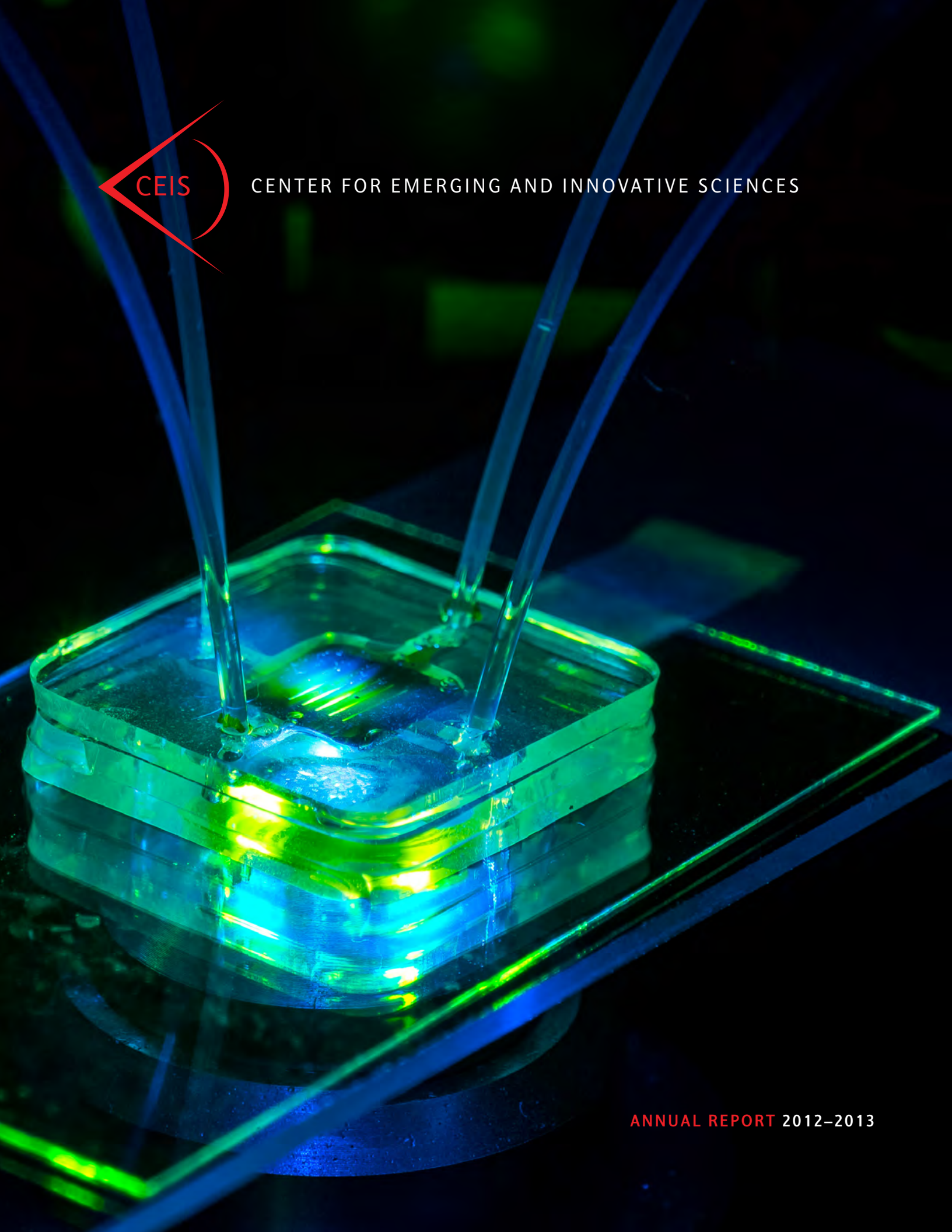


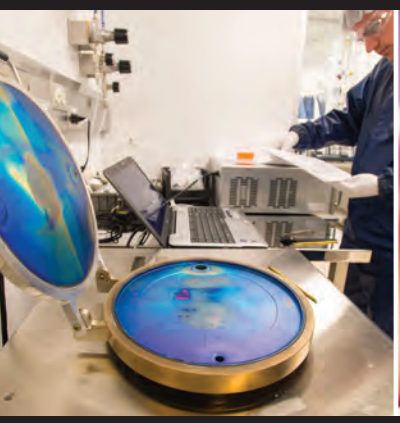
CEIS

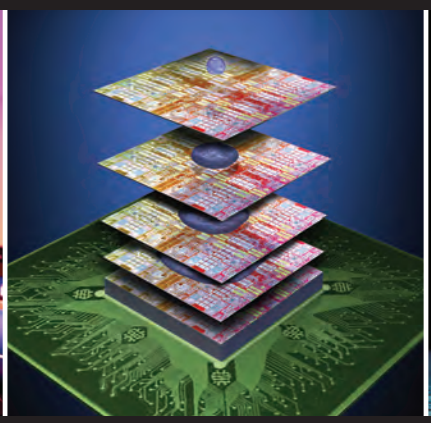
CENTER FOR EMERGING AND INNOVATIVE SCIENCES

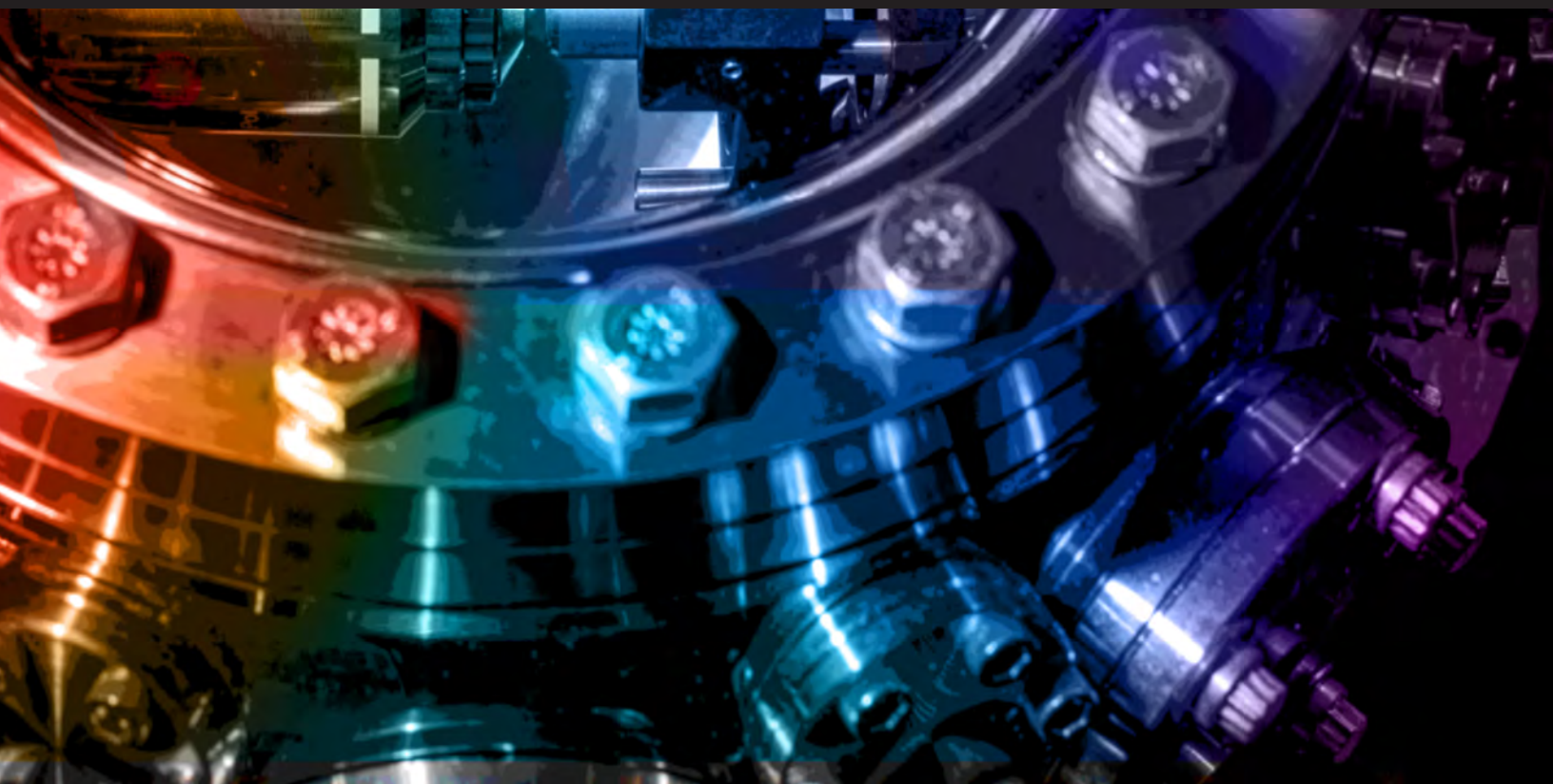
ANNUAL REPORT 2012–2013

Contents

Research + Industry = Transforming Technology







MARK F. BOCKO

We are pleased to present to you the CEIS Annual Report for the fiscal year 2012–13. This marks CEIS's 20th anniversary as a New York State Center for Advanced Technology (CAT). Each year we use this report to summarize our work at CEIS to help grow the regional and state economies through industry-university collaboration and technology transfer. We work through two primary mechanisms: providing matching funds for on-campus university research sponsored by New York State companies and outreach services such as our annual University Technology Showcase. Our funding comes primarily from the CAT program at the New York State Division of Science, Technology, and Innovation (NYSTAR), now part of the NYS Department of Economic Development. And for the first time, CEIS is now receiving federal support for economic development in the optics, photonics, and imaging (OPI) industries. We are grateful to all of these agencies and to the companies we work with for their continued support.

Over the past 20 years, there have been dramatic changes of the OPI industry in Rochester. Twenty years ago Eastman Kodak, Xerox, and Bausch + Lomb, three of CEIS's largest sources of matching corporate funds and economic impact, employed over 65,000 people in the Rochester region. Today they employ just over 10,000. Kodak has gone through a painful restructuring, and B + L was recently acquired, resulting in the move of the corporate headquarters to New Jersey and large job losses. However, in a classic example of how an industrial cluster works, the large corporations have spun out smaller OPI companies, and some of the people who left the large companies have started their own companies. In addition, the world-class talented workforce, educational system, and manufacturing infrastructure that supports the OPI industry is still intact. These changes are having a large impact on the types of companies we work with and the way we approach economic development. While large companies continue to provide the majority of matching funds and report most of the economic impact, our focus is increasingly on the small- and mid-sized OPI companies in the region that are growing.

In the past year, CEIS made some significant strides in creating new ways to drive economic growth by working with state and federal governments as well as universities, industry, and other nonprofits. In 2012, we were awarded a three-year $2.6 million grant from the federal government to support small optics manufacturers in the region. This program, called the Rochester Regional Optics, Photonics, and Imaging Accelerator (RRPA), brings together the University of Rochester, RIT, Monroe Community College, High Tech Rochester, and the Rochester Regional Photonics Cluster (RRPC) in a comprehensive and coordinated effort to strengthen the Rochester OPI industry. The program is well under way and is already having an impact in the community. CEIS continues to bring together universities, companies, and economic development organizations in other initiatives to grow the regional economy, and we are becoming a catalyst in economic growth. In recognition of this work, the CEIS Deputy Director received a special Leadership Award at the RRPC annual meeting this year.

In our annual review of economic impact from CAT-supported initiatives, 22 entities reported impact totaling over $38 million in overall job and non-job categories that included 28 plus new jobs and 43 retained positions. This EI is over twice what we were able to report last year, in spite of continued downsizing at the area's large employers. Our partner, Harris Corporation, led the way—4 new jobs, 16 retained jobs, and $20.4 million in non-job impacts. And we are especially pleased with the job impacts reported by two of our small company partners: Integrated Nano-Technologies (10 retained jobs) and OptiPro Systems (18 new jobs).

For the current academic year, CEIS is providing financial support to 23 principal investigators working with 13 different companies on 21 projects. Total funding for the 2013–14 year is projected to be $450,000. Our focus continues to be in the optics, photonics, and imaging areas, and we are continuing to court more small-to-medium-sized partners in keeping with the changes taking place in the region. This year, 18 of our funded projects are in optics or imaging and 5 of the projects are with small businesses.

We would like to thank the staff at CEIS, including our business manager, Cathy Adams; our recently recruited administrative assistant, Melissa Higgins; and our student interns, Ana Garcia, Joe Montante, and Ervis Vukaj. And we acknowledge the continued support of NYSTAR, now a division of the New York State Department of Economic Development and our newer federal partners—EDA/NIST/DOE/ETA/SBA for the Advanced Manufacturing Jobs and Innovation Accelerator Challenge initiative.

