have already seen a positive economic impact. Over half of those companies reporting an economic impact this year were small companies, reflecting the larger macroeconomic trend of smaller companies providing much of the country's economic growth. Within the participating universities 40 students were supported by CEIS.

The dynamic interplay of our research investigators' expertise with the technology needs of CEIS industry partners continues to be at the heart of our ongoing success. We will continue to confront economic challenges with highly productive, mutually beneficial solutions that result in innovative new electronics, bio-imaging, and nano technologies. From remote-piloted military drones to medical devices and flat panel displays, our PIs and industry partners are at the forefront of technologies that make our lives safer, healthier, and more entertaining.

Most recent NYSTAR-verified Economic Impact

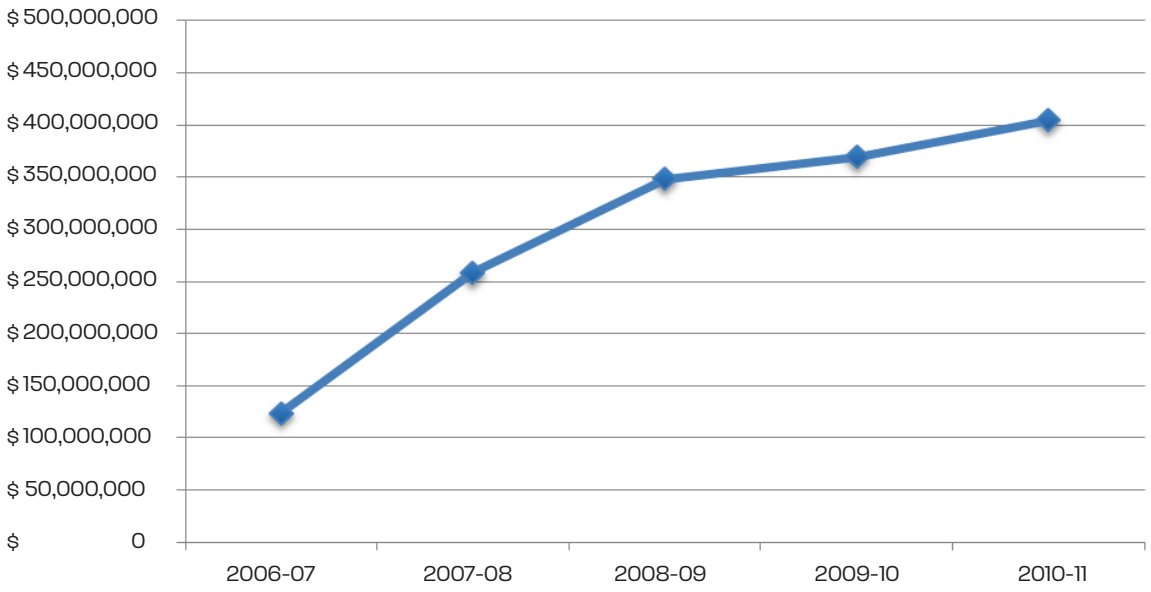
Year	'06-'07	'07-'08	'08-'09	'09-'10	'10-'11	Total
Increased Revenues	$104,756,800	$ 107,723,300	$ 56,224,541	$ 7,244,229	$ 9,287,081	$ 285,235,951
Cost Savings	$ 10,533,460	$ 9,543,230	$ 7,891,280	$ 5,933,200	$ 3,842,000	$ 37,743,170
Funds Acquired	$ 7,002,500	$ 12,822,500	$ 4,752,700	$ 4,260,000	$ 11,801,946	$ 40,639,646
Capital Improvements	$ 415,000	$ 94,000	$ 18,682,720	$ 518,235	$ 5,591,664	$ 25,301,619
Job Value	$ 1,201,739	$ 4,352,632	$ 2,551,074	$ 3,022,380	$ 4,559,006	$ 15,686,831
New Jobs	14.7	35	20.5	22.5	25.5	118.2
Retained Jobs	4.5	37	17	20.5	42.3	121.3
Total Impact	$123,909,499	$ 134,535,662	$ 90,102,315	$20,978,044	$ 35,081,697	$404,607,217
Total Cumulative Impact	$123,909,499	$ 258,445,161	$348,547,476	$369,525,520	$ 404,607,217	$404,607,217

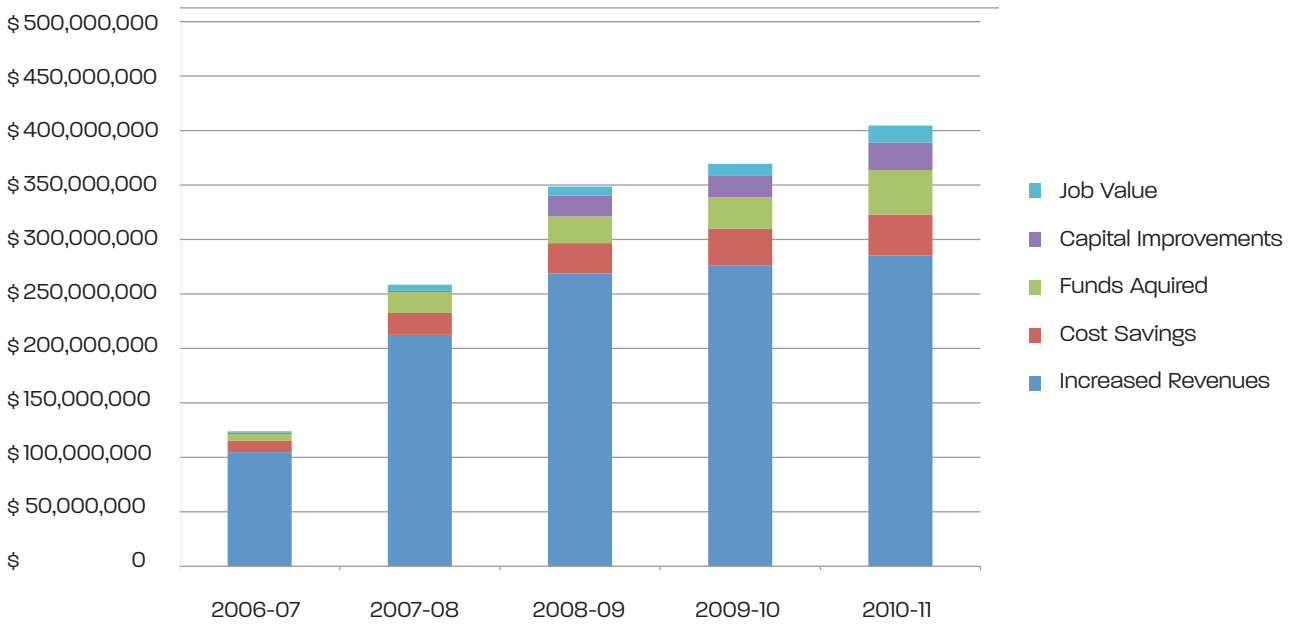
NYSTAR evaluates the economic impact of its CAT program in terms of increased jobs, retained jobs, capital improvements, growing revenues, cost savings, more funding and capital improvements.

Companies Reporting Economic Impact in 2010-2011 from CEIS Interactions

Adarza BioSystems, Inc.
Advanced Acoustical Imaging Technologies, LLC
ADVantage Imaging Systems, Inc.
Applied Coating, Inc.
Bausch & Lomb
Blue Highway, INC.
Corning, Inc.
Eastman Kodak Company
Harris Corporation
iCardiac Technologies, Inc.
Impact Technologies, LLC
Integrated Nano-Technologies, LLC
ITT Geospatial Systems
Litron Laboratories
Lucid, Inc.
Philips Electronics, NA
PL E-Communications, LLC
Positive Science, LLC
SiMPore, Inc.
Thermo Fisher Scientific, Inc.
UR Integrated Nanosystems Center (URnano)
Xerox Corporation

Total Cumulative Economic Impact



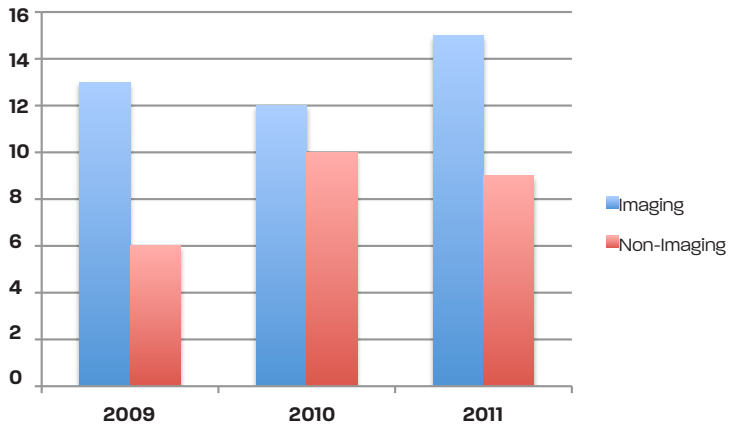


CEIS Year in Review

The 2010-2011 academic year was one of significant change and growth for CEIS. In addition to being the first year of a new team, we refined our focus and expanded the ways in which we bring academia and industry together.

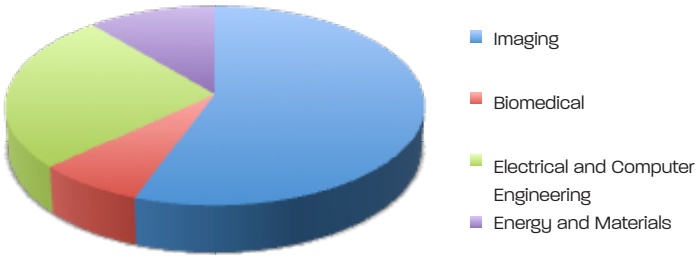
While continuing our focus on imaging, which plays a key role in the Finger Lakes economy, we also support other technologies that are important to the state and local economies. In 2010-2011, imaging comprised 54% of our funding. That was down from 68% the previous year. In the current year, 62% of our projects are related to electronic imaging. This distribution reflects the diversification of the local economy. The rest of our funding can be broken down into 3 industries, all of which are important to the Finger Lakes region. These are biomedical technology (other than imaging), electrical engineering and computer science, and energy and materials.

CAT 3 Year Project Comparison

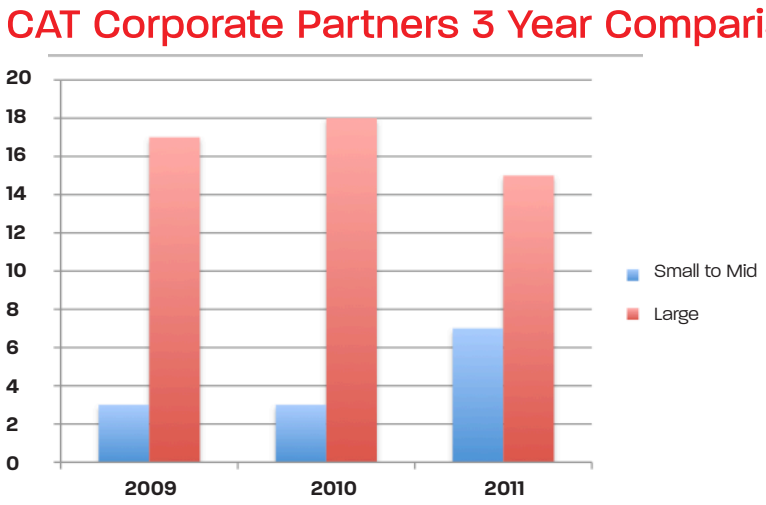


The approach to all of these areas is the same: identify emerging cluster industries, get to know the faculty and companies in these areas, and identify specific opportunities for collaboration. For work outside of imaging, we first try to identify another CAT focused on that technology that can support the program. Last year we were very fortunate to work with the Stony Brook Biotechnology CAT to fund a very exciting collaboration between a UR professor of biology and a local start-up company. When no other CATs are able to support the collaboration, we evaluate the economic potential and consider its support.

2011-2012 CAT Projects



The distribution in the size of companies we work with also continues to evolve. Small to mid-sized companies comprised only 15% of the projects we supported in 2009 and 2010 compared to 32% in 2011. This too reflects the changing Rochester economy as small businesses emerge as drivers for both innovation and economic growth. This trend is true not only for Rochester, but for the state and the nation as a whole. While this may result in smaller economic impact in the near term, we are laying a solid foundation for those small to mid-sized companies to grow. Recognizing that larger industrial companies are still a significant part of the New York economy, we have targeted a half-dozen large companies across the state as strategic partners. Our relationship with these companies is being coordinated with other organizations across the University of Rochester and RIT to ensure there is good visibility across both the companies and the universities about these engagements, many of which are synergistic.



Our approach to technology transfer has broadened as well. We kicked off the STAR program this year to help small companies solve tactical issues in the short term. And we have listened to our partner companies who tell us they often cannot wait for the next funding cycle if they have a project and financial support in place but is out of sync with CEIS' annual RFP cycle. In response, we have increased the number of funding cycles from one to two per year.

In addition to co-funding collaborative research on campus, we increased our efforts to create informal relationships and the hiring of students, both of which are viewed by companies as critical pathways of technology transfer. To help promote informal relationships, which is often the first step towards collaborative research, we launched the CEIS Industrial Speaker Series. Throughout the year we bring in leading technologists and managers from companies across the state and have them talk to the academic community about the opportunities and challenges they face. This gets the faculty thinking about ways to make their research have more commercial potential. The seminars are held in conjunction with academic departments at both the U of R and RIT. The rest of the day we invite the speaker to meet one on one with faculty working on related projects to expose industry to new ideas. We have already seen some of these visits result in defined areas of collaboration. We have also begun to work with the Office of Technology Transfer to help faculty write patent applications to address identified market needs and therefore be more attractive for licensing. Other new areas of outreach are a blog on our CEIS web site and a brochure that pulls together in one place a list of analytical and nanoscale prototyping services available in the Finger Lakes region.

Annual Business Meeting

To celebrate last year's accomplishments and recognize the most outstanding partnerships, we held our annual business meeting dinner in November 2010. Bob Naum, the chair of our Industry Advisory Board, was the master of ceremonies. Two companies, iCardiac and Adarza were recognized for their success in taking university technology and translating it into company growth. Ed Reinfurt, Executive Director of NYSTAR, spoke about the CAT program, and Michael Summers, managing partner of venture capital firm Cody Gate Ventures, gave the key note address. Michael described three start-up companies that have been brought to Rochester, one of which is collaborating with a U of R Electrical and Computer Engineering faculty member on a CEIS sponsored project. Michael was able to talk about the importance of venture funding in helping to establish new companies and gave a model for how industrial development can take place through industry-university collaboration.

University Technology Showcase

The 2011 CEIS University Technology Showcase was the largest one ever. We had 250 attendees and over 50 poster presentations by faculty and graduate students covering all 5 of the areas we support. And we had keynote speeches by leaders from both academia and industry.

Looking to the future

Going forward, we will continue to refine the categories of industry we support. We will also build off of the new programs we have initiated while being open to new ideas and feedback from our partners. We have begun discussions with SEMATECH, the consortium of semiconductor companies based in Albany, to identify ways to bring the optics, photonics, and imaging resources in Rochester to bear on the challenges in extending Moore's Law down to the nanometer scale. This includes the use of imaging in the manufacturing process as well as the development of optical interconnects and integrated photonics. We are working to identify other areas of competency in the universities in our region that are of value to industry. These include the University of Rochester Medical Center's ability to do clinical trials of new biomedical devices, and the design capabilities at the U of R and other regional universities. With the rich history of product development and manufacturing, and the vast amount of academic research and talent in the greater Rochester area, we are excited about our role in helping to increase industry-university collaboration and grow the state and local economy.


Bio-X

CEIS in the Community

CEIS is fortunate to play an important role in revitalizing the state and regional economies. The Finger Lakes region possesses tremendous industrial resources to build on, and our universities provide a rich source of technology to be leveraged. This past year there has been ample evidence of growth in our economy and of the important role CEIS and our universities are playing.