Mark F. Bocko, Director

Paul Ballentine, Deputy Director

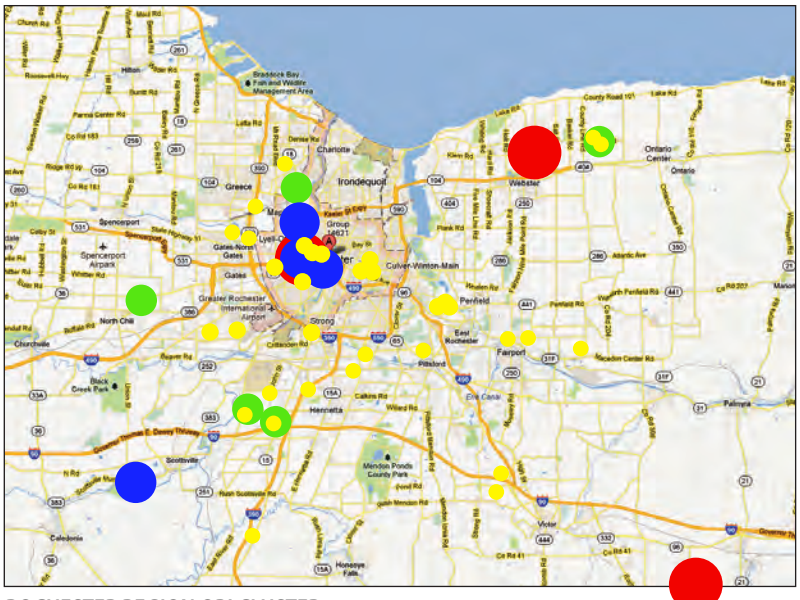
ECONOMIC IMPACT—FROM CEIS INNOVATIONS

For the fiscal year July 1, 2012, to June 30, 2013, the total documented dollar value of the economic impact due to the research we helped support over the last five years was more than $38 million. This impact, due to the value of new and retained jobs, increased sales, decreased costs, additional funding acquired and capital investment was almost twice the impact reported the prior year and the most robust reporting since 2008–09. The number of jobs (61) this research helped create or retain is on par with the five-year average. Approximately 65 percent of these jobs are with the small companies we work with, and we believe this is the most important metric in the current economic environment of high unemployment.

MOST RECENT NYSTAR-VERIFIED ECONOMIC IMPACT

Year	'08–'09	'09–'10	'10–'11	'11–'12	'12–'13	Total
Increased Revenues	$56,224,541	$7,244,229	$9,287,081	$7,493,412	$22,058,613	$102,307,876
Cost Savings	$7,891,2800	$5,933,200	$3,842,000	$3,444,000	$3,146,200	$24,256,680
Funds Acquired	$4,752,700	$4,260,000	$11,801,946	$4,040,141	$7,380,774	$32,235,561
Capital Improvements	$18,682,720	$518,235	$5,591,664	$176,000	$679,000	$25,647,619
Job Value	$2,551,074	$3,022,380	$4,559,006	$3,015,652	$4,921,362	$18,069,474
New Jobs	20.5	22.5	25.5	7.75	28.35	105
Retained Jobs	17	20.5	42.3	34.5	43	157
Total Impact	$90,102,315	$20,978,044	$35,081,697	$18,169,205	$38,185,949	$202,517,210
Total Cumulative Impact	$90,102,315	$111,080,359	$146,162,056	$164,331,261	$202,517,210	$202,517,210

OPTICS, PHOTONICS, AND IMAGING (OPI) CLUSTER



ROCHESTER REGION OPI CLUSTER

The cluster of optics, photonics, and imaging (OPI) companies in the greater Rochester region is one of the oldest, largest, and most important industrial clusters in the country.

Number of Employees

- **>5000**
- **1000–5000**
- **100–1000**
- **<100**

COMPANIES REPORTING ECONOMIC IMPACT IN 2012–13 FROM CEIS INTERACTIONS

Adarza BioSystems, Inc.

Advanced Acoustical Imaging Technologies, LLC

ADVantage Imaging Systems, Inc.

Bausch+Lomb

Corning, Inc.

DichroTec Thin Films

FluxData

Harris Corporation

IBM

Integrated Nano-Technologies, LLC

ITT Exelis

Lucid, Inc.

OptiPro Systems, LLC

PL E-Communications, LLC

Positive Science, LLC

RRPA: UR/RIT/RRPC/HTR

Robotic Therapeutic and Imaging, LLC

Semrock

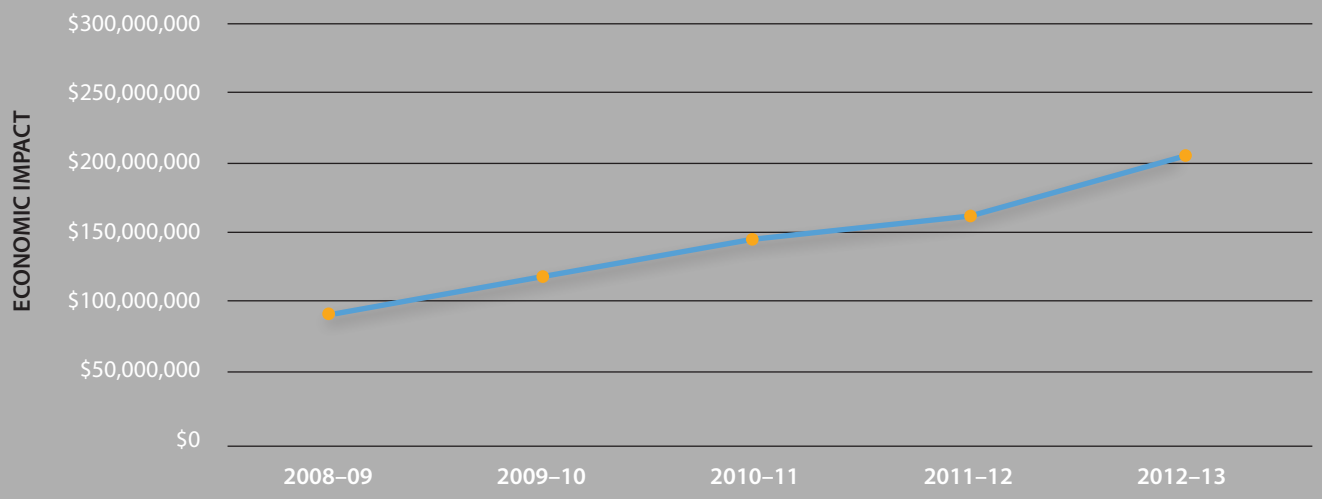
Thermo Fisher Scientific, Inc.

UCB Pharma

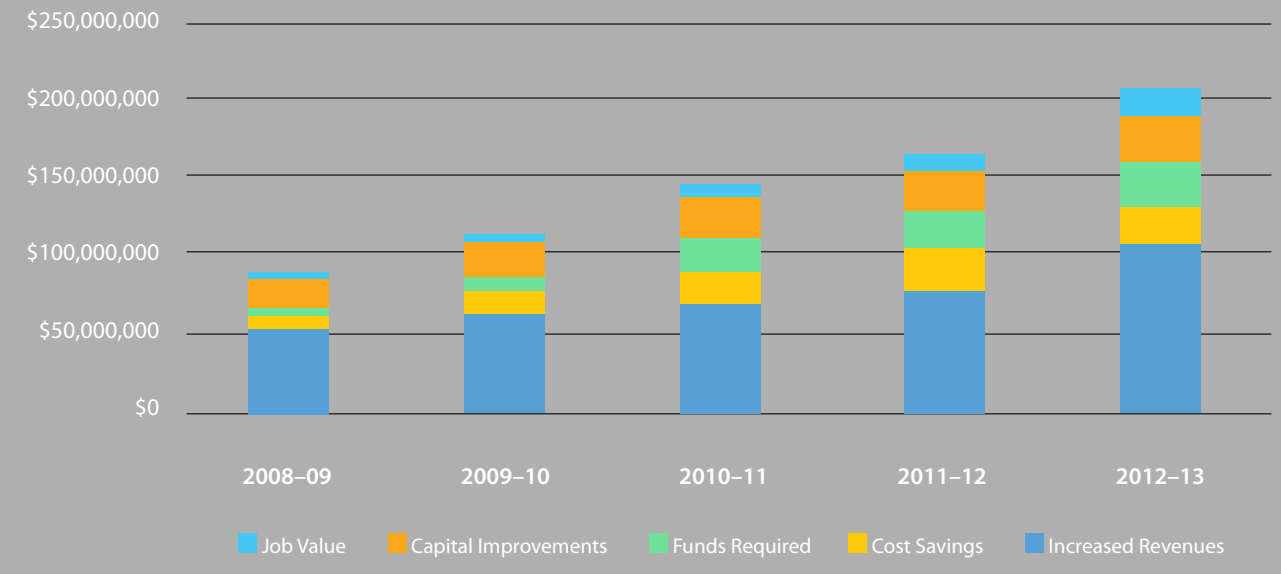
UR Integrated Nanosystems Center (URnano)

Zomega Terahertz

TOTAL CUMULATIVE ECONOMIC IMPACT



FIVE–YEAR ECONOMIC IMPACT



YEAR IN REVIEW

This past year there have been some very significant events at CEIS, at our partner companies, and in the Rochester region's industrial economy as a whole. Here are some of those developments and some of the changes they have brought to CEIS and the community we serve.

The CEIS 2012–2013 fiscal year included some exciting new developments at CEIS and at some of the area's small optics, photonics, and imaging (OPI) companies. Our annual research project award announcement included several new company partners: OptiPro Systems, Zomega Terahertz Corp, and IBM, while our Short Term Applied Research (STAR) program fostered new local collaborations with Semrock, J&J Ortho Clinical Diagnostics, and FluxData. As has been the trend, the year also brought some challenges for the Rochester region's OPI industry, as some of the largest companies continued to downsize.

For CEIS, the new academic year began with our first grant submission for federal funding to help develop the region's economy. Last July, CEIS applied for a grant through the Advanced Manufacturing Jobs and Innovation Accelerator Challenge (AMJIAC) program. The AMJIAC program is part of the Obama administration's focus on advanced manufacturing jobs and combines funding from five different federal agencies* to support regional manufacturing clusters. The CEIS proposal brought together five regional organizations to fund development of the Rochester OPI industry with a focus on the region's small- and medium-sized optics manufacturers. The team included the University of Rochester, RIT, Monroe Community College, High Tech Rochester, and the Rochester Regional Photonics Cluster (RRPC). This was the first time that all five of these organizations joined together in a common effort to rebuild the OPI industry in Rochester in the face of declining employment at the area's largest firms.

Building on this teaming effort, CEIS and RRPC collaborated in July to submit a proposal through the New York State Consolidated Funding Application (CFA) process. The proposal was for a grant to purchase two pieces of optical measurement equipment, both made in Rochester, for use by both university researchers and local OPI companies. The equipment was to lay the groundwork for establishing the Center for Advanced Optics Manufacturing, which will be a sequel to the highly successful Center for Optics Manufacturing at the University of Rochester. While this proposal was not funded, it did help raise awareness of the region's OPI industry to the Finger Lakes Regional Economic Development Council (FLREDC) and the New York State government. The participation of CEIS in the CFA process also resulted in Paul Ballentine being named to the FLREDC Optics and Photonics Working Group and further integrated CEIS with the local OPI community.

In August, the RRPC held their annual meeting at which they hosted a panel session to discuss the soon-to-be-released report by the National Research Council titled *Optics and Photonics: Essential Technologies for our Nation*. This report describes the role optics and photonics technologies play in the U.S. economy and in our daily lives. The panel included speakers from across the country, another indication of the importance of Rochester to the national OPI industry.

In October, we were informed CEIS had been awarded the AMJIAC grant, one of only 10 awards made in the United States last year. Our program is the Rochester Regional Optics, Photonics, and Imaging Accelerator (RRPA). This is a three-year $2.6 million grant that supports cluster development, business development, technology development, and workforce development at the region's small- and medium-sized optics companies. There were several highlights during the first nine months of the RRPA program. RRPC used a portion of the EDA grant to purchase a new banner to hang above the exhibition hall space where RRPC members exhibit. The banner was first displayed in February 2013 at Photonics West, the largest photonics trade show in North America. The result was increased traffic through the area and increased sales leads for the RRPC members. A portion of the DOE money is being used to support research collaboration between the Laboratory for Laser Energetics and Flint Creek Resources (FCR). FCR has developed a technology that allows a lens polishing slurry containing cerium oxide to be recycled. Cerium is a rare earth element and is found only in China. Due to export restrictions and tariffs, cerium is subject to large price swings, so the recycling process is important for the U.S. optics manufacturing industry. The ETA grant is used to provide continuing education courses for workers who are in or would like to be in the OPI industry in the Rochester region. This past year, CEIS was able to offer $78,000 in scholarships to 42 people, 21 of whom were either unemployed or underemployed at the time they took the course.

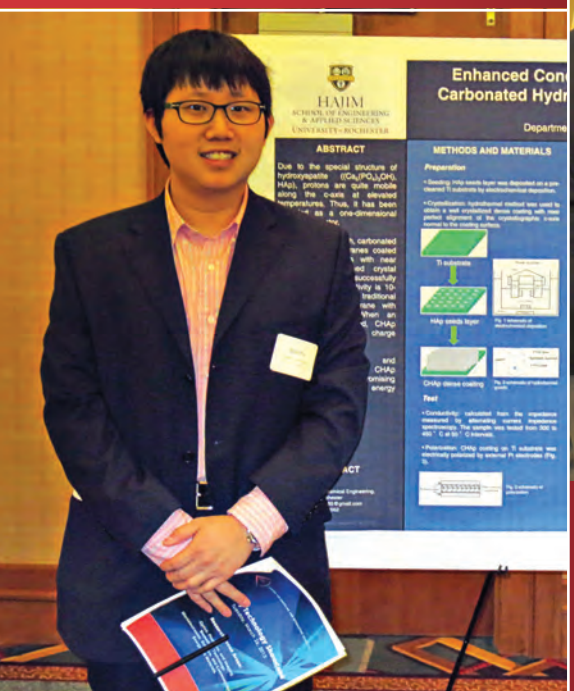
Another advanced manufacturing jobs program from the Obama administration is the National Network for Manufacturing Innovation (NNMI). This one billion dollar program, proposed by the president in March 2012, calls for the establishment of 15 Institutes for Manufacturing Innovation (IMI) to be set up around the country, similar in a way to the Fraunhofer Institutes in Germany. Each IMI is to receive between $70 and $150 million over a five-to-seven year period. In October, CEIS submitted a white paper to the NNMI program office suggesting that one of the IMI's be for optics, photonics, and imaging. The white paper included inputs from across the Rochester OPI community. In December, CEIS hosted an all-day workshop on the formation of POMATech (Photonics and Optics MAnufacturing Technology). The event drew over 100 people and resulted in very valuable input from people in the region and across the United States

**The Economic Development Administration (EDA), the National Institute of Standards and Technology (NIST), the Department of Energy (DOE), the Employee and Training Administration, (ETA), and the Small Business Administration (SBA).*

Jim Roberts, University Relations Director at Empire State Development, and Bill Bond, Director of RIT's Intellectual Property Management Office, taking in the 2013 University Technology Showcase held on March 26, 2013.

Teamwork: Cathy Adams and Abby Brengle registered over 250 showcase attendees.

Rochester's Center for Integrated Research Computing's Director Brendan Mort and staff, (from left to right) Russell Nordquist, Mort, Carl Schmidtmann, Chris Wilson, and Harry Stern, manned their display table at the showcase event.



Poster presentation by Rochester chemical engineering graduate student Cong Fu (left).

CEIS Director Mark Bocko interviewed with *Fox News* at the showcase event (above).

July 2012—CEIS submits AMJIAC proposal in collaboration with four local partners

July 2012—CEIS and RRPC submit a proposal to FLREDC through the New York State CFA process

Aug. 2012—RRPC annual meeting: National Photonics Initiative panel discussion

Oct. 2012—RRPA program receives three-year AMJIAC award from five federal agencies: EDA/NIST/DOE/ETA/SBA

Oct. 2012—NNMI white paper for POMATech submitted to NIST

Oct. 2012—Steve Sasson speaks on campus about disruptive innovation

Dec. 2012—Eastman Business Park (EBP) event: "Making It Work in America: Manufacturing Next-Generation Tech in the U.S."

Dec. 2012—CEIS hosts first POMATech Workshop

Feb. 2013—U.S. Senator Gillibrand visits Rochester Precision Optics to promote "Made in America" legislation

Feb. 2013—U.S. Senator Schumer comes to EBP to voice his support for POMATech

Mar. 2013—CEIS hosts Annual University Technology Showcase

Apr. 2013—Kodak signs deal with UniPixel to make touch screen sensors at EBP

May 2013—Valeant buys B+L for $8.7 billion

June 2013—CEIS announces 2013–14 CIR awards for 23 projects

on how to structure the IMI. A proposed design of POMATech emerged from the workshop, and CEIS started approaching some of the largest OPI manufacturers in the United States and Europe to drum up support.

Congress has not yet appropriated funds for the NNMI program, and CEIS has not had an opportunity to submit a proposal for POMATech to NIST. However, the idea has raised awareness of the OPI resources in Rochester at both domestic and foreign OPI companies as well as at the Optical Society of America and SPIE. At this point, two of the companies we approached have expressed interest in setting up manufacturing facilities in Rochester. The POMATech idea also generated interest in Washington, D.C.

There were also some very positive developments in the Rochester region's OPI industry. There were a number of developments at Eastman Business Park (EBP), a very important partner of CEIS, in regional economic development. This past December, EBP held a daylong event called "Making It Work in America: Manufacturing Next-Generation Tech in the U.S." to promote manufacturing jobs to the region. Later that month Kodak announced an agreement to sell the coal-fired power plant at EBP to an energy development company and have the plant converted to clean burning natural gas.

Also in December, New York State announced that the Finger Lakes region was awarded $96.2 million for regional economic development. This was the highest award made to any of the state's 10 economic development regions.

In February 2013, both U.S. Senators from New York came to Rochester to pledge support for creating manufacturing jobs in the region, and the backdrop of both visits was the OPI industry. Senator Kirsten Gillibrand paid a visit to Rochester Precision Optics to announce the "Made in America Manufacturing Act." Subsequently, Senator Charles E. Schumer came to Rochester to introduce legislation that would fund the NNMI program. Speaking at Eastman Business Park, the senator pledged his support for establishing an NNMI in Rochester for optics, photonics, and imaging. This was another indication of the impact our effort to establish POMATech is having at the national level.

On March 26, CEIS held the annual University Technology Showcase at the Doubletree Hotel in Henrietta. Each year we hold this event to showcase some of the research and innovation carried out at the University of Rochester, RIT, and other New York universities. The goal is to bring businesses and faculty researchers together to spur collaboration and technology transfer. This past event was another success, with 41 poster presentations, 18 company displays, and 251 attendees.

In April, Kodak announced it struck a deal with UniPixel to manufacture touch screen sensors at Eastman Business Park using roll-to-roll fabrication processes. This was the first of two such announcements by Kodak. In June, the company announced an agreement with Kingsbury to manufacture touch screen sensors at a new facility in the park. Leveraging the assets of EBP, including roll-to-roll technology, to manufacture next generation digital imaging products is an important part of CEIS's strategy to help rebuild the Rochester OPI industry. This technology fits in nicely with an exciting new product developed at another CEIS partner. In June 2012, Corning introduced Willow Glass, a glass that is so thin and flexible that it can be rolled up and used in roll-to-roll manufacturing processes to create flexible photonic devices. The synergies between the different OPI companies in the Rochester region present exciting opportunities for developing new products and new businesses.

While many of Rochester's small- and medium-sized OPI companies are expanding, and Kodak is making progress on its transition to a digital printing company, not all of the news was good for the area's OPI industry cluster. In December of last year, Warburg Pincus, the

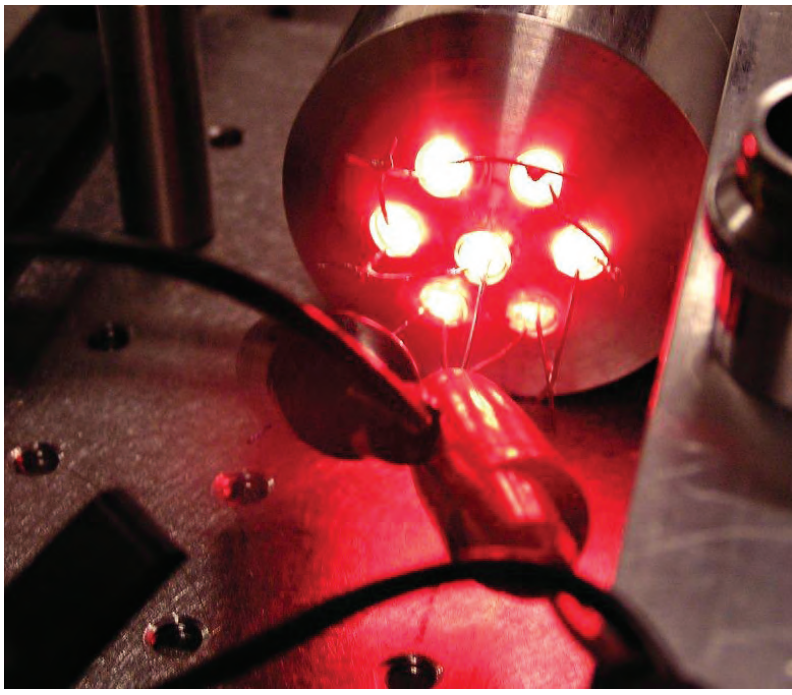
private equity firm that owned Bausch + Lomb, hired Goldman Sachs to explore selling the company. As a result, Valeant, a Canadian pharmaceutical company, purchased B+L for $8.7 billion in May 2013. This turned out to be bad news for Rochester when the company announced later in the year that it would move the B+L headquarters to New Jersey and lay off 500 people. B+L was the first optics company in Rochester and had its headquarters here since it was founded in 1853.

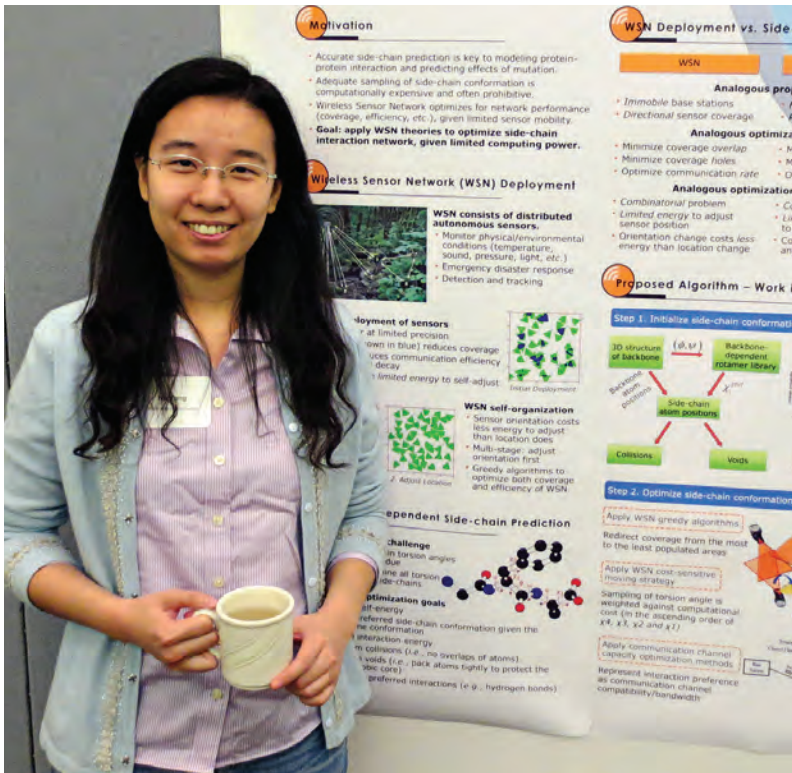
On the upside, there were several CEIS industry partners reporting "value-add" from collaborations with university researchers and CEIS. For example, Exelis hired three RIT graduates who had been involved in the CEIS-funded projects for positions locally, and OptiPro Systems reported the creation of 18 new jobs and credited this collaboration for obtaining four Phase II SBIR awards during 2012–2013 for a total of $3 million. According to UCB Pharma, by utilizing CEIS support in collaboration with University of Rochester's Professor Wendi Heinzelman, they were able to gain access to expertise in communications and sensor networks that led to cost savings for the company. In addition, UCB had planned to relocate a research position overseas and terminate a software engineer position, but with CEIS support, both jobs were retained in the United States.