Imaging continues to make up an important component of the Finger Lakes region economy and has been one of the bright spots during the past few years. Corning Inc., one of the regions' largest and most profitable companies, reported an increase in revenue of 22% in 2010 and saw net income increase by 75%. The company is the largest producer of glass for flat panel displays in the world and has been sponsoring CEIS-supported research at RIT over the last few years. Rochester Precision Optics, another CEIS partner, announced plans to add up to 150 new jobs in a $10M expansion. The company makes molded glass components using equipment and process technology obtained from a former Kodak business unit. And Optimax Systems Inc., a company whose CEO and president are graduates of UR and RIT respectively, is in the midst of a $4M expansion and expects to add 50 workers within 2 years. All told, there are more than 50 small to medium sized optics and imaging companies in Rochester employing about 2,500 people. Many of these companies have strong ties to our region's universities and several have had successful CEIS-funded projects.

Outside of Optics, Harris RF Communications has emerged as one of the leading companies in the region and this year reported $7.5M in economic impact due to CEIS supported projects – the largest of any one company. The Rochester-based business unit employs 2300 people locally and reported annual sales were up 11% over the previous year. The company continues to make significant headway in the public safety business and introduced the first soldier smart radio earlier this year. In September, Harris opened up a new 573,000 sq. ft. manufacturing center in Henrietta NY that will keep 1,100 jobs here in upstate NY.

Healthcare is another critical element of the Finger Lakes economy and it is no surprise that this sector makes up a large portion of CEIS supported projects. The healthcare research base available to CEIS is vast, with UR doing over $300M in medical related research this past academic year. Bausch + Lomb, one of the region's largest employers, has been collaborating with scientists at the U of R on multiple CEIS-supported contracts for several years. The research involves the use of femtosecond lasers to improve the properties of the intraocular lens after cataract surgery. In a related development, B+L acquired a femtosecond laser surgery company in September 2011. On the small company side, CEIS partner Diffinity Genomics, a UR spinout based at the High Technology Rochester business incubator, was honored as one of the 10 most innovative companies by The Scientist.

Another strong driver for the Finger Lakes region economy is education. The U of R and RIT grew last year in terms of both numbers of students and research budgets, and CEIS helped both universities attract federal funding. In September 2011, the U of R announced the opening of URnano, a nanotechnology imaging and prototyping center that received $4M from the federal government. CEIS provided funding for some of the early research that lead to the creation of that facility.

All across the Finger Lakes region there are signs of economic growth and an increasing awareness across the country of this region's technical capabilities. In September, Forbes rated Rochester the 7th fastest-recovering city in the country and last year ranked Rochester the 14th most innovative city in the country. CEIS, along with our partner academic researchers and companies, continue to help drive that innovation and accelerate economic growth in the region.

Research Themes

The following pages highlight the major research themes of our CEIS Principal Investigators as well as the current projects that are underway. The themes and abstracts underscore the diversity of research interests, the collaborative nature of CEIS work, the innovation that is in progress, and the limitless potential of research when it is a shared venture of science and industry.

1. **Image Processing**
2. **Biomedical**
3. **Microelectronics, Software, and Communications**
4. **Energy and Materials**

2010-2011

Image Processing

Project Title
Hardcopy Document Forensics

Principal Investigator
Gaurav Sharma

University
U of R

Sponsor Company
Xerox Corporation

This project is developing methods for non-intrusive forensics of hardcopy printed documents. Our goal in this project is to develop a toolkit of techniques that allows forensic analysis of printed documents in order to answer forensic questions related to a) source identification, i.e., determining the printing device that originated the documents, b) processing history i.e., determining the processing operations that a printed image has been subjected to, and c) manipulation detection, i.e., detecting if a printed document has been altered and, if so, what parts. In addition, we will conduct an analysis of device forensics to establish the fundamental limits of device forensics. The work is supported by Xerox Corporation, which has a broad interest in this area. It is also of interest externally to the FBI, to the department of Homeland Security, and to other law enforcement agencies because printed documents are used extensively in a number of legal and financial transactions.

Project Title
Object and Image Segmentation of Thermal and Multispectral/ Hyperspectral Images

Principal Investigator
Sohail Dianat

University
RIT

Sponsor Company
Xerox Corporation

The goal of this research proposal is to investigate and develop an automatic technique for object and image segmentation of thermal and multispectral/ hyperspectral images. The object segmentation of gray scale and RGB images will be extended to multispectral as well as thermal images for various applications. We will focus our algorithm development on license plate recognition and identification of humans where the underlying data can be gray scale, RGB, thermal or multispectral type images. We will investigate the performance of our algorithm with respect to images of different characteristics such as noisy images, blurred and low-contrast images, shadows, bumper stickers and dents in the plate. We will also benchmark our approach with respect to the existing algorithms. A MATLAB GUI with menu options will be provided for the user to load an image and enter the necessary system parameters. The license plate number will be displayed in alpha numeric symbols. Human objects will be highlighted with identifiable marks.

Project Title
Display Color Gamut and Power Modeling and Co-optimization

Principal Investigator
Gaurav Sharma

University
U of R

Sponsor Company
Sharp Labs America

With the increasing ubiquity of color image display devices, joint consideration of display performance and power consumption is becoming increasingly important. In the home environment, for instance, driven by higher performance requirements and new features, TV and computer displays are seeing larger sizes, higher frame-rates, and designs that incorporate multiple, i.e., more than three, primaries, and high dynamic range features. All of these performance improvements have caused a hefty increase in the power consumption of display devices, which, in turn, is contributing to strains on the already challenged power grid. Research under this proposal will enable joint modeling of performance, as characterized by the color gamut, and power consumption. This will be utilized by the sponsor to explore more power-efficient display designs. In addition, the same framework will also be utilized to develop methodologies for reducing peak power demand for displays by potentially trading off performance. The latter work becomes crucial in emerging smart grid scenarios where alternative generation sources such as solar and wind can result in significant variability. Additionally, the co-optimization of performance and power also plays an important role in mobile display devices.

Project Title
Persistent Surveillance Activities: The Next Steps

Principal Investigator
Judith Pipher

University
U of R

Sponsor Company
ITT Geospatial Systems

ITT has interest in infrared persistent surveillance experiments. Following up on our prior work with ITT, UR will provide the ground truth measurements and calibration for scenes which RIT colleagues are modeling. In addition, UR will execute and evaluate a new method of MTF measurement on existing IR detector arrays for which we have already characterized MTF using a knife edge lying on the array, and will compare the results.

Project Title
Speckle-based MTF Testing, Development and Validation

Principal Investigator
Mark Bocko

University
U of R

Sponsor Company
ITT Geospatial Systems

In many cases, the modulation transfer function (MTF) of image sensors is measured with a complex system of test targets, scanning mechanisms and optics. In addition, multiple targets have to be used for each particular spatial frequency to be studied or a slant edge has to be aligned precisely [ISO 12233]. Previous research has shown that a speckle-based MTF measurement methodology eliminates the need for precision optics, moving parts and alignment. By removing optics in the image processing chain, we do not need to account for the optical MTF in the system to measure just the image sensor's MTF. In this project we will develop and validate a system for making speckle-based MTF measurements.

Project Title
Enhancing the UV Sensitivity of CMOS Image Sensors

Principal Investigator
Zoran Ninkov

University
RIT

Sponsor Company
Thermo Fisher Scientific

This project continues our effort to improve the UV sensitivity of CMOS image sensors using two approaches: first, by coating the arrays using quantum dots and second, by using a deterministic backside thinning process. Such devices would see widespread application in the markets served by Thermo Fisher Scientific—namely—UV spectroscopy and radiation hard applications.

Project Title
Thermal Modeling of Vehicles

Principal Investigator
Zoran Ninkov

University
RIT

Sponsor Company
ITT Geospatial Systems

This project continues our effort to build accurate infrared models of a variety of vehicles, place such vehicles in background scenes generated using the software modeling package DIRSIG, move the vehicles in the scene and then use algorithms to track the cars in this scene. The goal is to build software test bed for tracking algorithm software development, and to see the effects on performance of different IR detector arrays and data acquisition platforms.

Project Title
Investigation on Material Properties of Silicon-on-Glass and the Impact on Device Operation

Principal Investigator
Karl Hirschman

University
RIT

Sponsor Company
Corning, Inc.

The goal of this proposal is development of a product with potential applications in a number of electronic technologies through the transfer of technology from the Rochester Institute of Technology (RIT) to Corning, Inc. The product under development is a new Silicon-on-Glass (SiOG) substrate material by Corning, which includes a high-quality thin-film silicon layer on their industry-leading flat-panel display glass. To date, RIT has demonstrated TFT performance that is superior compared to other FPD development centers, both industrial and academic. This project is focused on the material properties of the silicon layer, silicon surface, and bonded interface to the glass substrate, and the impact of these properties on TFT device operation. This technology will support system integration on glass that would have a significant impact on display and portable communication devices, and other electronic applications.

Project Title
Commercialization of Next-Generation Wearable Eyetrackers

Principal Investigator
Jeff Pelz

University
RIT

Sponsor Company
Positive Science, LLC

Wearable eyetrackers have advanced dramatically in the last several years, from a research oddity to a tool that is being accepted in academic and business environments. Positive Science, LLC, a startup that formed to fill the need of the emerging market, has provided hand-built trackers for academic and commercial research studies. The proposed project is a collaboration between an academic lab and a small company designed to move the startup to the next level of commercialization. The primary goal is to advance the hardware design to the point that a small-business innovation grant can be submitted for further development.

Project Title
Femtosecond Micromachining of Ophthalmic Polymers

Principal Investigator
Wayne Knox

University
U of R

Sponsor Company
Bausch & Lomb

In year six of this B&L-funded project, we will continue studying the two-photon sensitizing process in hydrophobic acrylates and hydrogels. We will work with B&L designs and write refractive corrections into several types of IOLs (intra-ocular lenses) and measure to determine the wavefront correction that we achieved by comparing before and after writing. The short-term goal of this project is to develop an ex-vivo customizing process for adjusting IOLs that will be implanted into a human patient, and the long-term goal is to develop an eye-safe in-vivo adjustment procedure.

Project Title
Computer-Aided Analysis of Interstitial Lung Disease Patterns in Chest Computer Tomography

Principal Investigator
Axel Wismueller

University
U of R

Sponsor Company
Carestream Health

The purpose of our project is to develop, test, and evaluate a novel method that helps radiologists to better detect and diagnose certain diseases affecting the lung (Interstitial Lung Diseases, ILD), by using innovative pattern recognition technology. To this end, specifically developed computer programs will process cross-sectional computer tomography images of the patients' lungs, and results of this analysis will be presented to the radiologist reading these images to support her/his diagnostic decision process. This will lead to improved accuracy of ILD diagnosing, monitoring, and response to therapy evaluation, diminish repeated imaging, and ultimately improve clinical outcomes.

Project Title
Adaptive Optics Visual Simulator to Test Multifocal Contact Lens Designs

Principal Investigator
Geunyoung Yoon

University
U of R

Sponsor Company
Bausch & Lomb

Presbyopia is a term used to describe the natural aging of the human eye. It is a gradual loss of the accommodative capability of the eye, resulting in a progressively diminished ability to focus on near objects. Reading glasses, contact lenses, laser refractive eye surgery and intraocular lenses have been used to correct presbyopia. Recently, there has been an impetus toward contact lenses that correct presbyopia by creating multiple foci simultaneously. Adaptive optics technology facilitates non-invasive testing of these lenses by optically simulating their performance when placed on an individual's eye. This proposal aims to evaluate novel designs of multifocal lenses by using adaptive optics to simulate conditions that are routinely observed in presbyopic eyes. Furthermore, we also propose to test subject's visual performance for near objects when viewing through these novel corrective lenses.

Project Title
Multi-model Objective Characterization of the Ocular Tear Film

Principal Investigator
James Zavislan and Geunyoung Yoon

University
U of R

Sponsor Company
Bausch & Lomb

Dry eye syndrome is recognized as one of the most common ocular disorders affecting as many as 60 million people in the United States. The tear film consists of three layers: mucin, aqueous and lipid. We propose to combine a Shack-Hartmann wavefront sensor with an imaging ellipsometer to make simultaneous non-contact, objective measurements of the aqueous and lipid layers to understand their dynamic relationships. This combined instrument will assist in the understanding of dry eye and the development of over-the-counter artificial tears and prescription drops to treat dry eye.

Project Title
Analysis of Consumer Behavior and Experiences Via Integrated Use of Mobil Eye-Tracking and Physiological Reactivity

Principal Investigator
Joseph Baschnagel and Andrew Herbert

University
RIT

Sponsor Company
Proctor & Gamble

The overarching goal of the collaboration between RIT and P&G is to develop a comprehensive consumer behavior analysis tool that incorporates eye-tracking technology, psychophysiological reactivity measurement and a software platform that integrates and analyzes the two data streams. This system will provide data that will be used to assess consumer attention and emotional reactions to products during product testing to improve product development and, ultimately, increase product sales. The emphasis of the work proposed in this document is to develop a procedure for synchronizing the eye-tracking data with physiological measurements that are collected simultaneously by two separate systems.

Project Title
Femtosecond Micromachining of the Cornea and IOLs

Principal Investigator
Krystel Huxlin

University
U of R

Sponsor Company
Bausch & Lomb

Our long-term goal is to use femtosecond micromachining as a non-damaging, non-contact method of customizing the refractive correction in a human eye, be it in the cornea or the lens. The proposed experiments will test the safety and efficacy of using blue laser light to change the refractive index of the cornea in live animals non-invasively. We will then characterize the resulting changes in ocular optics, biomechanics and tissue biology induced by this process over 6 months. Second, we will test IOL implantation techniques in living cats in preparation for our third goal of developing and testing methodology to allow micromachining of implanted IOL.

Microelectronics, Software, and Communications

Project Title
Intra-coaxial Near Field Antenna Structures on a Molded Interconnect Device

Principal Investigator
Robert Bowman

University
RIT

Sponsor Company
PPC

A self-diagnostic RF connector technology is being developed at the RIT ADIML lab. A sensor system and processing electronics are mounted on a molded interconnect device (MID) located inside a coaxial cable. The MID must interact with the RF transmission line for three reasons: 1) it must harvest power from the transmission line, 2) it must use the transmission line to communicate sensor status, and 3) it must sense reflected RF power in order to monitor the integrity of RF system. On the other hand, it is equally important that the sensor system remain transparent with respect to the RF transmission characteristics of the transmission line for normal operation. In this research effort small antenna structures for coupling electromagnetic energy between the RF transmission line and the sensor system on the molded interconnect device (MID) will be described both theoretically and experimentally.

Project Title
Protocol Architectures for Multimedia Radios

Principal Investigator
Wendi Heinzelman

University
U of R

Sponsor Company
Harris Corporation

The major goal of this project is to move toward enabling TRACE to support new forms of quality of service (QoS). TRACE is a suite of protocols that enable energy-efficient real-time communication of multimedia data, such as voice and video, through network broadcast, multicast and unicast. We have shown previously that the TRACE framework is better suited to the demands of real-time multimedia communication than existing approaches. However, TRACE needs to be adapted in order to support different forms of QoS. Specifically, this project aims to provide support for variable rate data; to enable data prioritization; to develop approaches to support local capacity adjustments; and to look at the effects of encryption. Together, these new features will enable TRACE to meet various QoS requirements, providing support for a range of network traffic.

Project Title
Methodologies for Modeling and Mitigating Noise Coupling in Advanced Image Sensor

Principal Investigator
Eby Friedman

University
U of R

Sponsor Company
IBM and NSF

With increasing scaling, greater functionality can be integrated onto a single integrated circuit. Diverse types of circuitry are used in imaging circuits, such as image sensors, analog blocks, and digital blocks. The primary objectives of our research are to investigate noise coupling among these domains and develop effective noise mitigation techniques. The common substrate typically is a primary noise coupling path in these mixed-signal integrated circuits. Our focus will be to develop substrate models to efficiently and accurately estimate noise coupling. In addition, we will investigate noise coupling within a globally integrated power and clock network.