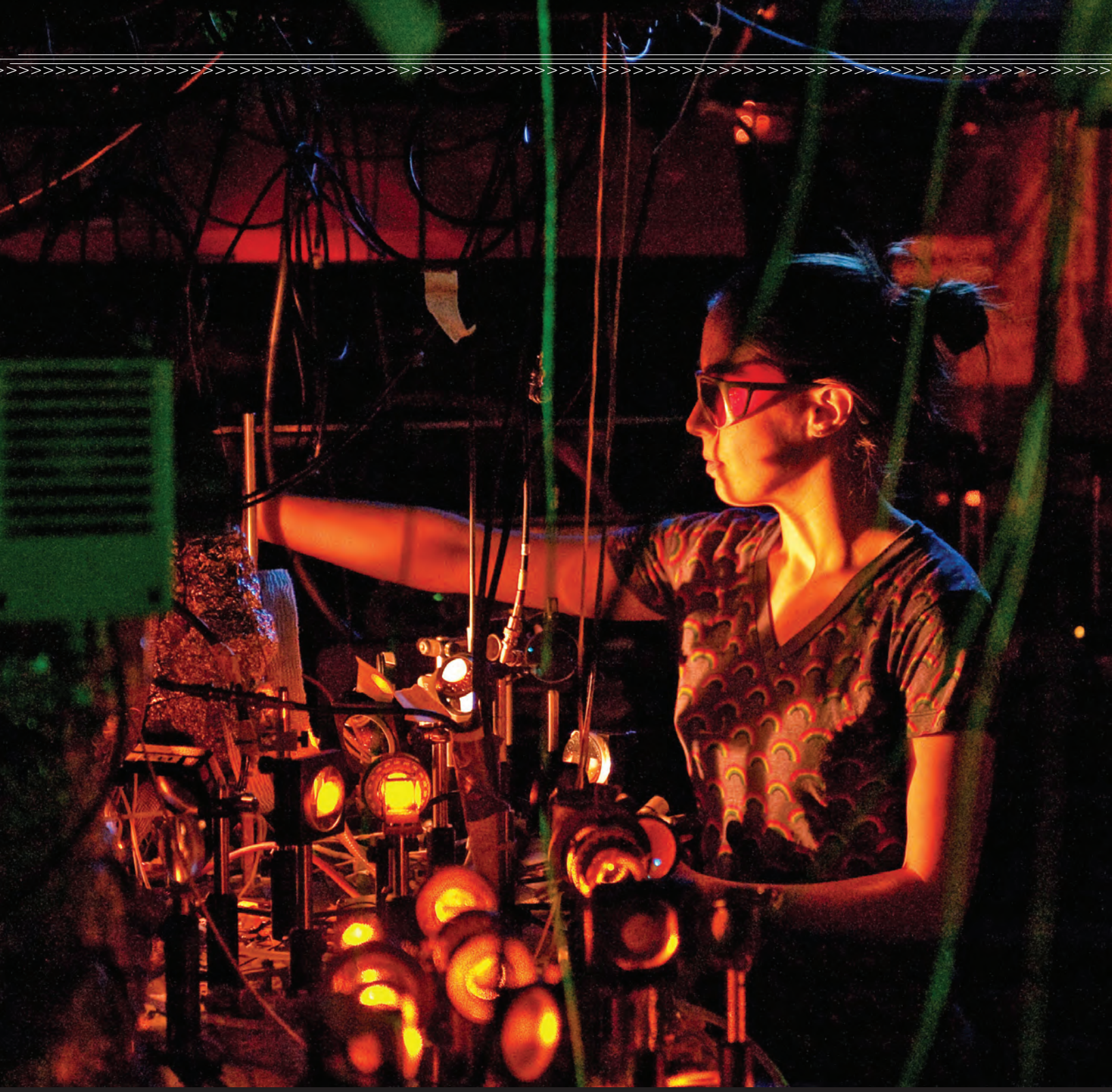
Winding up the year, in June CEIS announced the winners of the Collaborative Innovation Research and our Short Term Applied Research (STAR) programs for 2013–2014. Twenty-three awards totaling $476,000 were made to faculty at the University of Rochester and RIT with NYSTAR (a division of NYS Empire State Development) funds leveraged as match for these selected projects with NYS companies. These principal investigators are collaborating with a total of 12 different companies that operate in New York State. Several companies—AlchLight, Caliber ID, and GE Global research—are all new company partners for CIR projects, while our STAR program has fostered collaborations with two small companies—SiMPore and Micropen. Those research projects, as well as projects CEIS supported in the 2012–2013 academic year, are described in this report. Progress reports for the 2012–2013 projects acknowledged that the research undertaken by PIs and their industry partners has allowed more than 20 students the opportunity to participate in the projects and given several of them internship opportunities in partner companies. These reports also included details of the six federal awards obtained to further the research, two awarded patents and six invention disclosures applied for throughout this period.

CEIS recognizes the need and tremendous potential for the Rochester region to prosper and re-establish itself as the imaging capital of the world. We are committed to help lead this effort in collaboration with our equally committed academic, industry, and government partners.

In 2012 and 2013, CEIS continued to accelerate efforts to help rebuild the region's optics, photonics, and imaging industry.







2013-2014

ABSTRACTS

The AIR Flu Chip: A Multiplex Optical Biosensor for Influenza Serology

Benjamin L. Miller
University of Rochester
Adarza BioSystems, Inc.

There is an urgent global need for better tools for influenza surveillance, diagnosis, and vaccine development. Current laboratory methods for influenza serology have changed little in decades and are notable primarily for their complexity and requirement for highly regulated laboratory environments. Building on preliminary results from our group, we propose to develop a new optical biosensor chip on the Arrayed Imaging Reflectometry (AIR) platform, a sensitive label-free multiplex sensing technology, that will allow for the simultaneous detection and quantification of panels of influenza antibodies in human and animal serum.

Superwicking Cooling Devices for Computer CPU and Microelectronics

Chunlei Guo
University of Rochester
AlchLight

Currently, heat flux at both the chip and module levels of packaging in computers can be so high (200–1000 W/cm2) that it exceeds the practical limit of traditional air cooling. To combat this problem, liquid cooling is now being actively pursued. Recently, we developed a laser surface processing technique that turns a regular material surface superwicking. The structured surfaces exhibit a superwicking effect that can draw liquid vertically uphill against gravity. In this project, we plan to characterize the cooling performance of the superwicking surface and eventually integrate it to a heat pipe or heat sink device for cooling computer CPUs and other high-heat-flux electronic devices.

Ocular Surface Metrology and Inflammatory Mediator Response to Topical Administration of Anti-inflammatory Drug

James V. Aquavella, Geunyoung Yoon, James Zavislan, and Richard Phipps
University of Rochester
Bausch + Lomb

Ocular surface metrology obtained in noninvasive and objective fashion in a controlled environment can be utilized in contribution with identification of surface inflammatory mediators to access the efficacy of topically applied anti-inflammatory drugs utilized to treat dry eye syndrome. This combined application of environmental stress to increase evaporation will improve our ability to access the potential efficacy of new drugs and therapies.

Optomechanical Scanners for Femtosecond Micromachining

Jonathan D. Ellis and Wayne Knox
University of Rochester
Bausch + Lomb

This project's long-term goal is to use femtosecond micromachining to customize refractive corrections in human eyes, be it in the cornea, contact lenses, or implanted IOLs. This requires high numerical aperture (NA) lenses (>0.6), placing severe limits on optical scanning. To achieve high throughput either for manufacturing or clinical applications, scan speed during lasering must exceed 500 mm/s over scan areas greater than 5 mm. Our goal is to develop an optical scanner capable of micromachining with high NA lenses in <5 min. over a large area and with intensity modulation. These properties together are necessary for writing customized corrective structures for ophthalmic applications.

Femtosecond Laser Intra-tissue Refractive Index Shaping (IRIS) in Living Cornea
Krystel Huxlin and Wayne Knox
University of Rochester
Bausch + Lomb

This project's long-term goal is to use femtosecond micromachining as a nondamaging method of customizing the refractive correction in a human eye. The proposed experiments focus on corneal applications of this technology to: (1) assess the feasibility of inscribing a 1.0D spherical lens into the cornea of a living cat over a 3 mm diameter area; (2) assess the feasibility of inscribing high-quality refractive structures into the living cornea over a 5 mm diameter area; (3) assess the longevity of inscribed patterns up to 12 months using wavefront, and (4) assess biological impact and safety post-IRIS in cat and human corneas.

Femtosecond Micromachining of Hydrogels
Wayne Knox
University of Rochester
Bausch + Lomb

This project's long-term goal is to use femtosecond micromachining as a method of customizing the refractive correction in a human eye, be it in the cornea, lens or implanted IOLs. The proposed experiments use a femtosecond laser to write different kinds of refractive correctors with principal goals to (1) optimize materials and find the best two-photon sensitizers and writing conditions, (2) write and directly measure wavefront quality, optical scattering, and other characteristics of refractive correctors using our newly developed shaker-type scanner system, and (3) implement intensity control using new acousto-optic modulators and develop a systematic design methodology for writing of refractive correctors that can be applied to ophthalmic materials, ocular tissues, and, ultimately, in live eyes.

Enhancing Neural Function of Presbyopia by Improved Optics and Visual Training
Geunyoung Yoon
University of Rochester
Bausch + Lomb

Perceptual learning refers to vision training that increases the gain of neuronal signals, thereby improving visual performance and has been shown to be effective especially in subjects with amblyopia, 'lazy eye.' We propose to apply visual training protocol to presbyopia, age-related loss of near visual quality, to examine whether the visual system of presbyopia is sufficiently plastic to enhance neural function through the visual training, resulting in improving visual performance at both distant and near object distances. We will also test the hypothesis that the visual training combined with improved through focus optics of the eye stimulates neural plasticity more efficiently compared to normal presbyopic optics. We will use binocular adaptive optics vision simulator and computer-generated psychophysical visual tasks including both contrast threshold and resolution.

Handheld Enhanced Reflectance Confocal Microscopy for Neuropathy Screening
James Zavislan
University of Rochester
Caliber Imaging and Diagnostics

Reflectance confocal microscopy (RCM) is an FDA-cleared clinical imaging modality capable of performing a noninvasive optical biopsy. Dr. Zavislan has developed optical enhancements to RCM that increase the image fidelity of reflectance in vivo imaging by reducing speckle artifact by more than 10X as well as enabling an imaging mode that objectively measures the polarization properties of the tissue. This project works with Caliber Imaging and Diagnostics, which has licensed the patents covering this technology to implement this imaging mode in its VS-3000 handheld RCM to enable screening and monitoring of peripheral neuropathy affecting more than 13 million people in the United States.

Development of Glass Panel Distributed Mode Loudspeakers
Mark F. Bocko
University of Rochester
Corning, Inc.

This proposal is for a continuation of a project sponsored by Corning Inc. to explore the feasibility of employing glass panels as "distributed mode loudspeakers." In the first year of the project we explored the effect of the material properties of various glass compositions on loudspeaker performance. The ideal loudspeaker has a flat frequency response over the audio spectrum: 20 Hz to 20 kHz. To achieve this there must not be any strong, under-damped transverse mechanical modes of vibration in the panel, thus the primary material parameter affecting loudspeaker frequency response and, thereby, sound quality is the glass internal friction. Specifically, it is important that the sound radiating transverse modes of vibration of a glass panel demonstrate high damping, which leads to a loudspeaker characteristic that is closer to the ideal "flat" frequency response. The mechanical losses of several different glass compositions were measured, and it was determined that Gorilla glass displays the highest degree of internal friction of the samples tested. In the continuation of this project we will employ a newly acquired scanning laser vibrometer to correlate the measured frequency response, audio quality, and the vibrational mode structure of glass distributed mode loudspeakers to identify optimal panel mounting and excitation methods. A 2-D transmission line model for the distributed mode loudspeaker also will be developed in the second year of this project.

Polycrystalline Silicon and Metal Oxide Thin Film Transistor (TFT) Development
Karl D. Hirschman
Rochester Institute of Technology
Corning, Inc.

This project is a continued study of LTPS and metal-oxide TFT processes and devices at Rochester Institute of Technology (RIT). Baseline processes have been developed for thin-film transistor fabrication. The goals of this work are:

- improve upon shortened-cycle TFT processes that demonstrate reproducible results
- investigate alternative processing techniques and device structures for improved TFT performance
- investigate the influence of alternative glass formulations on the electrical characteristics of fabricated devices

Glass substrates will be prepared by Corning Incorporated. Device fabrication will be done at the Semiconductor & Microsystems Fabrication Laboratory (SMFL) at RIT, with certain thin-film deposition processes and treatments performed at the Corning clean room facility. This proposal presents a plan of work to fabricate and characterize thin film transistors on LTPS substrates.

Small Fragment Removal for Next Generation Sequencing
Lewis Rothberg
University of Rochester
Diffinity Genomics

Diffinity Genomics sells DNA purification kits using chromatographic materials that retain the desired nucleic acids confined in functional pipette tips. The original materials developed at the University of Rochester selectively adsorb unwanted nucleotides and primers while leaving the desired double-stranded DNA in solution. The present project aims to develop material that uses a different pore size and coating strategy, enabling it to sequester DNA fragments of size as large as 150 base pairs that could be used as part of next generation sequencing protocols.