Project Title
Carrier lifetime characterization of photovoltaic cell thin-film absorber materials

Principal Investigator
Roman Sobolewski

University
U of R

Sponsor Company
Corning, Inc.

The program objective is to develop an optimized time-resolved spectroscopy system and, subsequently, characterize novel, provided by Corning, thin-film, amorphous and poly-crystalline semiconductors, such as amorphous silicon, poly-crystalline silicon, cadmium telluride, and copper-indium-gallium-selenium for possible photovoltaic cell applications. Such materials can have carrier lifetimes on the order of 10s to 100s of picoseconds and any traditional techniques are not capable of resolving their carrier lifetime dynamics. The femtosecond optical spectroscopy at the University of Rochester employs femtosecond laser pulses for both carrier excitation and sampling and is fully capable of resolving even the fastest relaxation processes.

Project Title
Terahertz Ballistic Nanodevices for Ultrafast Low-Power Electronics

Principal Investigator
Roman Sobolewski

University
U of R

Sponsor Company
National Science Foundation

The objective of our research is to design and characterize ballistic nano-electronic devices and circuits with the emphasis on their successful operation in ultrafast electronic imaging and digital circuits. The focus will be put on femtosecond (THz-bandwidth) time-domain and radiation-hardness measurements of ballistic deflection transistors (BDTs), as they are the most promising ballistic devices, operational at room temperature and predicted to successfully operate up to THz frequencies. The BDTs are finding applications in real-time, analog electronic imaging circuits, where their ultra-low-power consumption and ultrafast operation are the most desired features.

Project Title
RFID Systems for Inventory Management

Principal Investigator
Wendi Heinzelman

University
U of R

Sponsor Company
Omni-ID Corporation

The goal of this project is to develop a low-cost, energy-efficient and reliable RFID system for inventory management that can provide extended coverage. To accomplish this goal, we will design a system that uses simple, battery-operated edge-controlling devices to extend the operational range of an RFID Reader. These edge devices will act as multi-hop relay stations, reporting tag reads back to a central RFID Reader. Our research will focus on the communication protocols and data processing algorithms to ensure reliability and energy-efficiency of the system, and on the edge device placement algorithms that ensure all areas have coverage and hence all tags can be read.

Project Title
Distributed On-Chip Power Delivery in Low Power Multi-Core Communication Circuits

Principal Investigator
Eby Friedman

University
U of R

Sponsor Company
Qualcomm

Efficient generation and distribution of on-chip power supply voltages using moderate resources is a significant challenge. Two primary components to provide efficient multi-voltage power delivery are small area, efficient voltage converters, and methodologies to simultaneously co-design on-chip voltage regulators and decoupling capacitors. The proposed research project with Qualcomm will be composed of two primary objectives: 1) develop, design, and test an on-chip power supply targeted at 28 nm CMOS, and 2) design methodologies to optimize the placement and capability of the on-chip regulators and decoupling capacitors to effectively deliver current while minimizing power/ground noise.

2011-2012

Image Processing

Project Title
IR experiments in support of ITT's Persistent Surveillance Projects

Principal Investigator
Judith Pipher and Craig McMurtry

University
U of R

Sponsor Company
ITT Geospatial Systems

The Univiersity of Rochester (UR) proposes to conduct a variety of infrared experiments in support of ITT's persistent surveillance (PS) programs. These build on our current work with ITT, partially in collaboration with RIT, and partially in collaboration with Prof. Bocko's group. Experiments include, but are not limited to, measurement of MTF of Raytheon MWIR (5.2 Rm cutoff) and LWIR (9.5 and 11.0 Rm cutoff) detector arrays to Nyquist and twice Nyquist frequency using a laser speckle technique developed during the 2010-11 grant; measurement of MWIR (to 5 Rm) and LWIR (to 12 Rm) emissivities and thermal conductivities of materials germane to PS programs, but which do not currently exist; evaluation of a dual-color MWIR/LWIR QWIP camera for PS tracking ground truth measurements.

Project Title
Animal Trials with a Prototype Photoacoustic Imaging Device

Principal Investigator
Vikram Dogra & Navalgund Rao

University
U of R

Sponsor Company
Advanced Acoustic Imaging Technologies

This project is a continuation of last year's CEIS funding under Bio funding mechanism for developing photoacoustic imaging (PA) for animal and in-vivo studies. Camera design and electronic data acquisition has been achieved. In this phase of the funding we will perform live animal testing of our prototype.

Project Title
Optimizing multifocal contact lens design in modified monovision for presbyopia

Principal Investigator
Geunyoung Yoon

University
U of R

Sponsor Company
Bausch & Lomb

Human accommodation, the ability of the eye to dynamically change optical power in order to focus objects at various distances, decreases with age and the decrease becomes noticeable in middle age. Monovision in which each of the two eyes is corrected for distance and near is a clinically accepted method. However, the significant difference in optical quality between the two eyes can cause a challenge from patients and subsequently diminish their visual performance. To overcome these limitations, we propose to modify monovision by making the optical quality of the two eyes less disparate, thereby improving through-focus visual performance in presbyopia.

Project Title
Content-Based Image Retrieval for Computer-Aided Analysis of Interstitial Lung Disease Patterns

Principal Investigator
Axel Wismueller

University
U of R

Sponsor Company
Carestream Health

The purpose of our project is to further develop, test, and evaluate a novel method that helps radiologists to better detect and diagnose certain diseases affecting the lung (Interstitial Lung Diseases, ILD), by using innovative content-based image retrieval technology. To this end, specifically developed software will process crosssectional computer tomography images of patients' lungs and will retrieve similar image data from a knowledge base of already diagnosed cases to support the radiologist in her/his diagnostic decision process. This will lead to improved accuracy of ILD diagnosing, monitoring, and response to therapy evaluation, diminish repeated imaging, and ultimately improve clinical outcomes.

Project Title
Enhancing Focal Plane Array Quantum Efficiency with Quantum Dots

Principal Investigator
Zoran Ninkov

University
RIT

Sponsor Company
Thermo Fisher Scientific

Sensitivity to ultraviolet (UV) light is becoming increasingly important for CMOS and CCD focal plane arrays (FPA). Absorption by the gate and clock structures on the front surface of traditional FPAs prevents a significant portion of the UV light from reaching the active region of the detector. Back thinning can be used to improve performance but it i extremely costly. Alternatively the sensor may be coated with a thin film of fluorescent organic material, such as lumogen, to convert the UV light into a wavelength to which the underlying sensor is sensitive. One application of such UV sensitive arrays is to look for scattered deep-UV light in wafer inspection systems. Unfortunately the deep-UV causes rapid deterioration in the imaging properties of uncoated FPAs because of silicon damage and lumogen is rapidly evaporated from the surface of FPAs by the UV. We are developing a technique (patent pending) that uses a thin film of quantum dots, instead of lumogen, that fluoresce in the visible under UV illumination. The absorption by the QDs is 100% at very thin film thicknesses (ie 100 nm) and thus eliminates any damage to the underlying FPA. An electrospray technique is being developed that will permit such a coating to be applied to any CMOS or CCD array.

Project Title
Femtosecond Micromachining of Ophthalmic Polymers

Principal Investigator
Wayne Knox

University
U of R

Sponsor Company
Bausch & Lomb

In year seven of this B&L funded project, we will continue to optimize the design of refractive correctors in two-photon sensitized hydrogels. We will write refractive corrections into several types of flat plates and IOLs (intra-ocular lenses) and measure the wavefront correction that we achieved by comparing before and after writing. The short term goal of this project is to develop an ex-vivo customizing process for adjusting IOLs that can be implanted into a human patient, and the long term goal is to develop an eye-safe in-vivo adjustment procedure.

Project Title
Virtual Scene and Target Generation and Tracking in the Infrared

Principal Investigator
Zoran Ninkov

University
RIT

Sponsor Company
ITT Geospatial Systems

Target tracking in the thermal infrared is important for persistent surveillance applications. To test the performance of tracking algorithms, a variety of videos depicting different scenarios are necessary. We propose using synthetically generated video as it has many benefits over physically collected video. A set of tools for creating physically accurate synthetic video are being developed using many software packages. In addition to synthetic video generation, algorithm testing software and quantitative metrics are also being developed. The result is a coherent means of comparing target detecting and tracking algorithms quantitatively for any given scenario.

Project Title
3D Imaging Systems

Principal Investigator
Tsuhan Chen & Ashutosh Saxena

University
Cornell University

Sponsor Company
Eastman Kodak Company

In this project, we consider the problem of converting a 2D image or a 2D video into a 3D image or 3D video (i.e. viewable as a VRML model or on 3D display devices that have recently become available to the public). This project involves two key research issues: (a) estimating dense depth maps from a single image (or a single frame of the video), and (b) using this single image information together with other information available (such as stereo disparity maps, user input or how an object moves over time across video frames) in order to produce visually pleasing 3D images/videos that are also quantitatively accurate. The key to our approach is machine learning algorithms that learn to extract information from visual data in order to produce better 3D images/videos.

Project Title
Objective Characterization of the Ocular Surface using Thermal Imaging

Principal Investigator
James Aquavella & Geunyoung Yoon

University
U of R

Sponsor Company
Bausch & Lomb

Dry eye syndrome is recognized as one of the most common ocular disorders affecting as many as 60 million people in the United States. The tear film consists of three layers: mucin, aqueous and lipid. We propose to evaluate real time variation in the ocular surface temperature combined with objective lipid layer evolution during the blink cycle. This combined instrument will assist in the development of over-the-counter artificial tears and prescription drops to treat dry eye.

Project Title
Compressed sensing for wireless streaming and image super resolution of single/multi/hyperspectral video images

Principal Investigator
Sohail Dianat

University
RIT

Sponsor Company
Xerox Corporation

The goal of this research proposal is to investigate and develop techniques for the wireless streaming and generation of super-resolution single/multi/hyper-spectral video images using compressed sensing (CS) techniques. We use compressed sensing to recover the data loss in wireless data/image/video streaming applications for single/multi/hyperspectral videos for mobile devices. The recovery of the lost data is to be achieved at the image reconstruction level. An additional goal is to increase the resolution of each frame of video of the underplaying signal modality. We will focus our algorithm development on the generation of the super-resolution of underlying data of different modalities such as RGB (spatial), thermal or multispectral type images (wavelength), and video (temporal). MATLAB GUI with menu options will be provided for the user to load a video stream and enter the necessary system parameters for both video recovery as well as desired resolution.

Project Title
Understanding Function of Accommodating IOL Using Dynamic Aberrometry

Principal Investigator
Geunyoung Yoon

University
U of R

Sponsor Company
Bausch & Lomb

Accommodation allows the eye to automatically adjust its focal point onto objects at different distances without sacrificing image quality. The magnitude of the human accommodation is decreased with aging. Among many options to overcome this problem, the ideal solution is to implant an accommodative intraocular lens (IOL) that allows the eye to see clearly at all distances without additional ophthalmic aids. Crystalens is the only accommodative IOL approved by FDA and has the potential to restore the accommodative ability. The goal of the project is to objectively assess the accommodative response of the IOL after implantation under normal binocular viewing condition by using a real-time ocular wavefront sensor.

Project Title
Investigation on the influence of alternative glass formulations on low-temperature polysilicon thin-film transistors

Principal Investigator
Karl D. Hirschman

University
RIT

Sponsor Company
Corning, Inc.

In response to Corning's expressed interest in low-temperature polysilicon (LTPS) thin-film transistor (TFT) fabrication, we propose a study on LTPS processes and devices at the Rochester Institute of Technology (RIT). The primary goal of this work is to develop shortened-cycle and baseline TFT processes that demonstrate reproducible results, and the ability to investigate the influence of alternative glass formulations on the electrical characteristics of fabricated devices. The LTPS substrates will be prepared by Corning Incorporated; device fabrication will be done at the Semiconductor & Microsystems Fabrication Laboratory (SMFL) at RIT. This proposal presents a plan of work to fabricate and characterize both simplified device structures (MOSCAPs & RingFETs) and thin-film transistors on LTPS substrates.

Project Title
Low Noise Digital CMOS Image Sensors for Night Vision Applications

Principal Investigator
Mark Bocko

University
U of R

Sponsor Company
ITT Geospatial Systems

ITT Geospatial Systems is exploring the use solid-state image sensors as a possible alternative to their currently employed image intensifier technology in an effort to improve the performance and to reduce the size, weight and power of their night vision products. Digital CMOS image sensors being researched at the University of Rochester have demonstrated industry leading low readout noise (by a factor of two) and thus are a promising avenue of investigation for this application. In this project we will conduct two tasks, the first will be to develop noise models to determine the achievable performance of the new digital readout technology in combination with high-qualityphotodiodes. The second task will be to construct a low noise image sensor test and characterization setup to accurately measure sub-electron equivalent readout noise levels and to complete measurements on available prototype sensors.

Project Title
Femtosecond micromachining of the cornea and IOLs – Phase 2

Principal Investigator
Krystel Huxlin

University
U of R

Sponsor Company
Bausch & Lomb

Our long-term goal is to use femtosecond micromachining as a non-damaging method of customizing the refractive correction in a human eye, be it in the cornea, lens or implanted IOLs. The proposed experiments use a cat animal model and aim to: (1) develop an appropriate Akreos IOL for implantation in a cat eye, (2) once the lens is successfully implanted, develop a technique to modify the refractive index of the lens in situ, and (3) micromachine a powered pattern into a cat cornea to show a change in spherical refraction.

Biomedical

Project Title
Application of Communication Theories in Protein Structure Prediction

Principal Investigator
Wendi Heinzelman

University
U of R

Sponsor Company
UCB

We propose an innovative interdisciplinary study that combines the research fields of Structural Bioinformatics and Communications to provide effective and efficient solutions to the protein structure prediction problem. Well-developed theories in Communications, such as clustering hierarchy, will be utilized to develop a novel approach to protein side-chain prediction, offering information critical to structure-based drug discovery and rational drug design. Preliminary results are provided as proof of concept. Our work possesses considerable academic, industrial and economic significance, and is promising to inspire subsequent researches. The outcome has direct applications in pharmaceutical research, improving drug efficacy and reducing clinical trial attrition rate.

Project Title
Development of a Prototype for Robotic Delivery of High Intensity Focused Ultrasound (HIFU) for Hemostasis after Liver Biopsy

Principal Investigator
Navalgund A. Rao

University
RIT

Sponsor Company
RT&I, LLC

Percutaneous liver biopsy remains a cornerstone of diagnosis and disease staging in many forms of liver disease. There are however complications associated with internal bleeding that requires intervention in up to 3.6% of patients. The average cost of interventions is in excess of $20,000 per patient, not to mention the anxiety and suffering they have to withstand. Robotic Therapeutic and Imaging (RT&I), LLC is developing a prototype of a robotic machine, named HEMOBLOT, that localizes the bleeding spot during the biopsy procedure and delivers High Intensity Focused Ultrasound (HIFU) to that spot to cause coagulation and stop the bleeding. The technology is based on patent pending design concept (PCT/US2009/053011) licensed to RT&I. HEMOBLOT has three major parts, a B-scan ultrasound scanner with linear array scanner head, biopsy needle holder and the HIFU transducer. All three will be controlled by one computer. The hardware and robotic assembly is in progress. This project will focus on the software development and system integration of the entire process from ultrasound image acquisition to needle guidance and image guided HIFU delivery.

Project Title
Dietary Restriction (DR) for the diagnosis and treatment of Inflammatory Age-related Diseases

Principal Investigator
David S. Goldfarb

University
U of R

Sponsor Company
Calorics Pharmaceuticals

Calorics Pharmaceuticals leverages a novel drug discovery platform for age-related and inflammatory diseases. A high throughput screen of the NIH library identified a number promising hits, one of which, the C1-SCRINs, is effective against inflammation in rodents and is the focus of our current drug development program. This proposal aims to develop two of our other equally attractive hits with commercial potential. The primary goals are to elucidate the structure activity relationship of two chemically distinct probes in order optimize their biological activity and develop proprietary molecules that can be fed into our preexisting drug development program.