Further Development and Test of THz Imager Array in Support of Exelis's Commercial THz Development
Zeljko Ignjatovic
University of Rochester
Exelis

This project proposes to conduct a variety of THz measurements, parameter characterization, and develop design methodologies for THz focal plane arrays in standard CMOS technologies in support of Exelis's THz initiative. The proposed work is a continuation of our current efforts with Exelis. During the 2013–14 academic year, we will begin tests on the THz test imagers fabricated in 2012–13. The results of this analysis will be used to model the THz response of standard MOSFETs and design an optimal THz focal plane array, which will be fabricated and tested subsequently.

THz Virtual Scene Generation and THz Antenna Modeling
Zoran Ninkov
Rochester Institute of Technology
Exelis

This project looks to expand the virtual scene generation capabilities of the software modeling package DIRSIG into the THz spectral region. This work will complement the efforts at the University of Rochester in developing THz detectors and utilize the THz infrastructure bought to the university's Institute of Optics by its new director, Xi-Cheng Zhang. In addition, at RIT we will continue to model the performance of THz antenna arrays built in the microelectronics facility here and tested in the THz calibration laboratory. The goal of the two projects are: (a) to produce realistic THz images and videos of scenes and (b) to produce optimum antenna designs for hybridizing to focal plane arrays being developed by the remaining team at the University of Rochester (Pipher, McMurtry, Ignjatovic, and Bocko).

Further Development and Test of THz Plasmonic Imager in Support of Exelis's Commercial THz Development
Judith. L. Pipher and Craig McMurtry
University of Rochester
Exelis

This project proposes to conduct a variety of THz measurements in support of Exelis's THz initiative. These build on our current work with Exelis in collaboration with RIT and with Professor Zhang's group and Professors Bocko and Ignjatovic's engineering faculty. During the 2012–13 academic year, we have measured THz performance of a silicon readout integrated circuit and participated in design discussions of a new THz imager. At the end of April, we will begin test and analysis of results on 252 variations, which will be fed into the next design phase and subsequent test and analysis.

Sonoelastography to Measure Intrahepatic Fat
Christopher Barry and Kevin Parker
University of Rochester
GE Global Research

This project proposes an innovative and low-cost noninvasive method to accurately measure intrahepatic fat content, which could be used for both screening and therapy. "Sonoelastography" builds on the well-described principles of elastography, which has been used to quantitate liver stiffness and employs additional calculations to simultaneously measure steatosis as well as fibrosis. This tool would have a profound impact on the practice of medicine, since it would allow cost-effective, real-time, and accurate diagnosis and surveillance of patients suffering from the entire spectrum of fatty liver disease.

Support for Distributed Computing and Network Management in Mobile Ad Hoc Networks Using a Cloudlet Approach
Wendi Heinzelman
University of Rochester
Harris Corporation

Performing communication and computation in an ad hoc network of mobile devices is challenging yet critical for next-generation military networks. Not only must we ensure that data can be communicated where it is needed, when it is needed, we must ensure that heavy computation can be accomplished quickly using available resources in the network and at the network edge, rather than relying on external computing resources that may not be readily available in the battlefield environment. To address these issues, the goals for this project include exploring in a mobile ad hoc network setting: 1) the use of distributed cloud computing via a framework called GEMCloud that uses mobiles themselves as the cloud resources, and 2) approaches for network monitoring and management to support network operations and optimal task allocation for the GEMCloud distributed computing system.

Structured Light-based Microscope for Deep Sub-Wavelength Imaging

Thomas Brown, Jonathan D. Ellis, and Miguel Alonso
University of Rochester
IBM

The semiconductor industry is the gold standard for scalability in nanoscience. Since one defect sends an entire chip to the recycle bin, rapid nanometer scale metrology becomes essential. Many metrology tools exist for the nanoscale, including electron microscopy and atomic force microscopy. However, for manufacturing, nothing quite beats light-based techniques for speed and accuracy. The near-future projections for geometrical scaling of advanced semiconductor technology is making it progressively more difficult for optical metrology systems to generate information from which meaningful process control parameters can be extracted. These require techniques that deduce spatial information from samples well beyond the diffraction limit.

Structured Polarization States for Deep Sub-Wavelength Imaging

Miguel Alonso, Thomas Brown, and Jonathan D. Ellis
University of Rochester
IBM

The semiconductor industry is the gold standard for scalability in nanoscience. Since one defect sends an entire chip to the recycle bin, rapid nanometer scale metrology becomes essential. Many metrology tools exist for the nanoscale, including electron microscopy and atomic force microscopy. However, for manufacturing, nothing quite beats light-based techniques for speed and accuracy. The near-future projections for geometrical scaling of advanced semiconductor technology is making it progressively more difficult for optical metrology systems to generate information from which meaningful process control parameters can be extracted. These require techniques that deduce spatial information from samples well beyond the diffraction limit.

Optical Probing for Freeform Optics Metrology

Jonathan D. Ellis and Paul Funkenbusch
University of Rochester
OptiPro Systems, LLC

One of the limiting technologies for OptiPro's UltraSurf platform, a 5-axis coordinate measuring machine, is the optical probe used to measure the optical surface. Current probing technologies have limited range, resolution, and bandwidth. We propose building a fiber coupled optical probe that uses a simple LED or laser diode source with a completely passive architecture to measure surface topography and local slope as the probe is rastered across the part. This could potentially lead to OptiPro's own optical probing system rather than incorporating systems from other manufacturers. The goal for the project is to build a demonstration system and validate its performance on the UltraSurf.

Enhancing the UV/VUV Sensitivity of CMOS Image Sensors

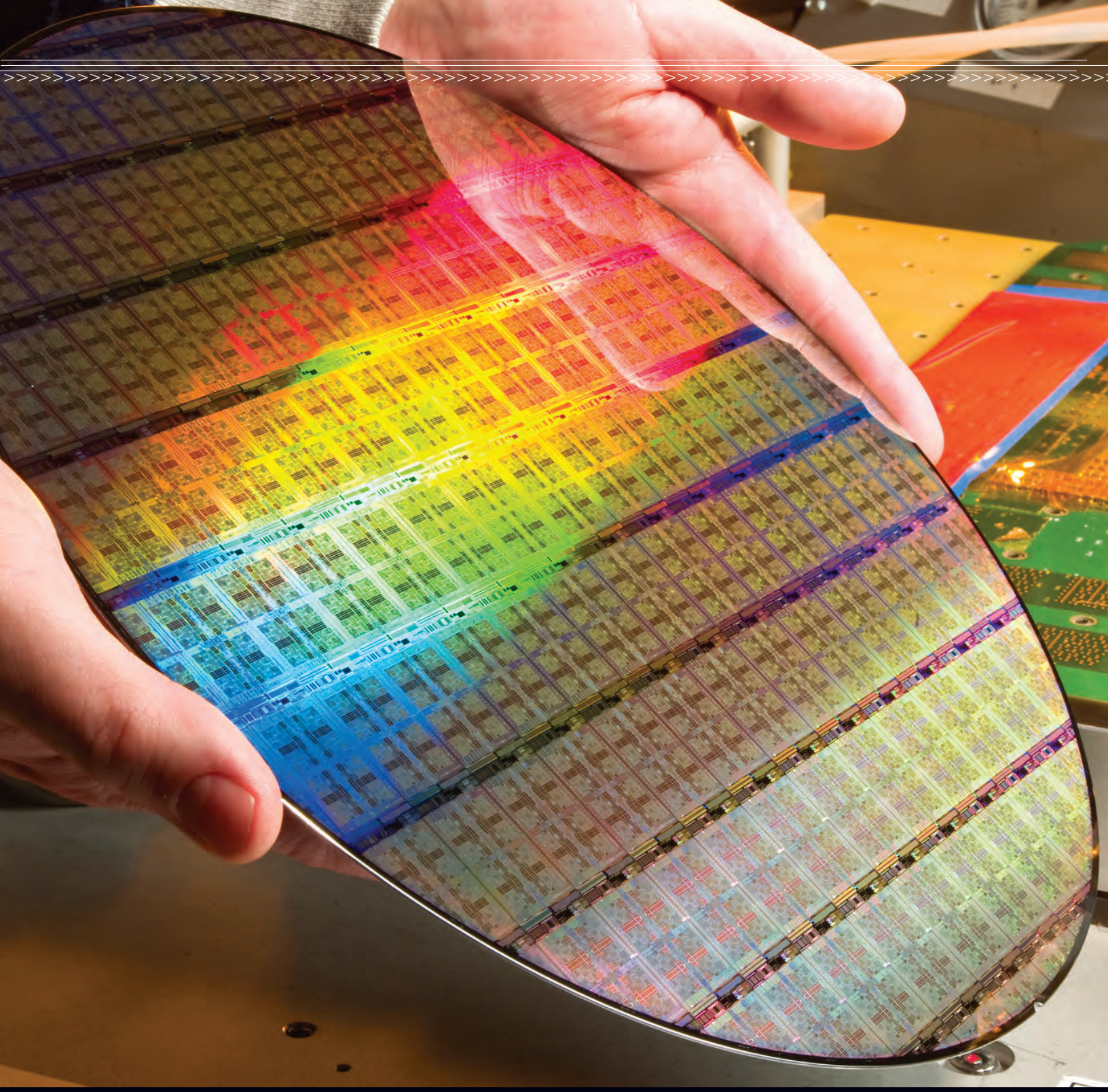
Zoran Ninkov
Rochester Institute of Technology
Thermo Fisher Scientific

This project continues our effort to improve the U/VUV sensitivity of CMOS image sensors by coating the arrays with quantum dots (QD). This year's work will proceed with detailed testing of the devices that are now routinely coated with QD. In order for Thermo Fisher to proceed with the plans for commercialization, two key measurements are required. These tests are: (a) radiation testing of the CMOS and (b) deep UV/VUV absolute sensitivity measurements. If these two tests are positive, these devices would see widespread application in the markets served by Thermo Fisher Scientific, namely UV/VUV spectroscopy and radiation hard applications. We will be conducting the two tests at the NIST SURF III Cyclotron Facility in Gaithersburg, Md., and the 88-inch Cyclotron at Lawrence Berkeley National Laboratory in California.

Distributed-Cloud Computing to Support Computationally Complex Bio-Applications

Wendi Heinzelman
University of Rochester
UCB Pharma

Cloud computing provides an approach to accessing shared computing resources. In this project, we explore the use of a distributed mobile cloud (GEMCloud) that utilizes the idle computing power of readily available smart phones as the computing resources, providing an energy-efficient cloud. In GEMCloud, profiling can help with optimizing the distribution of jobs to available resources. Our goals in this research are: 1) complete the implementation of GEMCloud on real devices; 2) run large-scale tests of GEMCloud using a volunteer-based study; 3) develop scheduling algorithms to distribute jobs to available computing resources based on profiling data; and 4) analyze the performance of different scheduling approaches, including the use of redundancy.



2012-2013

ABSTRACTS

Development of a High Speed High Numerical Aperture Scanner for Ophthalmic Applications

Jonathan D. Ellis and Wayne Knox
University of Rochester
Bausch + Lomb

Recent developments in femtosecond micromachining of ophthalmic polymers and ocular materials have created a need for a totally new kind of optical scanning system. Since the technology of 3-D refractive index writing in ophthalmic polymers and ocular tissues works best with very high numerical aperture lenses (NA>0.6), this places severe limitations on the optical scanner. This particular application requires scanning at high speed (>500 mm/sec.) over a large field (5 mm) with NA>0.6. A recently demonstrated optomechanical scanner will be developed into a fully operable 3-D system for writing arbitrary refractive correctors at high speed.

Femtosecond Laser Intratissue Refractive Index Shaping (IRIS) in the Living Cornea

Krystel Huxlin
University of Rochester
Bausch + Lomb

Our long-term goal is to use femtosecond micromachining as a nondamaging 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 focus on the corneal application to assess the durability of an inscribed femto-IRIS pattern in a living cornea over time, assess the presence or absence of corneal wound healing reaction to an inscribed femto-IRIS pattern in a living cornea over time, and assess the wavefront change induced by a spherical or cylindrical IRIS pattern over time.

Femtosecond Micromachining of Hydrogels

Wayne Knox
University of Rochester
Bausch + Lomb

Our long-term goal is to use femtosecond micromachining as a method of customizing the refractive correction in a human eye, be it in the cornea, lens, or implanted IOLs. The proposed experiments use a femtosecond laser to write different kinds of refractive correctors with principal goals to (1) optimize materials and find the best two-photon sensitizers and writing conditions; (2) write and directly measure wavefront quality, optical scattering, and other characteristics of refractive correctors; and (3) develop a systematic design methodology for writing of refractive correctors that can be applied to ophthalmic materials, ocular tissues, and, ultimately, in live eyes.