Project Title
Development and Characterization of Surfaces for Rapid Purification of Enzymatic Reactions

Principal Investigator
Lewis Rothberg

University
U of R

Sponsor Company
Diffinity Geonomics

Diffinity Genomics has developed a pipette-based product for rapid purification of polymerase chain reactions that amplify double-stranded DNA for downstream applications such as sequencing. The system is fast and efficient because it works in a single step by selectively adsorbing primers and nucleotides onto specially functionalized surfaces while leaving the desired double-stranded DNA in solution. The object of the present work is to develop chemistry that would enable a similar product for purification of enzymatic reactions.

Microelectronics, Software, and Communications

Project Title
Hybrid Design Methodologies for High Performance Three-Dimensional Image Sensing System-On-Chip Integrated Circuits

Principal Investigator
Eby Friedman

University
U of R

Sponsor Company
Eastman Kodak Company

3-D integration provides a path toward integrating disparate technologies. However, a composite system requires compatible voltages for each given technology as well as mitigation of noise coupled through common metal lines, such as power and ground. The primary objective is to develop technology agnostic, adaptable, interface circuitry to facilitate integration of heterogeneous technologies after wafer fabrication. This research will culminate in method to combine multiple planes in a “plug and play” manner to create different hybrid monolithic image sensing systems. This “mix and match” approach can be utilized to target several different applications using a standard set of waferlevel intellectual property.

Project Title
Development of a non-contact ECG Sensor

Principal Investigator
Mark Bocko

University
U of R

Sponsor Company
Blue Highway

This project is the Year-2 continuation of a 3-year program to develop a sensor for making non-contact electrocardiogram (ECG) measurements through clothing. Last year we developed a prototype sensor with sensitivity more than 10 times greater than the best previously published results. In the coming year we will refine methods to compensate for signal distortions from subject motion and triboelectric charge generation from the rubbing of clothing on the sensor electrodes. The three-year goal of the project is to develop a credit-card sized sensor capable of recording high quality ECG data continuously as a user goes about their daily activities.

Project Title
Protocol Architectures for Multimedia Radios

Principal Investigator
Wendi Heinzelman

University
U of R

Sponsor Company
Harris Corporation

TRACE is a suite of protocols that enable energy-efficient real-time communication of multimedia data, such as voice and video, through network broadcast, multicast and unicast. The major goal of this project is to move towards making TRACE suitable for deployment on Harris radios, including adding support for multi-rate data in the routing protocols, enabling improved capacity usage, determining how to support the security required for deployment, and implementing TRACE on USRP software-defined radios made by Ettus Research LLC to demonstrate the protocols working on real radios. This phase of the project will ensure that TRACE meets the needs for Harris radios in the field.

Energy and Materials

Project Title
Short Range Wireless Communication Systems and Applications in Energy Control

Principal Investigator
Alireza Seyedi

University
U of R

Sponsor Company
Phillips Electronics North America

This project considers short-range wireless communication systems and their applications in energy control. We will study 60GHz wireless personal area networks (WPAN), which promise very high data rates and low latency. We also consider the application of short-range wireless communication networks in energy control, in particular the issues arising in energy control in buildings.

Project Title
Antifouling strategies for pnc-Si filtration

Principal Investigator
Jim McGrath

University
U of R

Sponsor Company
SiMPore

This project will explore mechanisms and remedies for 'fouling' of pnc-Si membranes Pnc-Si is a new porous membrane platform, discovered and developed at UR and commercialized by the Rochester based start-up SiMPore Inc. The nanoporous membranes have many applications; however significant product opportunities for biologicals are limited by the accumulation of biomaterials in and around pores during filtration. While fouling plagues all porous filters used with concentrated biological samples, surface functionalization can help minimize the impact of fouling. Studies here will examine the mechanism of pnc-Si fouling during protein filtration and document the ability of surface functionalization and different flow configurations to minimize fouling.

Project Title
Development of Highly Active Oxygen Reduction Electrocatalysts

Principal Investigator
Hong Yang

University
U of R

Sponsor Company
General Motors

Reducing the amount of platinum used for the catalysis of oxygen reduction reaction (ORR) is the key to enable large scale application of fuel cells for multiple applications including automobiles and portable electronics. A potential breakthrough in platinum reduction lies in the two-order-of-magnitude increase in ORR activity per unit Pt surface area (vs. that for conventional Pt catalysts) for (111) surface-oriented Pt3Ni single crystals (Science, 2007, 315 , 493). The project will build upon our previous successful collaboration with General Motors to develop ORR catalysts at low Pt consumption for the same fuel cell performance.

Corporate Partners

Adarza BioSystems

http://www.adarzabio.com/

Adarza BioSystems, Inc., is an early stage medical diagnostics company developing a rapid and label-free biological assay platform for measuring clinical and point-of-care (POC) samples. In addition to performing sophisticated clinical tests within minutes, this technology is fully arrayable, potentially allowing hundreds of tests to be run simultaneously on a single chip. This proprietary platform technology will enable not only the next generation of clinical devices, but will revolutionize the medical diagnostics field. Ultimately, we envision this technology driving a broad range of devices from future in-home diagnostics where the patient will self-diagnose illness with minimal physician input, to large-scale customizable research-grade instrumentation. Adarza's proprietary chip-based platform, Arrayed Imaging Reflectometry (AIR), achieves high sensitivity by detecting intensity changes in images of antireflective chips functionalized with highly specific detection molecules (proteins, DNA, etc.).

Advanced Acoustic Imaging Technologies

Advanced Acoustic Imaging Technologies, LLC, (AAIT) is a private company located in Rochester, N.Y. Dr. Dogra and Dr. Rao have developed a revolutionary low-cost imaging technology that can be used for screening and diagnostics of soft tissue cancers. AAIT will first focus on the prostate cancer market and then will develop a product for the breast cancer market. This new imaging methodology takes C-scan images in the coronal plane of the prostate gland in real time based on the photoacoustic phenomenon. It can give doctors a more accurate way to distinguish tumors than current ultrasound imaging methods.

ADVantage Imaging Systems, Inc.

www.advis-inc.com/

ADVIS is a fabless semiconductor manufacturer of electronic image sensors and camera modules for applications that span the nearly $6 billion image sensor market. ADVIS applies its innovative technologies to the security and surveillance camera markets, and is expected to expand its technologies for additional products such as single-use digital cameras, camera phones, and automotive applications.

Applied Image Group

www.appliedimage.com

Applied Image Group is a consortium of optical, coating, imaging, and glass fabrication companies designed to provide photonics solutions. By combining diverse companies into a cohesive unit, AIG is able to streamline the design and production process to supply photonics solutions to a wide range of industries.

Bausch & Lomb

www.bausch.com

Bausch & Lomb offers one of the world's most comprehensive portfolios of eye health products. B&L markets five broad categories of products: contact lenses, lens care, pharmaceuticals, cataract and vitreoretinal surgery, and refractive surgery. Because of mutual strengths in imaging sciences, the partnerships between B&L, various University of Rochester departments, and CEIS have helped to move research from the earliest stages to commercial development and clinical application on a global scale. In partnership with CEIS, B&L has helped improve the vision of countless patients.

Blue Highway

www.blue-highway.com/bluehighway.aspx

BLUE HIGHWAY was formed to "create economic value through new customer insight, products or services, policy and regulatory insight, or business models." BLUE HIGHWAY is committed to thoroughly capitalizing on invention. The three kinds of innovation, according to BLUE HIGHWAY, are incremental innovation, radical innovation, and breakthrough innovation.

Calorics Pharmaceuticals

Carestream Health

www.carestreamhealth.com

Carestream Health (formerly Kodak's Health Group) is an international provider of medical and dental imaging systems, as well as information technology solutions, molecular imaging systems, and nondestructive testing products. Carestream products and services are found in 90% of all hospitals worldwide, appearing in more than 150 countries. Current research is intended to further knowledge and applications of imaging technology across many fields of medicine.

Corning, Inc.

www.corning.com

Corning, Inc., is a diversified technology company that develops breakthrough technologies that significantly improve people's lives. Corning pursues innovation and focuses on high impact growth opportunities in the telecommunications, flat panel display, environmental, life sciences, and semiconductor industries.

Diffinity Genomics

www.diffinitygenomics.com

Diffinity Genomics is a Western NY life science start-up company with technologies that enable the development of high margin, single use disposable products for medical, industrial and research applications in two very large and rapidly growing markets; DNA extraction and purification and molecular diagnostics. DNA extraction and purification customers include the 390,000 life science workers engaged in DNA analysis worldwide, spread among 45,000 industrial and academic research labs. The company is currently manufacturing and selling its first product, the Diffinity RapidTip for PCR Purification, to a very receptive market.

General Motors

www.gm.com

General Motors Company (NYSE: GM, TSX: GMM), one of the world's largest automakers, traces its roots back to 1908. With its global headquarters in Detroit, GM employs 209,000 people in every major region of the world and does business in more than 120 countries. GM and its strategic partners produce cars and trucks in 31 countries, and sell and service these vehicles through the following brands: Baojun, Buick, Cadillac, Chevrolet, GMC, Daewoo, Holden, Isuzu, Jiefang, Opel, Vauxhall, and Wuling. GM's largest national market is China, followed by the United States, Brazil, the United Kingdom, Germany, Canada, Italy, Russia, Mexico, and Uzbekistan. GM's OnStar subsidiary is the industry leader in vehicle safety, security and information services.

Geospatial Systems, Inc.

www.geospatialsystems.com

Geospatial Systems focuses on creating state-of-the-art situational awareness systems for the Departments of Defense and Homeland Security, as well as the environmental monitoring market. Core Geospatial Systems technologies focus on advanced image analysis and detection.

Harris Corporation

www.harris.com

Harris is an international communications and information technology company serving government and commercial markets in more than 150 countries. The company has more than 13,000 employees—including 5,500 engineers and scientists—dedicated to the development of best-in-class assured communications™ products, systems, and services. The company's operating divisions serve markets for government communications, RF communications, broadcast communications, and microwave communications.

High Tech Rochester

www.htr.org

High Tech Rochester is a non-profit whose mission is to be a catalyst for entrepreneurship and innovation-based economic development, by applying business expertise and network connections to aid in the formation and profitable growth of companies in the Greater Rochester, NY Region.

HTR provides a suite of services including: Technology Commercialization for very early stage opportunities, Business Incubation for high-growth-potential startups, and Growth Services for existing businesses seeking to improve their top and bottom line performance.

iCardiac Technologies, Inc.

www.icardiac.com

iCardiac Technologies, Inc., provides drug development companies worldwide with the complete range of core lab services. Its team of cardiac safety experts collectively brings over 100 years of cardiology, electrophysiology, drug development, regulatory and academic experience. The iCardiac team pioneered the field of autonomic nervous system effects on the QT interval, a phenomenon estimated to produce false-positive results in conventional QT studies for as many as 25% of all molecules currently in clinical development. iCardiac team members are active contributors on several FDA working groups that are advancing the field of cardiac safety. iCardiac's core laboratory services include scientific and regulatory consultation, protocol development, and end-to-end project and data management.

Impact Technologies, LLC

www.impact-tek.com/

Impact Technologies is a world-class engineering firm that provides a wide range of products and services for analyzing, predicting, and managing the health of critical systems. As a high-tech engineering consulting and health management system development firm, the company is dedicated to supplying advanced machinery diagnostic and prognostic solutions and software tools in the aircraft, land-based equipment, power, and defense industries.

Integrated Nano-Technologies, LLC

www.integratednano.com

Integrated Nano-Technologies, LLC, was founded on the idea that the fusion of molecular biology, chemistry, and microelectronics holds the potential for revolutionary technical advances. Through the confluence of these disciplines, INT is able to create selfassembled nanoscaled circuits. A simple on/off circuit forms the basis for the first product, a novel biosensor capable of detecting single molecules of a target substance. This sensor can be deployed in a variety of devices for use in biosecurity, clinical diagnostics, food safety, and tracking systems.

International Business Machines

www.ibm.com

IBM is an information technology company that also provides business, technology, and consulting services. The company's major operations comprise a Global Services segment, a Systems and Technology group, a Software segment, a Global Financing segment, and an Enterprise Investments segment. IBM's current research portfolio includes the integration of nanotechnology into various systems and devices, and VLSI design studies.

ITT Geospatial Systems

www.ssd.itt.com

ITT Space Systems Division provides innovative remote sensing solutions to customers in the Department of Defense, Intelligence, Space Science, and Commercial Aerospace to help them visualize and understand critical events happening on Earth, in the air, or in space in time to take effective action. From components to complete payload integration, ITT's comprehensive offerings include intelligence, surveillance, and reconnaissance systems; image information solutions; and payload systems and components that have been part of every U.S. GPS navigation system ever launched.

Eastman Kodak Company
www.kodak.com

Eastman Kodak Company is a leading provider of innovative solutions for conventional, digital, and blended print production environments. Kodak promotes the future of Infoimaging by seeking out and leveraging targeted strategic innovation, technology, and intellectual property through formation of alliances with universities, government and research institutions, and early-stage firms. Kodak is committed to research and development in imaging science and technology.

Litron Laboratories
www.litronlabs.com

Litron is a leading testing laboratory providing services to product manufacturers looking to ensure the safety of new items. Among other things, Litron offers toxicology testing for ink and toner brands. In addition to testing, Litron also conducts research into new methodologies for quick detection of toxins.

Logical Images, Inc.
www.logicalimages.com

Logical Images works with the healthcare and life sciences industries to provide image recognition and visual software solutions for advanced applications. Recently, Logical Images released its VirtualDX Clinical Decision Support System, which will assist healthcare professionals in quickly diagnosing and treating patients with high accuracy and precision.

Lucid
www.lucid-tech.com

Lucid is a medical device and information company dedicated to developing innovative cellular imaging technology. Lucid's systems use the Internet to deliver secure and accurate images to medical professionals from their noninvasive imaging technologies. Current development at Lucid focuses on skin cancer diagnosis and treatment.

Med Graph, Inc.
www.med-graph.com/

Med Graph is a technology company specializing in the communication of diagnostic information between patients and medical personnel. In focusing on collecting and standardizing medical data, Med Graph ultimately aims to create a universal "report card" with medical information that can allow medical personnel access to real-time data from applications such as bioimaging devices.

NanoArk Corporation
www.nanoarkcorp.com

NanoArk Corporation was incorporated in 2007 to capitalize on a patent-pending capability to enable long-term preservation of records as images on silicon wafers or other reliable substrates using advanced imaging and semiconductor fabrication techniques. The wafer and reader technology is currently in development and testing, along with initial product applications for specific archival requirements. This storage medium is environmentally robust, information technology independent (both hardware and software), and can store data at high densities in such a way that it is visible to the human eye. As a result, this storage medium is an ideal candidate for longterm preservation of documents.

Omni-ID
www.omni-id.com

Omni-ID is the leading supplier of passive low-profile UHF RFID tags. The company is focused on delivering affordable high-performance tags that work reliably in harsh environments, including on, off, and near metals and liquids. Omni-ID technology enables near-perfect accuracy in RFID asset tracking.

Philips Electronics North America

One of the 100 largest manufacturing companies in the United States, Philips Electronics is the second largest supplier of color televisions and VCRs in the United States and the leading marketer of electric razors. Other products include industrial X-Ray, CD-ROM drives, communication and security systems, dialogue and dictation systems, electronic manufacturing technology, interactive media systems, automation systems, energyefficient lighting, multimedia presentation equipment, semiconductors and electronic components, and telecommunication systems. Research is conducted at Philips Laboratories in Briarcliff Manor, N.Y.

Physiologic Communications, LLC

www.physiocomm.com

Physiologic Communications, LLC (PhysioComm), based in Rochester, N.Y., is an early-stage company that designs and develops implantable wireless biosensors that integrate living cells within the electronics to create a "biological chip." This innovative technology is based on intellectual property licensed from the University of Rochester Medical Center as well as the company's own rapidly growing IP portfolio.