Pupil Apodization to Improve Visual Quality Using Ophthalmic Lenses

Geunyoung Yoon
University of Rochester
Bausch + Lomb

Both ocular monochromatic and chromatic aberrations degrade retinal image quality. Most of practical correction methods to improve vision, including laser refractive surgery and customized ophthalmic lenses, have been proposed to compensate for the monochromatic aberration. Despite the potential in providing a large visual benefit, these methods have practical issues that are currently under investigation. Visual benefit can further be amplified by correcting chromatic aberration induced under normal viewing (white light) condition once contribution of the monochromatic aberration to retinal image quality is reduced. Two methods we propose are controlling the spectral bandwidth of light and apodizing light transmission over the eye's pupil to effectively reduce the impact of chromatic and monochromatic aberrations.

Sound Generation from Driven Glass Plates—Making Corning's Gorilla Sing

Mark Bocko and Robert Clark
University of Rochester
Corning, Inc.

Corning Inc. recently has begun to explore the feasibility of employing driven vibrating glass plates as sources of acoustic radiation. Building such glass loudspeakers with sufficient sound quality would enable a number of compelling applications, from flat panel displays and televisions to smart phones and architectural uses. Initial concepts have been explored, and prototype loudspeakers employing Corning's Gorilla Glass have been demonstrated. However, significant technical issues remain both to optimize the sound quality and to develop completely transparent loudspeaker structures, i.e., without driving transducers mounted to the middle of the vibrating plate. In this project we will explore a number of issues, from basic material properties to mechanical and acoustic system design to develop high-quality glass driver loudspeakers.

Visibility of Artifacts in Flat Panel Displays

James Ferwerda
Rochester Institute of Technology
Corning, Inc.

Flat panel displays have eclipsed other display technologies. Creating large-area, high-resolution displays continues to be a challenge. One approach is to tile small display panels to create larger arrays. This raises issues about the production requirements necessary to create displays that are visually seamless and uniform. The goals of this project are to identify sources of visual artifacts in tiled flat-panel displays, to conduct psychophysical studies to determine visual thresholds for detecting these artifacts, to investigate solutions for eliminating the artifacts, and to develop guidelines for producing tiled flat-panel displays that assure visual quality.

Investigation on the Influence of Alternative Glass Formulations on Low-Temperature Polysilicon Thin-Film Transistors

Karl Hirschman
Rochester Institute of Technology
Corning, Inc.

This project is a continued study of LTPS processes and devices at Rochester Institute of Technology (RIT). A baseline LTPS process using solid-phase crystallization (SPC) has been developed for thin-film transistor fabrication. The goals of this work are to improve upon shortened-cycle TFT processes that demonstrate reproducible results and to investigate the influence of alternative glass formulations on the electrical characteristics of fabricated devices. Glass substrates with amorphous silicon will be prepared by Corning Incorporated; polysilicon transformation and device fabrication will be done at the Semiconductor and Microsystems Fabrication Laboratory (SMFL) at RIT. This proposal presents a plan of work to fabricate and characterize both simplified device structures (MOSCAPs and RingFETs) and thin-film transistors on LTPS substrates.

New Approaches to Sanger Sequence Reaction Cleanup

Lewis Rothberg
University of Rochester
Diffinity Genomics

Diffinity Genomics has developed RapidTipTM, a product where users can purify polymerase chain reactions in a single set of aspirate and dispense cycles into a functional pipette tip. The product is based on material originally developed at the University of Rochester that will selectively absorb impurities such as nucleotides and primers while leaving the desired double-stranded DNA in solution. Our goal in the present work is to develop an analogous material that will leave single strands in solution with an eye to developing labeling and sequence reaction purifications products.

Protocol Architectures for Multimedia Radios

Wendi Heinzelman
University of Rochester
Harris Corporation

TRACE is a suite of protocols that enables energy-efficient real-time communication of multimedia data throughout a mobile ad-hoc network. We have begun the implementation of the TRACE protocols on Microsoft SORA software-defined radios. Our initial implementation includes the basic MAC structures of TRACE, and the goal of this project is to continue this development, implementing the extended features of TRACE (such as capacity adjustment) and the multi-hop ability of TRACE. Working with the SORA radios, we will demonstrate the benefits and limitations of TRACE on real radios, which will benefit Harris's own development of this technology.

Structured Polarization States for Deep Sub-Wavelength Imaging

Miguel Alonso, Thomas Brown, and Jonathan D. Ellis
University of Rochester
IBM

The semiconductor industry is the gold standard for scalability in nanoscience. Since one defect sends an entire chip to the recycle bin, rapid nanometer scale metrology becomes essential. Many metrology tools exist for the nanoscale, including electron microscopy and atomic force microscopy. However, for manufacturing, nothing quite beats light-based techniques for speed and accuracy. The near-future projections for geometrical scaling of advanced semiconductor technology is making it progressively more difficult for optical metrology systems to generate information from which meaningful process control parameters can be extracted. These require techniques that deduce spatial information from samples well beyond the diffraction limit.

Structured Light-Based Microscope for Deep Sub-Wavelength Imaging

Thomas Brown, Jonathan D. Ellis, and Miguel Alonso
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The semiconductor industry is the gold standard for scalability in nanoscience. Since one defect sends an entire chip to the recycle bin, rapid nanometer scale metrology becomes essential. Many metrology tools exist for the nanoscale, including electron microscopy and atomic force microscopy. However, for manufacturing, nothing quite beats light-based techniques for speed and accuracy. The near-future projections for geometrical scaling of advanced semiconductor technology is making it progressively more difficult for optical metrology systems to generate information from which meaningful process control parameters can be extracted. These require techniques that deduce spatial information from samples well beyond the diffraction limit.

Design of a Compact THz Focal Plane

Mark Bocko and Zeljko Ignjatovic
University of Rochester
Exelis

Exelis, Inc. (formerly ITT Geospatial Systems) employs focal plane arrays in nearly all of its product lines, from night vision systems to geospatial mapping satellites. In this project we will explore two specific topics of interest to Exelis. The first is the development of "computational imaging arrays," which are detector arrays with an integrated image processing computational engine at the focal plane. Of particular interest is the use of this approach for the development of programmable hyperspectral imaging cameras that avoid the overwhelming data storage and transmission requirements of current hyperspectral cameras. The second topic that will be explored is the modeling and design of CMOS detectors for terahertz imaging arrays, which is an emerging area of interest for Exelis.

Test and Characterization of THz Focal Plane
Judith Pipher and Craig McMurtry
University of Rochester
Exelis

This project looks to expand the virtual scene generation capabilities of the software-modeling package DIRSIG into the THz spectral region. This work will complement the efforts of the Pipher group at the University of Rochester in THz detection and utilize the THz infrastructure bought to the University of Rochester's Institute of Optics by its new director, Xi-Cheng Zhang. In addition, we plan to develop pixilated wire grid polarizer arrays for use in the infrared and, eventually, the THz to assist Exelis with the use of polarization for target tracking.

Image Chain Modeling of THz Sensor
Zoran Ninkov and David Rhodes
Rochester Institute of Technology
Exelis

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Fabrications of Corrective Optics for Aerodynamic Domes
Jonathan D. Ellis
University of Rochester
OptiPro Systems, LLC

The demands for steep aspheric, freeform, and conformal optics manufacturing are increasing due to requirements for increasing the performance of illumination optics, lithography optics, solar concentrators, and domes/conformal windows for surveillance applications. One of the few universal tools for manufacturing freeform optics is OptiPro's UltraForm platform, a fully controlled 5-axis platform that can both grind and polish using compliant belts. UltraForm Finishing (UFF) figure correction is limited to approximately $\lambda/8$, limiting the ultimate achievable accuracy of these optical components. A fundamental understanding of the material removal mechanics is needed to make this technology compete with existing planar/spherical optics manufacturing techniques.

UltraForm Belt and Grinding Development
Jonathan D. Ellis
University of Rochester
OptiPro Systems, LLC

The demands for steep aspheric, freeform, and conformal optics manufacturing are increasing due to requirements for increasing the performance of illumination optics, lithography optics, solar concentrators, and domes/conformal windows for surveillance applications. One of the few universal tools for manufacturing freeform optics is OptiPro's UltraForm platform, a fully controlled 5-axis platform that can both grind and polish using compliant belts. UltraForm Finishing (UFF) figure correction is limited to approximately $\lambda/8$, limiting the ultimate achievable accuracy of these optical components. A fundamental understanding of the material removal mechanics is needed to make this technology compete with existing planar/spherical optics manufacturing techniques.

Feasibility of High-Throughput Cellular Co-Culture Screening Assays
Thomas Gaborski
Rochester Institute of Technology
SiMPore

This project will investigate the feasibility of miniaturizing conventional cell culture assays that can be used as high-throughput screens for stem cell differentiation and cancer cell response to drugs. Ultrathin silicon-based nanoporous membranes used in this project are a breakthrough technology 1,000 times thinner than conventional and other nanoporous membranes, with permeability more than 100 times greater. This technology enables development of cellular co-culture microarrays to perform small volume high-throughput screening assays. Specifically, we will explore creating miniature microwells supported on a nanoporous membrane using photo-polymerized polyethylene glycol that can be used to help screen for heterogeneity within cellular populations.

Enhancing Focal Plane Array Quantum Efficiency with Quantum Dots
Zoran Ninkov
Rochester Institute of Technology
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. 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 percent at very thin film thicknesses (i.e., 100 nm) and thus eliminates any damage to the underlying FPA. An air spray technique has been developed that will permit such a coating to be applied to any CMOS or CCD array.

Application of Communication Theories in Protein Structure Prediction
Wendi Heinzelman
University of Rochester
UCB Pharma

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. Approaches from communications, such as coverage in a three-dimensional camera network, 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 promises to inspire subsequent research. The outcome will have direct applications in pharmaceutical research, improving drug efficacy and reducing clinical trial attrition rate.

Distributed-Cloud Computing to Support Computationally Complex Bio-applications
Wendi Heinzelman
University of Rochester
UCB Pharma

With recent advancements in mobile, wireless, and cloud technologies, computationally intensive applications can run on devices with limited resources, such as tablets, netbooks, and smartphones, using the cloud remotely as the provider of the computation. To support this, we have developed a platform called MOCHA, consisting of mobile, multiple-cloud servers utilizing an intermediate node, termed cloudlet. In this project, we extend MOCHA, implementing the full mobile-cloudlet-cloud platform by adding security to the system and exploiting the availability of multiple co-located cloudlets and mobile devices that communicate through high-speed 802.11n links to further reduce application response time.

THz Air-Based Coherent Detection
Xi-Cheng Zhang
University of Rochester
Zomega Terahertz Corporation

This project aims to develop a suitable approach for remote terahertz (THz) sensing. THz air-biased-coherent-detection (ABCD) uses ambient air or selected gases for both generation and detection of THz waves. This approach allows us to produce a broadband THz wave at a great distance, eliminating a significant amount of propagation loss. Our goal is to develop a THz ABCD system with superior bandwidth, field strength, detection sensitivity, and frequency resolution that can achieve standoff detection in explosives and weapons as well as nondestructive evaluation of products.

THz Shoe Scanner
Xi-Cheng Zhang
University of Rochester
Zomega Terahertz Corporation

This project aims to develop a reliable device capable of retrieving the internal structure of a shoe and performing spectroscopic analysis to identify hazardous materials. Our goal is to develop a real-time shoe scanner that can inspect shoe soles without requiring the passengers to take off their footwear, thereby facilitating passenger screening in the transportation industry. The shoe scanner will ensure passenger safety, reduce passenger inconvenience, and maintain throughput levels within the current security architecture. We propose a shoe scanner that contains a continuous wave (CW) terahertz (THz) system and a THz Time-Domain Spectroscopic (TDS) system.

CORPORATE PARTNERS

ADARZA BIOSYSTEMS
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. Adarza's propriety chip-based platform, Arrayed Imaging Reflectometry (AIR), achieves high sensitivity by detecting intensity changes in images of antireflective chips functionalized with highly specified detection molecules (proteins, DNA, etc.).

ADVANCED ACOUSTIC IMAGING TECHNOLOGIES, LLC

Advanced Acoustic Imaging Technologies, LLC (AAIT), is a private company located in Rochester, N.Y. AAIT has developed a revolutionary low-cost imaging technology that can be used for screening and diagnostics of soft tissue cancers. 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.

ADVANTAGED IMAGING SYSTEMS, INC.
www.advis-inc.com

ADVIS is a fabless semiconductor of electronic image sensors and camera modules for applications that span the nearly $6 billion image sensor market. ADVIS applies its innovation 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.

ALCHLIGHT

AlchLight focuses on technological development and commercialization in the areas of laser engineering, materials processing, device cooling, energy harnessing, and biomedical applications.