PL E-Communications, LLC

www.ple-communications.com

PL E-Communications, LLC (PLe), has expanded its services to include heavy-duty database solutions and all areas of print and radio media presentation materials, as well as work in the government service areas of surveillance and sensors. PLe approaches all projects, both large and small, with a commitment to excellence, knowing that successful development requires multiple skills and clear processes to deal with the often-complex nature of their projects.

Positive Science, LLC

www.positivescience.com/

Positive Science is a research and development company specializing in the design and construction of lightweight eye-tracking systems for mobile and wearable applications. Since 2002, PSLLC has developed lightweight eye-tracking headgear and custom software for universities and research labs across the globe.

PPC

www.ppc-online.com

PPC, the world leader in telecommunication connector technology, is ready to help its customers provide increasingly sophisticated cable television, telecommunications and Internet services. A family-owned business, PPC invests in plants, people, research and in new ventures.

Proctor & Gamble

www.pg.com

Driven by passionate people and a common purpose, P&G brings beloved brands to consumers around the world—including our 50 Leadership Brands that are among the world's most well known household names.

Qioptiq

www.qioptiq.com

The Qioptiq Group is a leading international organization of world-leading optics companies with locations throughout Europe, Asia, and the U.S. The group has an enviable reputation spanning over 100 years for providing advanced optical systems, equipment, modules, and components for a diverse range of civilian and defense applications. Qioptiq's manufacturing operations offer some of the most advanced capabilities in optical system and module design, build, and manufacture. This capability extends from complex optical components to complete turnkey optomechanical solutions in visible, infrared, and ultraviolet wavebands.

Qualcomm

www.qualcomm.com

From the written word, to image and photos, to music, to videos, games, streaming content, and more, Qualcomm is on a never-ending quest to feed the mind. Whether by developing our technologies or partnering with companies who share our vision, we're leading the charge in the digital revolution.
The world leader in next generation mobile technologies, Qualcomm ideas and inventions are driving wireless growth and helping to connect people to information, entertainment and one another.

Rochester Precision Optics

www.rpoptics.com

Previously known as Kodak Optical Imaging Systems, RPO has combined the assets and know-how of optical manufacturing into an ultra modern 65,000 square foot facility. This expertise in Aspherical Precision Glass Molding, Traditional Optics Fabrication and Diamond Turning provides unique solutions to our customers. With vertically integrated support functions such as thin film coatings and machine shop, our comprehensive design and manufacturing capabilities allow for the rapid prototyping and high volume production of lenses, assemblies and sub-assemblies.

RT & I

Robotic Therapeutic and Imaging, LLC (RT&I) is developing the HemoStopBot a medical device that performs precise robotic targeting of High-Intensity Focused Ultrasound (HIFU) for cardiac catheterizations performed with femoral artery puncture and for liver and kidney surfaces during biopsy. This causes hemostasis and prevents bleeding. This benefits the patient, doctor, and insurance companies by reducing the risk of serious complications from biopsies and reduces pain and anxiety. It will decrease the risk of life-threatening internal bleeding and therefore the risk of mal-practice lawsuits, expensive treatments and hospitalization. This device must work in conjunction with ultrasound medical devices that perform biopsies.

Sharp Laboratories of America

www.sharplabs.com

Sharp Labs of America, a corporate research lab, is a leader in the industry, foreseeing trends and creating advanced technologies in areas such as flat panel displays, consumer electronics, and digital information technology. Creating the next generation of technologies is the goal of each of Sharp Labs' six core research and development units: Digital Video, Multimedia Communications, Digital Imaging Systems, Information Systems Technologies, IC Process Technology, and LCD Process Technology. Current research focuses in part on LCD image quality improvements for next-generation optical devices.

SiMPore Inc.

www.simpore.com/

Located in Rochester, N.Y., SiMPore is in the process of developing a novel membrane filter. According to SiMPore, "This technology offers unparalleled precision in separation and purification with applications ranging from drug development to nanotechnology."

Spectracom Corporation

www.spectracomcorp.com

Spectracom's Time Server, Master Clock, and Synchronization products provide Legally Traceable Time®, as well as secure, accurate, and reliable time across the modern network and organization as a whole. Spectracom supports all kinds of industries and systems that have a need for precision timing, including aerospace and defense, government and civilian agencies, public safety, telecommunications, homeland security, healthcare, financial services, education, transportation, manufacturing, and legal.

Thermo Fisher Scientific

www.thermofisher.com/global/en/home.asp

Thermo Fisher Scientific Inc., (NYSE: TMO), is the world leader in serving science. The company takes pride in enabling customers to make the world healthier, cleaner, and safer.
With annual revenues of $10 billion, 30,000 employees work for the company and serve over 350,000 customers within pharmaceutical and biotech companies, hospitals and clinical diagnostic labs, universities, research institutions and government agencies, as well as environmental and industrial process control settings. Thermo Scientific and Fisher Scientific serve customers through two premier brands, helping solve analytical challenges from routine testing to complex research and discovery.

URnano

The Integrated Nanosystems Center consists of a 1,000 square-foot metrology (measurement) facility and a 2,000 square-foot, cleanroom fabrication facility. The cleanroom lab was designed and equipped in a way that ensures it is virtually free of dust, foreign particles, and chemical vapors. Congresswoman Slaughter secured a total of $4.4 million in federal money across three funding cycles to make the project possible.

VirtualScopics, LLC

www.virtualscopics.com

VirtualScopics is the leading developer of image-related biomarkers, as well as the premier provider of innovative imaging solutions utilizing biomarkers for pharmaceutical development, clinical trials, and medical device development. Virtual Scopics provides services to the pharmaceutical, biotechnology, and medical device industries for oncological, rheumatoid arthritic, osteoarthritic, neurological, and cardiovascular studies.

Xerox Corporation

www.xerox.com

Xerox Corporation is a document management company that man factures and sells a range of color and black-and-white printers, multifunction systems, photo copiers, digital production printing presses, and related consulting services and supplies. Xerox also produces many printing and office supplies such as paper in many forms. Xerox markets software such as DocuShare and FlowPort, and offers consulting services and printing outsourcing.

Foundations and Other Reseach Organizations

National Science Foundation

www.nsf.gov/

The National Science Foundation (NSF) is an independent federal agency created by Congress in 1950 “to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense. . .” It is the funding source for approximately 20% of all federally supported basic research conducted by America’s colleges and universities. The annual budget of the company is about $6.06 billion. NSF is the major source of federal backing in many fields such as mathematics, computer science, and the social sciences.

Smart System Technology & Commercialization Center (STC)

www.itcmems.com

STC is managed and supported by the College of Nanoscale Science & Engineering (CNSE) of the University at Albany. STC’s mission is to promote statewide, technology-led economic development through world-class smart systems’ innovation.

Faculty Researchers of CEIS

With pride in the breadth of their expertise, here we present biographical sketches of our CEIS PIs. Please use this as a jumping-off point to initiate contact with CEIS. Together, research and industry can transform technology. It all starts with the right relationship.

Faculty Researchers

33 Aquavella, James V.
Arney, Jonathan
Baschnagel, Joseph
Boeckman Jr., Robert K.

34 Bocko, Mark F.
Bowman, Robert
Brown, Thomas, G.
Chen, Tsuhan

35 Dianat, Sohail A.
Dogra, Vikram S.
Esterman, Marcos
Friedman, Eby

36 Goldfarb, David
Heinzelman, Wendi
Herbert, Andrew
Hindman, Holly

37 Hirschman, Karl D.
Huxlin, Krystel
Knox, Wayne H.
Lukowiak, Marcin

38 MacRae, Scott.
McGrath, James L.
McMurtry, Craig
Nelson, Randal C.

39 Ninkov, Zoran
Pelz, Jeff B.
Pipher, Judith
Rao, Navalgund A.

40 Rothberg, Lewis
Savakis, Andreas
Saxena, Ashutosh
Seyedi, Alireza

41 Sharma, Gaurav
Sobolewski, Roman
Wismueller, Axel
Yang, Hong

42 Yoon, Geunyong
Zavislan, James M.

Other Faculty Researchers

42 Allen, James
Apsel, Alyssa
Beck, Lisa

43 Bright, Frank V.
Brown, Christopher M.
Burns, Stephen
Chen, Shaw H.
Couderc, Jean-Philippe
DeLouise, Lisa A.

44 Dinnocenzo, Joseph P.
Edwards, Stephen
Fauchet, Philippe
Ferguson, George
Ferwerda, James
Fienup, James

45 Fujiwara, Keigi
Fuller, Lynn
Gao, Yongli
George, Nicholas
Gomes, Carla
Haake, Anne

46 Helguera, Maria
Hornak, Joseph
Huang, Michael
Huttenlocher, Daniel
Ignjatovic, Zeljko
Jones, Thomas

47 Kautz, Henry
Krauss, Todd
Lerner, Amy
Lipson, Michal
McKeown, Donald
Merrill, Douglas

48 Miles, R.N.
Miller, Benjamin L.
Myakishhev-Rempel, Max
Pal, Christopher
Parker, Kevin
Pentland, Alice

49 Raisanen, Alan
Rao, Raghuveer
Saber, Eli
Shenoy, Nirmala
Shepard, Kenneth
Tang, Ching

50 Tomita, Machiko
Williams, David
Yates, Matthew
Zannibbi, Richard
Zareba, Wojciech
Zukowski, Charles

Faculty Researchers

James V. Aquavella, MD

Professor of Ophthalmology, Department of Ophthalmology
University of Rochester Flaum Eye Institute

Education:

Johns Hopkins University, A.B. (1952)

Johns Hopkins University Graduate School

University of Naples School of Medicine, M.D. (1957)

Research Interests:

Corneal wound healing

Ocular surface imaging

Keratoprosthesis

Recent Research Projects:

Various Ocular Surface Imaging Projects.

(585) 273-3937 | James_Aquavella@urmc.rochester.edu | www.urmc.rochester.edu/eye-institute/index.cfm

Jonathan Arney

Professor, Center for Imaging Science,
Rochester Institute of Technology

Education:

Ph.D., University of North Carolina
Chemistry, 1975

Research Interests:

Image microstructure

Halftone modeling

Interaction of light with printing substrates

Recent Research Projects:

Analysis of consumer behavior and experiences via integrated use of mobil eye-tracking and physiological reactivity

(585) 475-7322 | http://www.cis.rit.edu/ | jsapci@cis.rit.edu

Joseph Baschnagel

Assistant Professor, Psychology
Rochester Institute of Technology

Education:

Ph.D., University of Buffalo
Psychology, 2006

M.A., University of Buffalo
Psychology, 2002

Research Interests:

Attention

Smoking behavior

Post-traumatic stress disorder

Psychophysiological

measurement

Recent Research Projects:

Analysis of consumer behavior and experiences via integrated use of mobil eye-tracking an physiological reactivity

(585) 475-4187 | http://people.rit.edu/jsbgsh/ | jsbgsh@rit. edu

Robert Boeckman Jr.

Marshall D. Gates, Jr. Professor of Chemistry
University of Rochester

Education:

NIH Postdoctoral Fellow with Gilbert Stork
Columbia University, 1972

Ph.D., Brandeis University
Organic Chemistry, 1971

B.S. with honors, Carnegie Institute of Technology, 1966

Research Interests:

New synthetic methodology

Applicable solution of complex stereochemical problems

Asymmetric synthesis Organometallic chemistry and conformational theory to assist in the creation of stereo-controlled synthetic transformations

Recent Research Projects:

Professor Boeckman's research efforts focus on the development of new synthetic methodology, applicable solution of complex stereochemical problems, including asymmetric synthesis. His research employs organometallic chemistry and conformational theory to assist creation of stereocontrolled synthetic transformations and utilizes complex multifunctional molecules as target structures for applications of his methodological studies.

(585) 275-4229 | http://www.chem.rochester.edu/faculty/pages/boeckman.html | robert.boeckmanjr@rochester.edu

Mark Bocko

Professor, Electrical & Computer Engineering and Professor of Physics; Professor, Music Theory, University of Rochester

Education:

Ph.D., University of Rochester Physics, 1984

M.S., University of Rochester Physics & Astronomy, 1980

B.S., Colgate University Physics & Astronomy, 1978

Research Interests:

Imaging microelectronics

Wireless sensors

Multimedia signal processing

Recent Research Projects:

Digital audio watermarking and steganography

Image sensors with built-in image compression

Digital CMOS image sensor read-out circuits

(585) 275-4879 | http://www.ece.rochester.edu/users/bocko/ | mark.bocko@rochester.edu

Robert Bowman

Professor, Electrical Engineering & Lab Director, Analog Devices Integrated Microsystems Lab, Rochester Institute of Technology

Education:

Ph.D., University of Utah Electrical Engineering, 1983

Ph.D., University of Utah Bioengineering, 1980

M.S., San Jose State University Electrical Engineering, 1977

B.S., Pennsylvania State University, Electrical Engineering, 1969

Research Interests:

Analog integrated circuit design and technology

Semiconductor device physics

Thin-film silicon devices and-circuits

Microelectromechanical systems, design and fabrication

Recent Research Projects:

Synthesis of High Q Filters Based on Surface Acoustic

Wave Resonators

Device Modeling and Circuit Synthesis for Thin-Film Silicon on Glass

Embedded MEMS Sensors for Monitoring RF Connector Viability

(585) 475-4205 | http://www.ee.rit.edu/research/adiml.html | rjbeee@rit.edu

Thomas Brown

Professor of Optics and Director, Robert E. Hopkins Center for Optical Design and Engineering, University of Rochester

Education:

Ph.D., University of Rochester Optics, 1987

B.S., Gordon College Physics, 1979

Research Interests:

Optical polarization and metrology

Optoelectronic modeling

Integrated optoelectronics

Recent Research Projects:

Enhancing image contrast using polarization correlations

Stress-engineering for polarimetry and imaging

Polarization control of optical nanostructures

Nonlinear properties of micro-structured optical fibers

(585) 275-7816 | http://www.optics.rochester.edu/people/faculty_students_staff/faculty/brown.html | brown@optics.rochester.edu

Tsuhan Chen

Professor and Director, School of Electrical and Computer Engineering (ECE) Cornell University

Education:

Ph.D., Caltech, 1993

M.S., Caltech, 1990

B.S., National Taiwan University

1987

Research Interests:

Computer vision and pattern recognition

Computer graphics

Multimedia coding and streaming

Multimodal biometrics

Recent Research Projects:

Interactive 3D reconstruction from unstructured 2D captures

(607) 255-5728 | tsuhan@ece.cornell.edu | http://chenlab.ece.cornell.edu

Sohail Dianat

Professor, Electrical Engineering,
Rochester Institute of Technology

Education:

Ph.D., George Washington University
Electrical Engineering, 1981

M.S., George Washington University
Electrical Engineering, 1977

B.S., Arya-Mehr University of Technology
Electrical Engineering, 1975

Research Interests:

Digital signal processing and digital image processing

Information theory and coding

Digital communications

Control systems

Recent Research Projects:

Image Data Compression

Spread Spectrum Communication

Control for Imaging

(585) 475-6740 | www.rit.edu/~sadeee | sadeee@rit.edu

Vikram S. Dogra

Professor of Diagnostic Radiology, Urology, and Biomedical Engineering
University of Rochester

Education:

Diplomat American Board of Radiology

ARDMS in Ultrasound Physics, and Abdomen,

OB/GYN, Neurosonography

MD India-Madras U, Madras Med Coll, Medicine, 1977

Research Interests:

Diagnostic radiology

Urology

Biomedical engineering

Imaging sciences

Recent Research Projects:

Working with the Medical Imaging Partnership to provide quality radiology equipment, training, and other critical resources to developing countries with a special emphasis on Africa and Latin America

(585) 275-6359 | vikram_dogra@urmc.rochester.edu

Marcos Esterman

Associate Professor, Industrial & Systems Engineering
Rochester Institute of Technology

Education:

Ph.D., Stanford University

M.S., MIT

Research Interests:

Product development

Design robustness

Recent Research Projects:

Implementation of an electrophotographic linear test-bed

(585) 475-6922 | http://www.cis.rit.edu/ | mxeeie@rit.edu

Eby G. Friedman

Distinguished Professor, Electrical & Computer Engineering,
University of Rochester

Education:

Ph.D., University of Calif., Irvine
Electrical Engineering, 1989

M.S., University of Calif., Irvine
Electrical Engineering, 1981

B.S., Lafayette College
Electrical Engineering, 1979

Research Interests:

Imaging microelectronics

Clock and power distribution networks

Mixed-signal CMOS circuits

Low power circuit architectures

On-chip noise

Speed/area/power trade-offs

Recent Research Projects:

Power and clock distribution networks

On-chip inductive effects

Global signaling

Mixed-signal circuits for noise mitigation

3-D design methodologies

Signal integrity in high-speed digital systems

(585) 275-1022 | http://www.ece.rochester.edu/~friedman | friedman@ece.rochester.edu

David Goldfarb

Professor Biology Department (primary) Biochemistry and Biophysics (secondary) Biomedical Genetics (secondary) Oncology (secondary)

Education:

Undergraduate: University of California, San Diego, B.A. Biology

Graduate: University of California, Davis, Ph.D. Biochemistry

Postdoc: Stanford University, Roger Kornberg

Research Interests:

Molecular mechanism of nuclear transport

Autophagy

Lifespan and aging

Drugs for age-related and inflammatory diseases

Recent Research Projects:

Drugs for age-related and inflammatory disease that target conserved aging pathways

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Wendi B. Heinzelman

Associate Professor, Electrical and Computer Engineering, Dean of Graduate Studies, Arts, Sciences and Engineering,
University of Rochester

Education:

Ph.D., Mass. Inst. of Technology Electrical Engineering & Computer Science, 2000

M.S., Mass. Inst. of Technology Electrical Engineering & Computer Science, 1997

B.S., Cornell University Electrical Engineering, 1995

Research Interests:

Multimedia communication

Wireless sensor networks

RFID systems

Cloud computing

Heterogeneous networking

Recent Research Projects:

Developing RFID systems for inventory management

Designing a QoS-aware protocol architecture to support real-time multimedia data transmission

Optimizing video-based sensor networks

(585) 275-4053 | http://www.ee.rochester.edu/users/wheinzel/ | wendi.heinzelman@rochester.edu

Andrew M. Herbert

Chair, Associate Professor, Department of Psychology,
Rochester Institute of Technology

Education:

Ph.D., University of Western Ontario, Psychology, 1994

M.A., University of Western Ontario, Psychology, 1989

B.Sc., McGill University, Biology, 1985

Research Interests:

Visual perception—pattern-perception, face perception & illusions

Visual attention—selective attention

Recent Research Projects:

Allocating and diverting attention

Of wildebeests and humans: A follow-up on the automatic detection of faces

(585) 475-4554 | http://people.rit.edu/amhgss/ | amhgss@rit.edu

Holly Hindman

Assistant Professor, Department of Ophthalmology,
University of Rochester

Education:

M.D., Harvard Medical School 2003

B.A., Stanford University Human Biology, 1998

Research Interests:

Cornea and Ocular Surface Disease

Surgical techniques including: penetrating, lamellar (DALK) and endothelial keratoplasty (DSAEK), keratoprosthesis, and laser refractive surgery (Including customized and conventional LASIK and PRK as well as PTK).

Recent Research Projects:

Cornea research

Corneal wound healing

Refractive problems of the eye

(585) 276-5482 | http://www.urmc.rochester.edu/eye-institute/ | holly_hindman@urmc.rochester.edu

Karl D. Hirschman

Micron Technology Professor of Microelectronic Engineering,
Rochester Institute of Technology

Education:

Ph.D., University of Rochester Electrical & Computer Engineering, 2000

M.S., Rochester Inst. of Tech. Electrical Engineering, 1992

B.S., Rochester Inst. of Tech. Microelectronic Eng., 1990

Research Interests:

Silicon device integration on non-traditional substrates

Metal-oxide semiconductors for thin-film electronics

Silicon-based optoelectronics

Recent Research Projects:

Development and characterization of high-performance transistors on glass (Corning, Inc. & NYSTAR/CEIS)

Development of bipolar and MOS high-power microwave transistors (Spectrum Devices Corporation, Hatfield, PA)

(585) 475-5130 | http://www.microe.rit.edu/hirschman.html | kdhemc@rit.edu

Krystel R. Huxlin

Associate Professor, Department of Ophthalmology,
University of Rochester

Education:

Ph.D., University of Sydney Neuroscience, 1994

B.S. (Med), University of Sydney, Neuroscience, 1991

Research Interests:

Optics of the eye

Femtosecond laser micromachining in cornea and lens

Visual perception and psychophysics

Biomedical imaging

Recent Research Projects:

Femtosecond laser micromachining

Effect of corneal wound healing on physiological optics of the eye

Perceptual learning with a damaged visual system

(585) 275-5495 | http://www.urmc.rochester.edu/eye-institute/research/labs/huxlin-lab.cfm | huxlin@cvs.rochester.edu

Wayne H. Knox

Professor of Optics The Institute of Optics, and Professor of Visual Sciences, University of Rochester

Associate Dean of Education and New Initiatives in the Hajim School of Engineering and Applied Sciences

Education:

Ph.D., University of Rochester Institute of Optics, 1983

B.S., University of Rochester Institute of Optics, 1979

Research Interests:

Ultrafast laser physics and prototyping

Ultra-broadband laser systems

Biomedical optics using novel ultrafast lasers

Femtosecond micromachining of polymers

Nonlinear fiber and semiconductor devices

Recent Research Projects:

Femtosecond micromachining of ophthalmic polymers

(585) 273-5520 | http://whknox.com | wknox@optics.rochester.edu

Marcin Lukowiak

Assistant Professor, Computer Engineering,
Rochester Institute of Technology

Education:

Ph.D., Poznan University of Technology
Microelectronics, 2001

M.S., Poznan University of Technology
Automatics and Robotics, 1995

Research Interests:

Digital system design

Efficient hardware and hardware-software implementations

High performance computing, applied cryptography

Recent Research Projects:

FPGA Single Chip Crypto

Solution for Secure Voice and Video Transmission over Bluetooth

(585) 475-2808 | http://www.ce.rit.edu/people/lukowiak/ | mxleec@rit.edu

Scott MacRae

Professor, Department of Ophthalmology,
University of Rochester

Education:

M.D.,
University of Wisconsin Medical School, 1977

B.S.,
University of Wisconsin Madison, Zoology, 1974

Research Interests:

Design of numerous refractive surgical instruments

Laser surgery techniques

Holds the patent on a commonly used astigmatism treatment

Recent Research Projects:

Investigation of accommodation and presbyopic lenses

(multifocal and accommodative intraocular lenses)

Development of The Rochester Nomogram which improve accuracy of Customized LASIK and is commonly used worldwide currently

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James L. McGrath

Assistant Professor, Biomedical Engineering,
University of Rochester

Education:

Ph.D., Mass. Inst. of Technology Biological Eng., 1998

M.S., Mass. Inst. of Technology Mechanical Eng., 1994

B.S., Arizona State University Mechanical Eng., 1991

Research Interests:

Nanopartile and molecularseparations

Nanotechnology

MEMS and microfabrication

Cell culture technologies

Recent Research Projects:

The interaction of nanoparticles with cells and protein mixtures

Ultrathin silicon-based nanomembranes for filtration of molecules and nanoparticles

Ultrathin silicon-based nanomembranes for biological co-culture

(585) 273-5489 | http://www.bme.rochester.edu/bmeweb/faculty/mcgrath.html | jim_mcgrath@urmc.rochester.edu

Craig McMurtry

Senior Research Engineer,
University of Rochester

Education:

Ph.D. University of Wyoming Physics and Astronomy, 2000

B.S. University of Rochester Physics and Astronomy, 1994

Recent Research Projects:

IR experiments in support of ITT's Persistent Surveillance Projects

(585) 275-4389 | http://www.pas.rochester.edu/urpas/admin_staff/mcmurtry_craig_w | craig.mcmurtry@rochester.edu

Randal C. Nelson

Associate Professor, Computer Science,
University of Rochester

Education:

Ph.D., University of Maryland Computer Science

M.S., University of Maryland Computer Science

B.S., University of Wyoming Physics, Mathematics

Research Interests:

Pattern and object recognition

Boundary extraction

Robot or machine vision

Recent Research Projects:

Development of a repertoire of primitive operations for visual navigation that are demonstrably usable in a wide range of real-world environments

Appearance-based recognition of complex 3D objects

Development of a real-time system for recognizing moving objects from a moving platform

(585) 275-8848 | www.cs.rochester.edu/~nelson/home.html | nelson@cs.rochester.edu

Zoran Ninkov

Micron Technology Professor of Microelectronic Engineering, Rochester Institute of Technology

Education:

Ph.D., University of Rochester Electrical & Computer Engineering, 2000

M.S., Rochester Inst. of Tech. Electrical Engineering, 1992

B.S., Rochester Inst. of Tech. Microelectronic Eng., 1990

Research Interests:

Silicon device integration on non-traditional substrates

Metal-oxide semiconductors for thin-film electronics

Silicon-based optoelectronics

Recent Research Projects:

Development and characterization of high-performance transistors on glass (Corning, Inc. & NYSTAR/CEIS)

Development of bipolar and MOS high-power microwave transistors (Spectrum Devices Corporation, Hatfield, PA)

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Jeff Pelz

Professor, Chester F. Carlson Center for Imaging Science; Co-Director, Multidisciplinary Vision Research Laboratory, Rochester Institute of Technology

Education:

Ph.D., University of Rochester Brain & Cognitive Sciences, 1995

M.S., Rochester Institute ofTechnology,Imaging and Photographic Science, 1986

B.F.A., Rochester Institute of-Technology, Photography, 1980

Research Interests:

Visual perception

Eye tracking

Recent Research Projects:

Eliminating communication and technological barriers to STEM education

Eye movement analysis for temporal display algorithms and tone scale preferences for higher brightness level displays

Head tracking for nextgeneration 3D displays

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Judith L. Pipher

Professor Emeritus, Physics and Astronomy, University of Rochester

Education:

Ph.D., Cornell University, Astronomy, 1971

M.S., Cornell University, Astronomy, 1970

B.S., University of Toronto, Physics and Astronomy, 1962

Research Interests:

Infrared observations of star forming regions

Infrared detector array development and applications to astronomy, and to persistent surveillance

Recent Research Projects:

Teledyne HgCdTe 10 micron cutoff detector arrays for use in future space experiments, with particular emphasis on NEOCam (Near Earth Object Camera)

Characterization of Raytheon long wavelength HgCdTe detector arrays

FIRE spectrometer development

Persistent surveillance-driven projects

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Navalgund A. Rao

Associate Professor, Chester F. Carlson Center for Imaging Science, Rochester Institute of Technology

Education:

Ph.D., University of Minnesota Physics

M.S., Banaras Hindu University Physics

Research Interests:

Ultrasound imaging systems

Biomedical imaging

Recent Research Projects:

Ultrasound echo signal analysis and tissue histology, NIH-NCI

Scalar diffraction from circular-aperture

Computer modeling of non-linear ultrasound wave propagation and image formation in soft tissue

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Lewis Rothberg

Professor, Chemistry, Chemical Engineering, & Physics,
University of Rochester

Education:

Ph.D., Harvard University
Physics, 1983

B.S., University of Rochester
Physics, 1977

Research Interests:

Organic device science

Metal nanoparticle enhanced-spectroscopy and imaging

Biomolecular sensing

Recent Research Projects:

Novel optical technologies for sensing of nucleic acids and proteins

Mechanistic studies of electronic polymers used in luminescent devices

Plasmonic enhancement of molecular absorption and luminescence

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Andreas Savakis

Professor and Department Head, Computer Engineering
Rochester Institute of Technology

Education:

Ph.D., North Carolina State Univ.
Electrical Engineering, 1991

M.S., Old Dominion University
Electrical Engineering, 1986

B.S., Old Dominion University
Electrical Engineering, 1984

Research Interests:

Real-time computer vision

Multimedia systems

Medical imaging

Recent Research Projects:

Currently developing real-time systems for object tracking and activity recognition

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Ashutosh Saxena

Assistant Professor, Department of Computer Science,
Cornell University

Education:

PhD, Stanford University, 2009.

Research Interests:

Machine Learning

Robotics

Computer Vision.

Recent Research Projects:

Personal Robotics. (http://pr.cs.cornell.edu)

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Alireza Seyedi

Assistant Professor, Electrical and Computer Engineering,
University of Rochester

Education:

Ph.D., Rensselaer Polytechnic Institute,
Electrical Engineering, 2004

M.S., Rensselaer Polytechnic Institute,
Electrical Engineering, 1999

B.S., Sharif University of Technology
Electrical Engineering, 1997

Research Interests:

Body sensor networks

Energy aware communications

Cognitive radios and networks

Multi-gigabit 60GHz WPANs

Recent Research Projects:

Short-range wireless communications with applications in medical imaging and personal heathcare

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Gaurav Sharma

Associate Professor, Electrical and Computer Engineering,
University of Rochester

Education:

Ph.D., North Carolina State Univ. Electrical Engineering, 1996

M.S., North Carolina State Univ. Applied Math, 1995

B.E., Indian Institute of Tech. Electronics and Communication Engineering, 1990

Research Interests:

Color Imaging and Image Processing

Multimedia Security, Data Hiding, and Authentication

Signal Processing for Communications and Bioinformatics

Recent Research Projects:

High-capacity data hiding in-printed images (Xerox)

High capacity 2-D barcodes

Color look-up table compression (Hewlett Packard)

Registration sensitivity analysis of color halftones (Xerox)

Display Gamut and Power co-optimization (Sharp)

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Roman Sobolewski

Professor, Electrical & Computer Engineering, Physics, and Materials Science,
Senior Scientist in Laser Energetics,
University of Rochester

Education:

Sc.D., Polish Academy of Sciences, Physics, 1992

Ph.D., Polish Academy of-Sciences, Physics, 1983

M.S., Warsaw Technical University

Research Interests:

Ultrafast optoelectronics

Quantum optoelectronic and spintronic devices

Ballistic transport in electronic nanodevices

Quantum communication and information

Recent Research Projects:

Quantum key distribution using polarized infrared single photons for practical quantum cryptography and deep-space optical communications

Subpicosecond electro- and magneto-optic characterization of electronic, optoelectronic, and spintronic materials and systems

(585) 275-1551 | http://www.ece.rochester.edu/users/roman/ | roman.sobolewski@rochester.edu

Axel Wismueller

Associate Professor, Imaging Sciences, Biomedical Engineering, Electrical and Computer Engineering,
University of Rochester

Education:

M.D. 1992;, M.Sc,1996; Technical University of Munich, Germany,

Ph.D. Electrical and Computer Engineering, Technical University of Munich, 2006;

Radiology, University of Munich, Faculty of Medicine, University of Munich, 2009

Research Interests:

Computer-assisted radiology

Biomedical image analysis

Machine learning

Pattern recognition in clinical-real-world applications

Recent Research Projects:

Computer-aided analysis of interstitial lung disease patterns in chest computer tomography; Integration of multimodality, multispectral and multidimensional imaging data for breast cancer diagnosis and therapy management; Content-based image retrieval for computer- aided analysis of interstitial lung disease patterns

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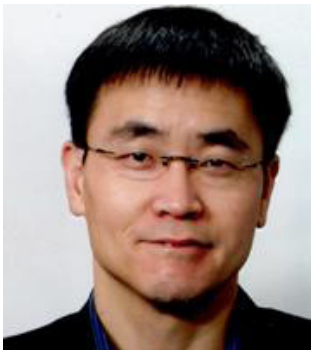
Hong Yang

Professor of Chemical Engineering Scientist, Laboratory for Laser Energetics
University of Rochester



Education:

Ph.D., University of Toronto 1998

M.Sc., University of Victoria, 1994

B.Sc., Tsinghua University, 1989.