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 applications on a global scale.

CALIBER IMAGING & DIAGNOSTICS
www.caliberid.com

New York State–based Caliber Imaging & Diagnostics (formerly Lucid, Inc.) is a medical technologies company that designs, develops, and markets innovative imaging solutions that show tissue at the cellular level. Caliber Imaging & Diagnostics, Inc. is currently the only company in the world to offer in vivo confocal microscopes designed specifically for imaging skin and other tissue. Caliber I.D.'s Rapid Cell ID technology enables scientists and physicians to characterize intact normal and abnormal cellular architecture that is otherwise invisible to the naked eye.

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 New York 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 purifications and molecular diagnostics. The company is currently manufacturing and selling its first product, the Diffinity RapidTip for PCR Purification, to a very receptive market.

EXELIS
www.exelisinc.com

Exelis is a global supplier of innovative night vision, remote sensing, and navigation solutions that provide sight and situational awareness at the space, airborne, ground, and soldier levels. Our integrated solutions capture, intensify, compress, encrypt, transmit, combine, analyze, and deliver data. Exelis serves international and domestic commercial and government customers in the Department of Defense, intelligence, earth and space science, and commercial aerospace arenas with one of the widest ranges of capabilities in the image intensification and capture, remote sensing, and navigation industry.

FLUXDATA, INC.
www.fluxdata.com

FluxData develops and manufactures multispectral and polarimetric imaging systems for aerospace, defense, industrial, medical, and scientific markets. FluxData is a privately held, women-owned company located in Rochester, N.Y. FluxData's imaging and system integration expertise helps guide customers from camera specification to delivery of the final system. Our staff of imaging experts work with customers to frame problems and deliver optimized systems based on a broad suite of options. Every product comes with FluxData's commitment to first-rate customer support.

GE GLOBAL RESEARCH
http://ge.geglobalresearch.com/

GE Global Research is headquartered in Niskayuna, N.Y., and is one of the world's most diversified industrial research labs, providing innovative technology for all of GE's businesses. Global Research has been the cornerstone of GE technology for more than 100 years, developing breakthrough innovations in areas such as medical imaging, energy generation technology, jet engines, and lighting. GE Global Energy's diverse set of technology expertise ranges from electronics to chemistry, biosciences to computing, metallurgy to fluid mechanics, materials to imaging—and everything in between.

HARRIS CORPORATION
www.harris.com

Harris is an international communications and information technology company serving government and commercial markets in more that 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 operation divisions serve markets for government communications, RF communications, broadcast communications, and microwave communications.

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 collective brings more than 100 years of cardiology, electrophysiology, drug development, regulatory, and academic experience. 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.

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 self-assembled 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 as well as VLSI design studies.

INTRINSIQ MATERIALS
www.intrinsiqmaterials.com

Intrinsiq Materials manufactures highly functional electronics inks for use at room temperature, in air, enabling printed electronics today and into the future. Intrinsiq Materials, the nanotechnology leader in printable electronic inks, offers a variety of electronic ink, including screen-printable and inkjetable copper ink, a silicon ink jet, and a nickel ink jet. Intrinsiq utilizes a unique process in making nanomaterial-based ink that allows the ink to be used in a room-temperature environment on paper, plastics, metals, and more.

EASTMAN KODAK COMPANY
www.kodak.com

Kodak has transformed itself into a technology company focused on imaging for business. Today's Kodak provides: disruptive technologies and breakthrough solutions in the fast-growing product goods packaging, functional, and digital printing markets, where Kodak is enabling customers to achieve transformational improvements in efficiency, quality, and productivity; quality enhancements for customers of our successful, established businesses in graphics and entertainment; and professional services that help businesses redefine flow and security.

MICROPEN TECHNOLOGIES
www.micropen.com

MicroPen Technologies is a design, development, and manufacturing resource and partner to electronics companies and medical device companies in the specialized technology of applying functional materials to surfaces.

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.

OPTIPRO SYSTEMS, LLC
www.optipro.com

OptiPro was founded on one revolutionary, yet simple, concept: optical fabricators deserve more. In the past 30 years, since we introduced the first affordable CNC machine designed specifically for the optics industry, we have consistently built a culture that cares—a culture of employees who live and breathe by our strong OptiPro values and a culture of best-in-breed customers who are collectively on a relentless pursuit of process efficiencies, design improvements, capability enhancements, and marketplace superiority.

ORTHO CLINICAL DIAGNOSTICS
www.orthoclinical.com/en-us/Pages/Home.aspx

Ortho Clinical Diagnostics serves the transfusion medicine community and laboratories around the world. We're a leading provider of total solutions for screening, diagnosing, monitoring, and confirming diseases early, before they put lives at risk. Headquartered in Raritan, N.J., with manufacturing operations in Rochester, N.Y.; Pompano Beach, Fla.; and Cardiff, Wales, Ortho Clinical Diagnostics has more than 2,500 employees worldwide. We are dedicated to investing significant resources to continuously improve our products and develop solutions to address unmet medical needs. Our single focus is to help hospitals, laboratories, and blood centers worldwide deliver results that help patients experience a better quality of life.

PHILIPS ELECTRONICS NORTH AMERICA
www.philips.com

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 electronic razors. Other products include industrial X-ray, CD-ROM drives, communications and security systems, dialogue and dictation systems, electronic manufacturing technology, interactive multimedia presentation equipment, semiconductors and electronic components, and telecommunication systems. Research is conducted at Philips Laboratories in Briarcliff Manor, N.Y.

PL E-COMMUNICATIONS, LLC
www.axial-tech.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.

RT & I

Robotic Therapeutic and Imaging, LLC (RT&I) is developing the HemoStopBot 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 device must work in conjunction with ultrasound medical devices that perform biopsies.

SEMROCK

www.semrock.com

Semrock was founded in 2000 based on a critical breakthrough in ion-beam sputtering technology that allowed the use of hard dielectric coatings on a single glass substrate. Since that time, more than half a million thin-film interference filters have been sold, and we remain at the forefront of optical filter technology for biotech and analytical instrumentation applications. We offer the most spectrally sophisticated optical filters on the market to drive significant improvements for our customers and their applications, like faster measurement times, reduced downtime, repeatable manufacturing, and lower optical component count. Semrock supports the biotech and analytical instrumentation market with three product platforms—optical filters for fluorescence instrumentation and microscopy, Raman instrumentation filters, and laser analytical instrumentation filters.

SiMPore, INC.

www.simpore.com

SiMPore is a Rochester, N.Y.–based nanotechnology company that designs and produces membranes and membrane-enabled products based on its unique patent-pending platform technology—the NanoBarrier™ ultrathin nanoporous silicon membrane. The NanoBarrier™ membrane is the world's first membrane to offer both tunable nanometer-scale thickness and pore size. SiMPore is developing products that take advantage of these one-of-a-kind features, including filters for separating and concentrating biological molecules and nanoparticles, cell culture substrates for growing cells, and electron microscopy grids for preparing and imaging samples at the nanoscale.

THERMO FISHER SCIENTIFIC INC.

www.thermofisher.com

Thermo Fisher Scientific Inc., (NYSE: TMO), is the world leader in serving sciences. 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 more than 350,000 customers within the pharmaceutical and biotech companies, hospitals and clinical diagnostic labs, universities, research institutions, and government agencies, as well as environmental and industrial process control settings.

UCB PHARMA

www.ucb.com

At UCB our sense of purpose is to help people suffering from severe central nervous system or immunological disorders lead normal, everyday lives. Our ambition is to offer them innovative new medicines and groundbreaking solutions that go beyond the drug. We are committed to enabling cutting-edge scientific research that is driven by the patients' needs. UCB is a global biopharma company with a team of more than 8,000 talented employees, a strong market presence in about 40 countries.

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.

XEROX CORPORATION

www.xerox.com

Xerox Corporation is a document management company that manufactures and sells a range of color and black-and-white printers, multifunction systems, photocopiers, digital production printing press, and related consulting services and supplies. Xerox markets software such as DocuShare and FlowPort and offers consulting services and printing outsourcing.

ZOMEGA TERAHERTZ CORPORATION

www.zomega-terahertz.com

Zomega Terahertz Corporation is focused on developing and deploying Terahertz-based technology solutions for both the public and private sector. We produce both pre-designed and custom systems for Time Domain Spectroscopy (TDS) and CW applications in both point measurement and imaging modalities, including the mini-Z 1000 compact THz TDS system for true turnkey operation and integration into larger systems requiring THz capabilities.

FACULTY RESEARCHERS

Miguel Alonso

Associate Professor of Optics in the Institute of Optics, University of Rochester

Education
PhD, The Institute of Optics, University of Rochester Optics, 1996

MS, Universidad Autonoma Metropolitana Physics, 1990

Research Interests
- Propagation of waves
- Connection between rays and waves
- Integral transforms
- Phase space representations
- Uncertainty relations

Recent Research Projects
- Building accurate estimates of wave fields propagating based on ray information alone

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James V. Aquavella

Professor of Ophthalmology, University of Rochester

Education
MD, University of Naples School of Medicine, 1957

BA, Johns Hopkins University, 1952

Research Interests
- Corneal wound healing
- Ocular surface imaging
- Karatoprosthesis

Recent Research Projects
- Various Ocular Surface Imaging project

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

Christopher T. Barry

Associate Professor Division of Solid Organ Transplant (Surgery), University of Rochester

Education
MD/PhD, Tufts University School of Medicine, Immunology, 1995

BA, University of Wisconsin–Madison, Music, 1986

Research Interests
- Liver cancer genomics
- Clinical research in fatty liver disease and HIV transplantation

Recent Research Projects
- Sonoelastography to Measure Intrahepatic Fat

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Mark Bocko

Professor of Electrical and Computer Engineering and of Physics and Professor of Music Theory at the Eastman School of Music, University of Rochester

Education
PhD, University of Rochester Physics, 1984

MS, University of Rochester Physics and Astronomy, 1980

BS, Colgate University Physics and 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 | www.ece.rochester.edu/users/bocko | mark.bocko@rochester.edu

Thomas G. Brown

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

Education
PhD, University of Rochester
Optics, 1987

BS, 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 microstructured optical fibers

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Robert Clark

Dean of the Edmund A. Hajim School of Engineering and Applied Sciences University of Rochester

Education
PhD, Virginia Polytechnic Institute
Mechanical Engineering, 1992

MS, Virginia Polytechnic Institute
Mechanical Engineering, 1988

BS, Virginia Polytechnic Institute
Mechanical Engineering, 1987

Research Interests
- Science of acoustics
- Bionanomanufacturing

Recent Research Projects
- Development of new instruments for the exploration of single-molecule mechanics and for the deposition and control of materials at the nanoscale

(585) 275-4151 | www.hajim.rochester.edu/dean.html | robert.clark@rochester.edu

Denis Cormier

Earl W. Brinkman Professor Industrial and Systems Engineering, Rochester Institute of Technology

Education
PhD, North Carolina State University

MS, SUNY University at Buffalo

Research Interests
- Rapid Prototyping
- Rapid Manufacturing

Recent Research Projects
- Cu Ink Adhesion Solutions

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Jonathan D. Ellis

Assistant Professor of Optics and of Mechanical Engineering, University of Rochester

Education
PhD, Delft University of Technology (The Netherlands)
Mechanical Engineering, 2010

MSc, BS, University of North Carolina at Charlotte
Mechanical Engineering

Research Interests
- Linear displacement interferometry
- High power gas laser frequency stabilization
- Refractometry
- Flexure systems
- Stage metrology

Recent Research Projects
- Designing and developing smart optical sensors for compact, remote displacement sensing and for multi-DOF interferometry

(585) 275-4950 | www.me.rochester.edu/projects/jdellis-lab/ellis.html | j.d.ellis@rochester.edu

James Ferwerda

Associate Professor in the Munsell Color Science Laboratory and in the Center for Imaging Science Rochester Institute of Technology

Education
PhD, Cornell University
Experimental Psychology, 1998

MS, Cornell University
Computer Graphics, 1987

BA, Cornell University
Psychology with Honors, 1980

Research Interests
- Computer graphics
- Digital imaging
- Data visualization
- Visual perception
- Low vision
- Assistive technologies

Recent Research Projects
- Effects of image dynamic range on apparent surface gloss

(585) 475-4923 | www.cis.rit.edu/jaf | jaf@cis.rit.edu

Paul Funkenbusch

Professor of Mechanical Engineering and of Materials Science, University of Rochester

Education
PhD, Michigan Technological University, 1984

Research Interests
- Relationships among microstructure, properties, and processing of materials

Recent Research Projects
- Optical Probing for Freeform Optics Metrology

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Thomas Gaborski

Assistant Professor, Rochester Institute of Technology

Education
PhD, University of Rochester
Biomedical Engineering, 2008

MS, University of Rochester,
Biomedical Engineering, 2004

BS, Cornell University
Biological and Environmental Engineering, 2002

Research Interests
- Nanomaterials and membrane fabrication
- Microfluidics, separations, and device design
- Cellular biophysics
- Quantitative fluorescence imaging

Recent Research Projects
- Cellular co-culture screening assays

(585) 475-4117 | http://thomasgaborski.com/ | trgbme@rit.edu

Greg T. Gdowski

Associate Professor of Biomedical Engineering and Executive Director, Center for Medical Technology and Innovation, University of Rochester

Education
PhD, Boston University, 1996

Research Interests
- Vestibule-collic reflexes (VCR)

Recent Research Projects
- Balloon catheter testing platform for evaluating radio frequency ablation

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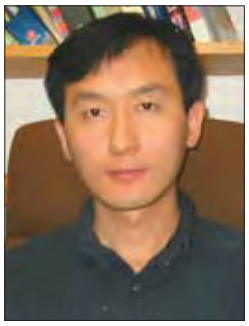
Chunlei Guo



Professor of Optics, the Institute of Optics, University of Rochester

Education
PhD Physics, University of Connecticut, 1999

BS Physics, Changchun Institute of Optics and Fine Mechanics, 1994

Research Interests
- Femtosecond Laser-Matter Interactions at High Intensities

Recent Research Projects
- Superwicking cooling devices for computer CPU and microelectronics

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Wendi B. Heinzelman

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

Education
PhD, Massachusetts Institute of Technology, Electrical Engineering and Computer Science, 2000

MS, Massachusetts Institute of Technology, Electrical Engineering and Computer Science, 1997

BS, 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

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Maria Helguera

Associate Professor, Imaging Science, Rochester Institute of Technology

Education
PhD Imaging Science, Rochester Institute of Technology, 1999

MS Electrical Engineering, University of Rochester, 1988

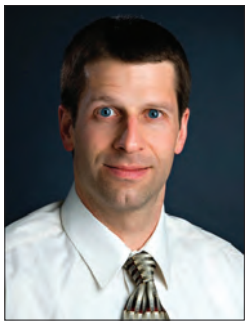
BS Physics, Universidad Nacional Autónoma de México, 1984

Research Interests
- Medical imaging system characterization
- Ultrasound tissue characterization
- Non-destructive evaluation techniques
- Digital image processing

Recent Research Project
- Designing an image processing toolkit to view through light scattering materials

(585) 475-7053 | www.rit.edu/cos/maria-helguera | helguera@cis.rit.edu

Karl D. Hirschman



Professor of Micron Technology of Microelectronic Engineering
Rochester Institute of Technology

Education
PhD, University of Rochester Electrical and Computer Engineering, 2000

MS, Rochester Institute of Technology, Electrical Engineering, 1992

BS, Rochester Institute of Technology, Microelectronic Engineering, 1990

Research Interests
- Silicon device integration on nontraditional 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 and NYSTAR/CEIS)
- Development of bipolar and MOS high-power microwave transistors (Spectrum, Devices Corporation, Hatfield, Pa.)

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

Krystel R. Huxlin

Associate Professor of Ophthalmology, University of Rochester

Education
PhD, University of Sydney
Neuroscience, 1994

BS (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

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Zeljko Ignjatovic

Assistant Professor, Electrical and Computer Engineering, University of Rochester

Education
PhD, University of Rochester
Electrical and Computer Engineering, 2004

MS, University of Rochester
Electrical and Computer Engineering, 2001

BS, University of Novi Sad
Electrical Engineering and Computer Science, 1999

Research Interests
- A/D conversion
- CMOS analog circuits
- Low power circuit architectures
- Image sensors

Recent Research Projects
- Developing and investigating focal plane compression techniques where majority of multiplication computations required by the compression are rendered unnecessary

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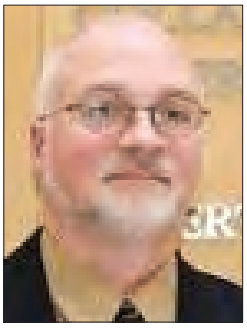
Wayne H. Knox



Professor of Optics and of Physics, Professor of Visual Sciences, and Associate Dean of Education and New Initiatives for the Hajim School of Engineering and Applied Sciences University of Rochester

Education
PhD, University of Rochester
Institute of Optics, 1983

BS, 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

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James L. McGrath

Associate Professor of Biomedical Engineering, University of Rochester

Education
PhD, Massachusetts Institute of Technology
Biological Engineering, 1998

MS, Massachusetts Institute of Technology
Mechanical Engineering, 1994

BS, Arizona State University
Mechanical Engineering, 1991

Research Interests
- Nanoparticle and molecular separations
- Nanotechnology
- MEMS and micro fabrication
- 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-cultures

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Benjamin Miller

Associate Professor, Dermatology, University of Rochester

Education
PhD, Organic Chemistry, Stanford University, 1994

BS, BA, Chemistry, Mathematics, and German, Miami University, 1988

Research Interests
- Biomedical nanotechnology
- Combinatorial chemistry
- Biophysical methods
- Biosensors

Recent Research Projects
- The AIR Flu Chip: A Multiplex Optical Biosensor of Influenza Serology

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Zoran Ninkov

Micron Technology Professor of Microelectronic Engineering, Rochester Institute of Technology

Education
PhD, University of British Columbia Astronomy, 1985

MS, Monash University Physical Chemistry, 1980

BS, University of Western Australia Physics, 1977

Research Interests
- Novel 2-D CMOS detector arrays
- Fundamental limitations of visible and IR arrays
- Miniaturized multispectral systems

Recent Research Projects
- Development of novel two-dimensional detector arrays
- Development of image processing techniques for optimal analysis of such two-dimensional astronomical image data

(585) 475-7195 | www.cis.rit.edu/people/faculty/ninkov/ | ninkov@cis.rit.edu

Kevin Parker

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

Education
PhD, Massachusetts Institute of Technology, 1981

MS, Electrical Engineering, Massachusetts Institute of Technology, 1978

BS, Engineering Science, SUNY Buffalo, 1976

Research Interests
- Imaging Processing
- Medical Imaging
- 3D/4D Image Synthesis
- Biomedical Imaging
- Ultrasound Imaging systems

Recent Research Projects
- Sonoelastography to Measure Intrahepatic Fat

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Richard Phipps

Dean's Professor of Environmental Medicine, Professor of Oncology, of Pediatrics, and of Microbiology and Immunology; Director, Lung Biology and Disease Program, University of Rochester

Education
PhD, Immunology, Medical College of Virginia, 1980

BS, Medical Technology, Loyola College, 1977

Research Interests
- Cellular and molecular characterization of fibroblasts
- Control of normal and malignant B lymphocyte activation

Recent Research Projects
- Ocular Surface Metrology and Inflammatory Mediator Response to Topical Administration of Anti-inflammatory Drug

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Judith L. Pipher

Professor Emeritus of Physics and Astronomy, University of Rochester

Education
PhD, Cornell University
Astronomy, 1971

MS, Cornell University
Astronomy, 1970

BS, 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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Lewis Rothberg

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

Education
PhD, Harvard University
Physics, 1984

BS, 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

(585) 273-4725 | http://chem.rochester.edu/Faculty/Rothberg.html | lewis.rothberg@rochester.edu

Geunyoung Yoon

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

Education
PhD, Osaka University
Laser Optics, 1998

MS, Osaka University
Laser Optics, 1995

BS, 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)

(585) 273-3998 | www.cvs.rochester.edu/yoonlab/yoon.htm | yoon@cvs.rochester.edu

James M. Zavislan

Associate Professor of Optics, of Dermatology, and of Biomedical Engineering; Director, Center for Institute Ventures, University of Rochester

Education
PhD, The Institute of Optics,
University of Rochester, 1988

BS, 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-model tumor mapping systems
- Handheld Enhanced Reflectance Confocal Microscopy for Neuropathy Screening

(585) 275-9819 | www.optics.rochester.edu/workgroups/zavislan/Mysite5/index.htm | james.zavislan@rochester.edu

Xi-Cheng Zhang

Director of the Institute of Optics, M. Parker Givens Professor of Optics, University of Rochester

Education
PhD, Brown University
RI Physics, 1986

MS, Brown University
RI Physics

BS, Peking University, 1982

Research Interests
- Terahertz optics sensing
- Terahertz optics imaging

Recent Research Projects
- The generation, detection, and applications of free-space THz beams with ultrafast optics

(585)275-0333 | www.optics.rochester.edu/people/faculty/zhang_xi-cheng | Xi-Cheng.Zhang@rochester.edu

OTHER FACULTY RESEARCHERS

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

Education
NIH Postdoctoral Fellow with Gilbert Stork Columbia University, 1972

PhD, Brandeis University, Organic Chemistry, 1971

BS, 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

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www.chem.rochester.edu/faculty/pages/boeckman.html
robert.boeckmanjr@rochester.edu

Sohail Dianat
Professor of Electrical Engineering, Rochester Institute of Technology

Education
PhD, George Washington University, Electrical Engineering, 1981

MS, George Washington University, Electrical Engineering, 1977

BS, 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

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

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

Education
PhD, Caltech, 1993

MS, Caltech, 1990

BS, National Taiwan University, 1987

Research Interests
- Computer vision and pattern recognition
- Computer graphics
- Multimedia coding and streaming
- Multimodal biometrics

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http://chenlab.ece.cornell.edu
tsuhan@ece.cornell.edu

Vikram S. Dogra
Professor of Diagnostic Radiology, of Urology, and of Biomedical Engineering University of Rochester

Education
Diplomat American Board of Radiology

ARDMS in Ultrasound Physics and Abdomen

OB/GYN, Neurosonography

MBBS, India-Madras U, Madras Medical College, Medicine, 1977

Research Interests
- Diagnostic radiology
- Urology
- Biomedical engineering
- Imaging sciences

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

OTHER FACULTY RESEARCHERS

Eby G. Friedman
Distinguished Professor of Electrical and Computer Engineering, University of Rochester

Education
PhD, University of California–Irvine, Electrical Engineering, 1989

MS, University of California–Irvine, Electrical Engineering, 1981

BS, 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

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eby.friedman@rochester.edu

Holly Hindman
Assistant Professor of Ophthalmology, University of Rochester

Education
MD, Harvard Medical School, 2003

BA, 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)

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holly_hindman@urmc.rochester.edu

Navalgund A. Rao
Associate Professor in the Chester F. Carlson Center for Imaging Science Rochester Institute of Technology

Education
PhD, University of Minnesota, Physics, 1979

MSc, Banaras Hindu University, Physics, 1972

BSc, Banaras Hindu University, Physics, Math, Chemistry, 1970

Research Interests
- Ultrasound imaging systems
- Biomedical imaging

(585) 475-7183
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rao@cis.rit.edu

Ashutosh Saxena
Assistant Professor in the Department of Computer Science, Cornell University

Education
PhD, Stanford University, 2009

MS, Stanford University, 2006

BTech, Indian Institute of Technology, 2004

Research Interests
- Machine Learning
- Robotics
- Computer Vision

(607) 255-7017
www.cs.cornell.edu/~asaxena
asaxena@cs.cornell.edu

Roman Sobolewski
Professor of Electrical and Computer Engineering, of Physics, of Materials Science, and Senior Scientist in the Laboratory for Laser Energetics, University of Rochester

Education
ScD, Polish Academy of Sciences
Physics, 1992

PhD, Polish Academy of Sciences
Physics, 1983

MS, Warsaw Technical University

Research Interests
- Ultrafast optoelectronics
- Quantum optoelectronic and spintronic devices
- Ballistic transport in electronic nanodevices
- Quantum communication and information

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roman.sobolewski@rochester.edu

CEIS STAFF

CEIS staff prides itself on its commitment to fostering industry-university partnerships that lead to economic development for our region.

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3 Taylor Hall
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CEIS ADVISORY BOARD

CEIS leadership meets with the advisory board to develop action-oriented plans to keep innovative technologies in the pipeline, connecting academic research with corporate product development.

CEIS acknowledges and applauds its advisory board members for their leadership, expertise, and forward-thinking ideas:

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ACADEMIC PARTNERS

While CEIS has a physical office located in Rochester, at its core it is a virtual center that is composed of top engineering and science researchers at some of New York State's best academic institutions, including the University of Rochester, Rochester Institute of Technology, 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, more than 50 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.

To explore research project opportunities, please contact
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CEIS recognizes the need and tremendous potential for the Rochester region to prosper and re-establish itself as the imaging capital of the world. We are committed to help lead this effort in collaboration with our equally committed academic, industry, and government partners.

Research + Industry = Transforming Technology

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