Research Interests:

The synthesis, fabrication and application of nanostructured materials

Recent Research Projects:

Development of Highly Active Oxygen Reduction Electrocatalysts

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Geunyoung Yoon

Associate Professor, Ophthalmology, Institute of Optics, Center for Visual Science, University of Rochester

Education:

Ph.D., Osaka University
Laser Optics, 1998

M.S., Osaka University
Laser Optics, 1995

B.S., SungKyunKwan University
Physics, 1990

Research Interests:

Adaptive optics and in-vivo ocular surface and intraocular imaging

Customized vision correction

Presbyopic correction

Recent Research Projects:

Large stroke adaptive optics for correcting highly aberrated eyes

Investigation of accommodation and presbyopic lenses (multifocal and accommodative intraocular lenses)

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James M. Zavislan

Associate Professor, Institute of Optics, University of Rochester

Education:

Ph.D., The Institute of Optics, University of Rochester, 1988

B.S., The Institute of Optics, University of Rochester, 1981, High Honors

Research Interests:

Improving the performance of optical imaging systems

Optical design

Optical fabrication

Optical design using anisotropic optical materials

Tolerancing of optical systems

Recent Research Projects:

Multi-modal tumor mapping system

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Other Faculty Researchers

Alyssa B. Apsel

Associate Professor, Electrical and Computer Engineering, Cornell University

Education:

Ph.D., The Johns Hopkins University, Electrical Engineering, 2002

M.S., California Institute of Technology, Electrical Engineering, 1996

B.S. (with distinction), Swarthmore College, Electrical Engineering, 1995

Research Interests:

Low-power I/O interfaces and signaling

Analog and mixed signal circuit design in scaled CMOS

Interconnect design

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James Allen

Professor, Computer Science, University of Rochester

Education:

Ph.D. University of Toronto
1979

M.S. University of Calif., Irvine
Electrical Engineering, 1981

B.S. Lafayette College
Electrical Engineering, 1979

Research Interests:

Natural Language Understanding

Knowledge Representation

Discourse

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Lisa Beck

Associate Professor, Department of Dermatology, University of Rochester

Education:

M.D., Stony Brook University Health Sciences Center School of Medicine, 1985

B.A., Mount Holyoke College Chemistry, 1981

Research Interests:

NIH-funded study to determine why certain patients are susceptible to the herpes simplex and Staphylococcus aureus viruses

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Frank V. Bright

Distinguished Professor, Chemistry, University at Buffalo

Education:

Ph.D., Oklahoma State University, 1985

B.S., University of Redlands, 1982

Research Interests:

Sensors, arrays and detections Tailored materials

Environmentally friendly chemistries

Chemical analysis

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Shaw H. Chen

Professor, Chemical Engineering, University of Rochester

Education:

Ph.D., University of Minnesota Chemical Engineering, 1981

M.S., National Taiwan University Organic Chemistry, 1973

B.S., National Taiwan University Chemical Engineering, 1971

Research Interests:

Liquid crystals

Light-emitting diodes (LEDs)

Optoelectronic display materials and devices

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Christopher M. Brown

Professor, Computer Science, University of Rochester

Education:

Ph.D., University of Chicago Information Sciences, 1972

M.S., University of Chicago Information Sciences, 1972

B.A., Oberlin College Philosophy, 1967

Research Interests:

Image understanding

Image fusion

Robot or machine vision

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Jean-Philippe Couderc

Associate Professor, Department of Medicine, University of Rochester

Education:

M.B.A., Simon School Health Care Management, 2003

Ph.D., National Institute of Applied Science, Biomedical Engineering, 1997

M.S., Medical Specialties, Oth, France - Non-Medical School, 1994

Research Interests:

Computational science and engineering

Numerical analysis

Computer science applied to electrophysiological signals

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Stephen Burns

Professor of Mechanical Engineering, University of Rochester

Education:

Ph.D., Cornell University, Materials Science and Engineering, 1967

M.S., Cornell University, Applied Physics and Engineering Physics, 1965

B.S., Pratt Institute, Engineering Science, 1961

Research Interests:

Experimental materials science Mechanical testing

X-Ray diffraction of single and poly crystalline metals, ceramics and polymers

Fracture mechanics

Thermodynamics especially of solids

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Lisa A. DeLouise

Assistant Professor, Dermatology and BME,, University of Rochester

Education:

Ph.D., Pennsylvania State University Physical Chemistry, 1984

B.S., Providence College Chemistry, 1979

Research Interests:

Chemical and biological sensors

Biomaterials

Nanotoxicology

Surface chemistry

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Joseph P. Dinnocenzo

Professor, Chemistry, University of Rochester

Education:

Ph.D., Cornell University Organic Chemistry, 1983

M.S., Cornell University Organic Chemistry, 1980

B.A., University of Notre Dame Chemistry, 1978

Research Interests:

Optical and photonic materials

Photochemistry Electron transfer processes

Polymer science

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George Ferguson

Professor, Computer Science University of Rochester

Education:

Ph.D., University of Rochester Computer Science, 1995

M.S., University of Rochester Computer Science, 1991

M.S., University of Alberta Computing Science, 1989

B.Sc., McGill University, Math & Computer Science, 1987

Research Interests:

Artificial intelligence

User interfaces

Natural language understanding

Agent communication languages

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Stephen Edwards

Associate Professor, Computer Science, Columbia University

Education:

Ph.D., University of California, Berkeley
Electrical Engineering, 1997

M.S., University of Texas at Austin
Electrical Engineering, 1994

B.S., California Institute of Technology
Electrical Engineering, 1992

Research Interests:

Languages and compilers for embedded systems

Computer-aided digital design

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James Ferwerda

Associate Professor, Munsell Color Science Laboratory, Center for Imaging Science, Rochester Institute of Technology

Education:

Ph.D., Cornell University Experimental Psychology, 1998

M.S., Cornell University Computer Graphics, 1987

B.A., Cornell University Psychology with Honors, 1980

Research Interests:

Computer graphics

Digital imaging

Data visualization

Visual perception

Low vision

Assistive technologies

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Philippe Fauchet

Professor and Chair, ECE, University of Rochester

Education:

Ph.D., Stanford University Applied Physics, 1984

M.S., Brown University Engineering, 1980

Ingēnieur Civil Electricien, Facultē Polytechnique de Mons, Belgium, 1978

Research Interests:

Ultrafast laser spectroscopy of solids

Picosecond opto-electronics Femtosecond laser technology

Applications of free electron lasers

Optical characterization of non-crystalline semi- conductors

(585) 275-1487 http://www.ece.rochester.edu/ html/people/Fauchet/Fauchet.html | fauchet@ee.rochester.edu

James Fienup

Robert E. Hopkins Professor of Optics, University of Rochester

Education:

Ph.D., Stanford University Applied Physics, 1975

M.S., Stanford University Applied Physics, 1972

B.A., Holy Cross College Physics/Mathematics, 1970

Research Interests:

Phase retrieval

Biomedical imaging

Image quality measurement

Digital restoration

(585) 275-8009 | http://www.optics.rochester.edu/workgroups/fienup/index.html | fienup@optics.rochester.edu

Keigi Fujiwara

Professor, Aab Cardiovascular Research Institute, University of Rochester

Education:

Ph.D., University of Pennsylvania
Cell Biology, 1974

B.A., International Christian University
Biology, 1968

Research Interests:

Cell mechanosignaling

Cell structural analysis

(585) 273-5714 | http://www.urmc.rochester.edu/cvri/faculty/keigi_fujiwara.cfm |

keigi_fujiwara@urmc.rochester.edu

Nicholas George

Joseph C. Wilson Professor of Electronic Imaging and Professor of Optics, University of Rochester

Education:

Ph.D., California Inst. of Tech.
Electrical Engineering and Physics, 1959

M.S., University of Maryland
Electrical Engineering, 1956

B.S., University of California, Berkeley,
Engineering Physics, 1952

Research Interests:

Electromagnetic theory and speckle

Image science

Computer and optical imaging systems

Automatic object recognition

(585) 275-2417 | http://www.optics.rochester.edu/people/faculty_students_staff/faculty/george.html | nicholas.george@rochester.edu

Lynn Fuller

Professor, Microelectronic Engineering, Rochester Institute of Technology

Education:

Ph.D., SUNY Buffalo
Electrical Engineering

M.S., Rochester Inst. of Tech.
Electrical Engineering

B.S., Rochester Inst. of Tech.
Electrical Engineering

Research Interests:

Design and fabrication of MEMS devices

CMOS IC design, fabrication and manufacturing

MEMS sensors and bio-sensors

Microsystems

(585) 475-2035 | http://people.rit.edu/lffeee/ | lynn.fuller@rit.edu

Carla Gomes

Associate Professor, Computer Science, Cornell University

Education:

Ph.D., University of Edinburgh
Computer Science, 1993

M.Sc., University of Lisbon
Applied Mathematics, 1987

Research Interests:

Constraint reasoning

Randomization in computation

Integration of methods from artificial intelligence and operations research for combinatorial optimization

(607) 255-9189 | http://www.cs.cornell.edu/gomes/ | gomes@cs.cornell.edu

Yongli Gao

Professor, Physics & Astronomy, University of Rochester

Education:

Ph.D., Purdue University
Physics, 1986

B.S., Central-South University of Tech., Physics, 1981

Research Interests:

Ultraviolet photoemission spectroscopy, Inverse photoemission spectroscopy, and X-ray photoemission spectroscopy

Femtosecond time-resolved photoemission spectroscopy

Scanning probe microscopy

Photoluminescence

Electroluminescence

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Anne Haake

Associate Professor, Information Technology, Rochester Institute of Technology

Education:

Ph.D., M.S., Univ. of South Carolina
Developmental Biology, 1985, 1981

M.S., Rochester Inst. of Tech.
Software Development & Management, 1999

B.S., Colgate University
Biology, 1979

Research Interests:

Biomedical informatics

Human-computer interaction

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Maria Helguera

Assistant Professor, Imaging Science, Rochester Institute of Technology

Education:

Ph.D., Rochester Inst. of Tech. Imaging Science, 1999

M.S., University of Rochester Electrical Engineering, 1988

B.S., Universidad Nacional Autōnoma de Mēxico Physics, 1984

Research Interests:

Medical imaging

Quantitative ultrasound imaging

Image processing

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Daniel Huttenlocher

John P. and Rilla Neafsey Professor of Computing, Information Science and Business, Cornell University

Education:

Ph.D., Massachusetts Inst. of Tech., Computer Science, 1988

M.S., Massachusetts Inst. of Tech., Computer Science

B.S., University of Michigan Computer Science and Experimental Psychology

Research Interests:

Image matching and comparison

Object tracking and video monitoring

Efficient algorithms for low-level vision

Computational geometry

Interactive document systems

(607) 255-1974 | http://www.cs.cornell.edu/~dph/ | dph@cs.cornell.edu

Joseph Hornak

Professor, Chemistry and Imaging Science, Rochester Institute of Technology

Research Interests:

Magnetic resonance imaging

Education:

Ph.D., University of Notre Dame Chemistry, 1982

M.S., Purdue University Physical Chemistry, 1978

B.S., Utica College Chemistry, 1976

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Zeljko Ignjatovic

Assistant Professor, Electrical & Computer Engineering University of Rochester

Education:

Ph.D., University of Rochester Electrical and Computer Engineering, 2004

M.S., University of Rochester Electrical and Computer Engineering, 2001

B.S., University of Novi Sad Electrical Engineering and Computer Science, 1999

Research Interests:

A/D conversion

CMOS analog circuits

Low power circuit architectures

Image sensors

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Michael Huang

Associate Professor, Electrical & Computer Engineering, University of Rochester

Education:

Ph.D., University of Illinois Computer Science, 2002

M.S., University of Illinois Computer Science, 1999

B.E., Tsinghua University Computer Science and Engineering, 1994

Research Interests:

High-performance computer system architecture

Processor microarchitecture

Low-power digital logic and memory subsystems

Embedded systems

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Thomas Jones

Professor, Electrical Engineering, University of Rochester

Education:

Ph.D., Mass. Inst. of Technology Electrical Engineering, 1970

S.M., Mass. Inst. of Technology Electrical Engineering, 1967

S.B., Mass. Inst. of Technology Electrical Engineering, 1966

Research Interests:

Microelectromechanical systems (MEMS)

Micro total analysis systems (MicroTAS)

Particulate dielectrophoresis and microfluidic systems

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Henry Kautz

Professor and Chair, Computer Science,University of Rochester

Education:

Ph.D., University of Rochester
Computer Science

M.Sc., University of Toronto
Computer Science

Research Interests:

Artificial intelligence

Pervasive computing

Assistive technology

Efficient algorithms for logical and probabilistic reasoning

Planning as satisfiability framework

Methods for behavior recognition from sensor data

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Todd Krauss

Associate Professor, Chemistry and Optics, University of Rochester

Education:

Ph.D., Cornell University
Applied Physics, 1998

M.S., Cornell University
Applied Physics, 1994

B.S., Cornell University
Applied and Engineering Physics, 1991

Research Interests:

Carbon nanotubes

Semiconductor nanocrystals

Single molecule spectroscopy

Ultrafast optical spectroscopy

Atomic force microscopy

(585) 275-5093 | http://www.chem.rochester.edu/Faculty/Krauss.html | krauss@chem.rochester.edu

Amy Lerner

Associate Professor, Biomedical Engineering, University of Rochester

Education:

Ph.D., University of Michigan
Mechanical Engineering, 1996

M.S., Unviersity of Michigan
Mechanical Engineering, 1996

B.S., University of Delaware
Mechanical Engineering, 1990

Cornell University
Textile Science, 1983

Research Interests:

Computational biomechanics modeling

Image metrology

Biomedical imaging

(585) 275-7847 | http://www.bme.rochester.edu | amy.lerner@rochester.edu

Michal Lipson

Assistant Professor, Electrical & Computer Engineering, Cornell University

Education:

Ph.D., Israel Inst. of Technology
Physics, 1998

M.S., Israel Inst. of Technology
Physics, 1994

B.S., Israel Inst. of Technology
Physics, 1992

Research Interests:

Optoelectronic display materials and devices

Optical nanostructures

Optoelectronic displays

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Donald McKeown

Distinguished Researcher, Rochester Institute of Technology

Education:

B.S.A.E., State University of New York at Buffalo
Aerospace Engineering, 1982

Research Interests:

Operations manager for airborne remote sensing programs for imaging science at RIT

Airborne and spaceborne remote sensing systems

System engineering

Project management

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Douglas Merrill

Professor and Director, Center for Bioscience Education and Technology, Rochester Institute of Technology

Education:

Ph.D., Syracuse University
Environmental Physiology, 1977

B.S., Syracuse University
Forest Biology, 1972

Research Interests:

Histology and photomicrography

Histochemistry

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R.N. Miles

Professor of Mechanical Engineering,
State University of New York at Binghamton

Education:

Ph.D., University of Washington
Mechanical Engineering, 1987

M.S.E., University of Washington
Mechanical Engineering, 1985

B.S.E.E., University of California
Berkeley, Electronics, 1976

Research Interests:

Primary research is on the development of biologicallyinspired microacoustic sensors for applications in health, automotive and consumer electronics.

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Benjamin L. Miller

Associate Professor, Dermatology, University of Rochester

Education:

Ph.D., Stanford University
Organic Chemistry, 1994

B.S., B.A., Miami University (Ohio)
Chemistry, Mathematics &
German, 1988

Research Interests:

Biomedical nanotechnology

Combinatorial chemistry

Biophysical methods

Biosensors

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Max Myakishhev-Rempel

Research Fellow, Department of Dermatology, University of Rochester

Education:

Ph.D., Institute of Gene Biology
Molecular Biology, 1994

M.S., Moscow State University
DNA Chemistry, 1986

Research Interests:

Image processing architectures

BioImaging

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Christopher Pal

Assistant Professor, Computer Science, University of Rochester

Education:

Ph.D., University of Waterloo
Computer Science

M. Math, University of Waterloo
Computer Science

B.Sc., University of Guelph
Physics

Research Interests:

Computer vision and pattern recognition

Document processing, analysis and data mining

Machine learning and interactive multimedia

Image and data analysis in bioinformatics and computational biology

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Kevin Parker

William F. May Professor of Engineering, Professor of Electrical & Computer Engineering, Biomedical Engineering, and Radiology, University of Rochester

Education:

Ph.D., Massachusetts Inst. of Tech.
Electrical Engineering, 1981

M.S., Massachusetts Inst. of Tech.
Electrical Engineering, 1978

B.S., SUNY Buffalo
Engineering Science, 1976

Research Interests:

Image processing

Biomedical imaging

Ultrasound imaging systems

3D/4D image synthesis

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Alice Pentland

Professor and Chair, Dermatology, University of Rochester

Education:

M.D., University of Michigan
1978

B.S., University of Michigan
Biology

Research Interests:

Cyclooxygenases and phospholipases in epidermal function

Carcinogenesis

Cell photobiology

(585) 275-1998 | http://www.urmc.rochester.edu/derm/faculty/pentlandRES.htm | Alice_Pentland@urmc.rochester.edu

Alan Raisanen

Technical Director, NYSTAR IT Collaboratory, Rochester Institute of Technology

Education:

Ph.D., University of Minnesota
Materials Science and Engineering, 1991

B.A., Drake University
Physics, 1985

Research Interests:

MEMS devices for mechanical, fluidic, and optical applications

Microsystems product design and prototyping

Microfluidic devices

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Raghuveer Rao

Professor, Electrical Engineering, Rochester Institute of Technology

Education:

Ph.D., University of Connecticut, Electrical Engineering, 1984

M.S., Indian Institute of Science
Electrical Communication Engineering, 1981

B.S., Mysore University
Electronics & Communication, 1979

Research Interests:

Sensor array imaging

Document image processing

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Eli Saber

Associate Professor, Electrical Engineering, Extended Faculty of the Imaging Science Program, Rochester Institute of Technology

Education:

Ph.D., University of Rochester
Electrical Engineering, 1996

M.S., University of Rochester
Electrical Engineering, 1992

B.S., SUNY Buffalo
Electrical and Computer Engineering, 1988

Research Interests:

Image & video classification and indexing

Image & video segmentation

Three-dimensional scene reconstruction

Object motion tracking

Multimedia understanding and indexing

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Nirmala Shenoy

Associate Professor, Information Technology, Rochester Institute of Technology

Education:

Ph.D., University of Bremen
Computer Science, 1991

M.S., University of Madras
Applied Electronics, 1980

B.S., University of Madras
Electronics and Telecommunications, 1978

Research Interests:

Mobility models

Mobile ad hoc networks and sensor networks

Mobility management protocols

Evaluation of wireless networks

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Kenneth Shepard

Professor, Electrical Engineering, Columbia University

Education:

Ph.D., Stanford University
Electrical Engineering, 1992

M.S., Stanford University
Electrical Engineering, 1988

B.S., Princeton University
Electrical Engineering, 1987

Research Interests:

Mixed analog-digital CMOS

integrated circuit design

Bioelectronics systems

Applications of CMOS electronics to biotechnology

(212) 854-2529 | http://www.bioee.ee.columbia.edu/~shepard/ | shepard@ee.columbia.edu

Ching Tang

Doris Johns Cherry Professor of Chemical Engineering, Physics, and Chemistry, University of Rochester

Education:

Ph.D. Cornell University
Physical Chemistry, 1975

B.S University of British Columbia
Chemistry, 1970

Research Interests:

Applications of organic electronic devices – organic light emitting diodes, solar cells, photoconductors, image sensors, photoreceptors. Basic studies of organic thin-film devices: charge injection, transport, recombination and luminescence properties. Metal-organic and organic-organic junction phenomena. Development of flat-panel display technology based on organic light emitting diodes.

(585) 275-3552 | http://www.che.rochester.edu/tang.htm | chtang@che.rochester.edu

Machiko Tomita

Clinical Associate Professor, Rehabilitation Science, University at Buffalo

Education:

Ph.D., University of Minnesota
Soc. Research/Statistics/Communication, 1989

M.A., University of Minnesota
Mass Communication Research, 1981

M.A., Sophia University
Mass Communication, 1976

B.A., Sophia University

Research Interests:

Communication technology and health behavior change

Aging with chronic conditions

(716) 829-3141 x153 | http://sphhp.buffalo.edu/rs/faculty/ tomita_machiko.php | machikot@acsu.buffalo.edu

Richard Zannibbi

Assistant Professor, Computer Science, Rochester Institute of Technology

Education:

Ph.D., Queen's University
Computer Science, 2005

M.S.c, Queen's University
Computer Science, 2000

B.A., Queen's University
Computer Science, 1998

Research Interests:

Pattern recognition

Machine learning

Document recognition

CAPTCHAs

Human-computer interaction

Programming languages

(585) 475-5023 | http://www.cs.rit.edu/~rlaz/ | rlaz@cs.rit.edu

David Williams

William G. Allyn Professor of Medical Optics, Brain & Cognitive Sciences, University of Rochester

Education:

Ph.D., University of California
Psychology, 1979

M.S., University of California
Psychology, 1976

B.S., Denison University
Psychology, 1975

Research Interests:

Optics of the eye

High-resolution retinal imaging

Adaptive optics

Vision measurement

(585) 275-8672 | http://www.cvs.rochester.edu/williamslab/p_williams.html | david@cvs.rochester.edu

Wojciech Zareba

Professor, Department of Medicine, University of Rochester

Education:

Ph.D., Medical University of Lodz
Cardiology, 1988
M.D., Medical University of Lodz, 1981

Research Interests:

Cardiac defibrillators and resynchronization devices

Cardiac safety in drug trials

(585) 275-5391 | wojciech.zareba@heart.rochester.edu

Matthew Yates

Associate Professor, Chemical Engineering, University of Rochester

Education:

Ph.D., University of Texas
Chemical Engineering, 1999

M.S., University of Texas
Chemical Engineering, 1998

B.S., Tulane University
Chemical Engineering, 1994

Research Interests:

Self-assembly and crystallization

Microencapsulation

Nanoengineering of particles and membranes

(585) 273-2335 | http://www.che.rochester.edu/yates.htm | myates@che.rochester.edu

Charles Zukowski

Professor and Vice Chair, Electrical Engineering, Columbia University

Education:

Ph.D., Mass. Inst. of Technology
Electrical Engineering, 1985

M.S., Mass. Inst. of Technology
Electrical Engineering, 1982

B.S., Mass. Inst. of Technology
Electrical Engineering, 1982

Research Interests:

Design and analysis of digital VLSI circuits

Circuit simulation

Circuits for simulation and communication

(212) 854-2073 | http://www.ee.columbia.edu/fac-bios/zukowski/faculty.html | caz@columbia.edu

Academic Partners

While CEIS has a physical office located in Rochester, at its core it is a virtual center that is comprised of top engineering and science researchers at some of New York State's best academic institutions, including University of Rochester, Rochester Institute of Technology, University at Buffalo, Columbia University, and Cornell University.

CEIS is a research resource and partner to major global corporations and small startups—all with the purpose of developing and commercializing new technologies in New York State so that they can be brought to market in diverse applications while growing the regional economy.

In total, approximately 90 researchers covering a wide array of research interests are the Principal Investigators of CEIS. This Annual Report includes the following overview of their scientific passions, projects and patents. We hope that reading about their accomplishments and capabilities will spark the potential for a new collaboration. Contact us so that we can work with you to develop your company's next wave of products or services.

University of Rochester

Please visit our website at http://www.ceis.rochester.edu

To explore research project opportunities, please contact:
Paul Ballentine, Associate Director, Business Development
(585) 273-2642
paul.ballentine@rochester.edu

Cornell University

Rochester Institute of Technology

CEIS Team

Mark Bocko, Director of CEIS | mark.bocko@rochester.edu | (585) 275-4879

Mark F. Bocko is a professor of Electrical and Computer Engineering and holds joint appointments in the Department of Physics and Astronomy and the Department of Music Theory at the University's Eastman School of Music. Professor Bocko's career spans many areas of basic and applied research from his research on the fundamental limits of force sensing for gravitational wave detectors built to probe the cosmos and the origins of the Universe, the invention of a new class of displacement sensors based on electron tunneling, the development of high performance superconducting digital electronic circuits and his work on superconducting quantum computers. He also has made many contributions in applied research in the areas of sensors and signal processing.

Professor Bocko has experience in commercial product development as a consultant to several sensor companies, and most recently as an entrepreneur and founder of ADVIS, Inc., a growing high-technology startup company located in Rochester, N.Y. As a Principal Investigator on various projects sponsored by the University of Rochester's NYSTAR Center for Emerging & Innovative Sciences, Bocko has more than $7M in documented economic impact for NYS companies in the past four years. He is the author of more than 110 technical papers and has eight patents granted and five pending. Professor Bocko has been the recipient of three University teaching awards and in 2008 he was named the Mercer Brugler Distinguished Teaching Professor of the University.

Paul Ballentine, Associate Director, Business Development | paul.ballentine@rochester.edu | (585) 273-2642

Paul Ballentine joined CEIS as Associate Director for Business Development in October 2010. He has played a leading role in helping new companies get started in the clean energy market. Paul is the founder and principal in Solennium, a consulting firm in specializing in renewable energy, energy efficiency, and smart grid and is the co-founder of the Solar Energy Entrepreneurs Network, an organization with over 1500 members from across the clean energy ecosystem. Prior to starting Solennium, Paul was the director of Clean Energy Business Development for Freescale Semiconductor. Paul has a B.S. in Physics from Siena College, an M.S. in Mechanical Engineering from MIT, and a Ph.D. in Electrical Engineering from the University of Rochester. While working on his Ph.D. at the University of Rochester, Paul co-founded CVC Partners, which eventually went public and was later acquired by Veeco Instruments.

Cathy Adams, Business Manager | cathy.adams@rochester.edu | (585) 275-3999

Cathy Adams joined CEIS in January 2010 after working in the School of Medicine and Dentistry's Division of Geriatrics and Aging for 18 years. Cathy brings a wealth of experience in business operations, budgeting, personnel management, and strategic planning. She is responsible for the day-to-day operations of the Center in compliance with University and NYSTAR policies and for managing the various affiliations the Center has with PIs and their University departments, and sponsored research departments at partner institutions and NYSTAR.

William McKenna, Business Innovation Consultant | mckennaceis@gmail.com | (585) 275-1990

Bill McKenna is CEO and co-founder of The Avout Group and President of Green River Technologies. Employed for 25 years at Eastman Kodak Company, Rohm and Haas, and Dow Chemical Company, Bill has held diverse leadership positions including: Laboratory Manager of Material Science, Program Manager for Flexible Display and Display Films, Director of External Technology, and Director of Research for Optical Display Films. He has significant experience in leading cross-functional teams of scientists and engineers and in delivering integrated product solutions. Bill is experienced in intellectual property development and IP appraisal, working with both universities and start-up companies. He completed a NATO Postdoctoral at Southampton University in the UK and holds a PhD in Chemistry from The University of Utah and a B.S. in Chemistry from the University of Oregon.

Kristine Long, Administrative Assistant
kristine.long@rochester.edu
(585) 275-2104

Kristine Long joined CEIS in the spring of 2010, and serves as Administrative Assistant. She is responsible for financial recordkeeping and budget oversight. Prior to joining CEIS, she was with the Division of Geriatrics & Aging with the University of Rochester. She has significant office management experience and takes responsibility for day-to-day oversight of CEIS financial records.

Greta Collins, Program Assistant
greta.collins@rochester.edu
(585) 273-2672

Greta Collins is a senior at the University of Rochester,. She contributes to the production of publications and assists with various office responsibilities. Greta is from Potsdam, N.Y., and is pursuing a major in Biomedical Engineering and a minor in Business.

Ana Garcia, Program Assistant
agarc14@seas.rochester.edu
(585) 275-8092

Ana Garcia is a Junior at the University of Rochester pursuing a degree in International Relations, originally from Bogota, Colombia. She aids in the programming of CEIS' Speaker Series and assists with other office tasks as well.

Luke Severski, Program Assistant
lseversk@hse.rochester.edu
(585) 273-2672

Luke Severski is a Junior currently pursuing a degree in Business at the University of Rochester. He assists CEIS printed materials as well as various other center responsibilities. Luke is from Penfield, NY, a suburb of Rochester.

Alyssa Smudzin, Program Assistant
smudzinceis@gmail.com
(585) 273-2672

Alyssa Smudzin is a senior at the University of Rochester. She contributes to CEIS publications and assists with various center responsibilities and tasks. Alyssa is from LeRoy, N.Y., and is pursuing a degree in Studio Arts.

Industry Advisory Board

The Industry Advisory Board works with CEIS to establish action-oriented plans and goals to keep innovative technologies in the pipeline, connecting academic research with corporate product development.

Bob Naum, *Applied Coatings* (Chair)

Bob Fiete, *ITT Geospatial Systems*

Richard Grzybowski, *Corning, Inc.*

Zoran Ninkov, *RIT*

Mark Peterson, *Greater Rochester Enterprise*

Christine Whitman, *Complemar Partners*

Ray Yingling, *Eastman Kodak Company*

Center for Emerging & Innovative Sciences

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260 Hutchison Road
Rochester, NY 14627-0194

From the north

Take I-390 South to Exit 17.

From the south

Take I-390 North to Exit 17.

From the east

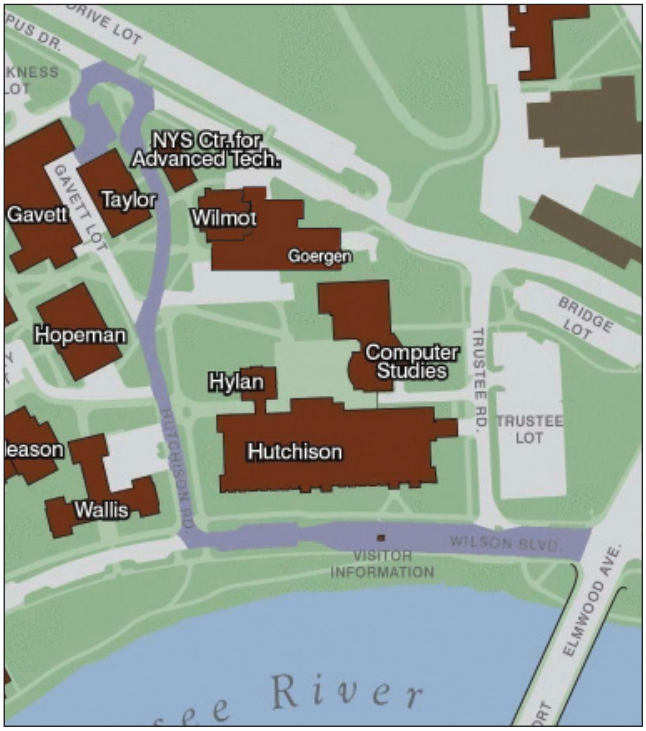
Travel west on the NYS Thruway (Rte. 90). Take Exit 46, and follow I-390 North to Exit 17.

From the west

Travel east on the NYS Thruway (Rte. 90). Take Exit 47, and follow I-490 East. Merge onto I-390 South and take Exit 17.

From Exit 17

- Turn left onto Scottsville Road. At the second light, bear right onto Elmwood Avenue. Cross the Genesee River Bridge and turn left onto Wilson Boulevard at the U of R sign.
- Proceed past the information booth.
- Turn right onto Hutchison Road.
- Follow Hutchison and bear right at the fork. You will pass Taylor Hall and CEIS on the left.
- Continue to the end of Hutchison at Intercampus Drive and turn left. Turn left again immediately at the first driveway, and again bear left into the parking lot.
- Park in one of the CEIS reserved parking spaces along the back of Taylor Hall, and follow the instructions on the signs.



Parking restrictions are strictly enforced on campus.

Center for
Emerging & Innovative
Sciences

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