CEIS

Center for
Emerging and
Innovative Sciences

ANNUAL REPORT 2017–2018

CEIS

Hydrophobic metal, treated with femtosecond laser pulses, floats in distilled water at the lab of University of Rochester professor Chunlei Guo.

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LETTER FROM THE DIRECTORS

Paul H. Ballentine and Mark F. Bocko

We are pleased to present our 2017–18 CEIS Annual Report, a summary of the activities and accomplishments of CEIS over the past year in our ongoing efforts to contribute to the expansion of the New York State economy through university–industry collaborations. Employing the state-defined metrics, this year CEIS activities accounted for more than $47 million of New York State economic impact, including 30.25 new jobs and 45.25 retained jobs for the region. We are grateful to NYSTAR, Empire State Development, and Governor Andrew Cuomo for the resources that afford us this opportunity, and all of us at CEIS are working hard with the hope that our programs will have a long-term positive impact on the economy and quality of life in Rochester, the Finger Lakes region, and the state.

An annual publication such as this one reporting facts, figures, and success stories fails to relay the entire impact of an organization, and we want to take the opportunity here to talk about CEIS's overarching strategy and aspirations for the region.

The Finger Lakes region has many remarkable assets: two top research universities, a highly skilled and innovative workforce, a high quality of life, world-class cultural assets in the musical and visual arts, and an engaged and supportive government at all levels. Our goal at CEIS is to add more "buzz" and excitement that clearly is a part of the culture in hotbeds of technology innovation and entrepreneurship such as Silicon Valley, Seattle, and Austin. An atmosphere of optimism and excitement encourages audaciousness and risk taking, and we subscribe to the belief that the mindset of a community can indeed be a self-fulfilling prophesy.

With this motivation, CEIS initiated the Light and Sound Interactive conference in 2017 to bring together our region's creative and artistic community and technology community to inform and inspire. We are now working with a broader consortium of universities, industry, and government to perpetuate this highly successful event, and LSI is due to return in coordination with the Rochester International Jazz Festival in June 2019. We also are taking a leading role in organizing an augmented and virtual reality initiative that spans the University of Rochester and RIT campuses. Our latest "town hall" AR/VR meeting attracted more than 75 faculty and 100 attendees in total from both universities and several local companies. This initiative already has led to a multimillion-dollar research and development funding commitment to our local universities from a major West Coast technology company working in the AR/VR space. We will work to deepen these connections and reach other similar agreements, but our ultimate goal is to contribute to building an AR/VR industry in the Finger Lakes that will leverage our regional strengths in optics, imaging, audio, games and media, publishing, and other elements of an emerging AR/VR industry. Another project on the CEIS drawing board is a Film and Media Music and Sound Festival in which CEIS is working with the Eastman School of Music's Beal Institute for Film Music and Contemporary Media to bring together composers, filmmakers, sound designers, audio technologists, and movie enthusiasts for a week of talks, workshops, screenings, and live performances in the fall of 2019.

These all have to be community efforts, so we encourage anyone and everyone who is reading this annual report and is inspired by this vision for our region and wants to reach out to us. We would love to hear from you.

Sincerely,

Mark F. Bocko, Director

Paul H. Ballentine, Executive Director

CEIS TEAM

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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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.

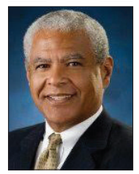
Bob Naum
Chair

Ian Cox
IGC Consulting Group

Bob Fiete
Harris Corporation

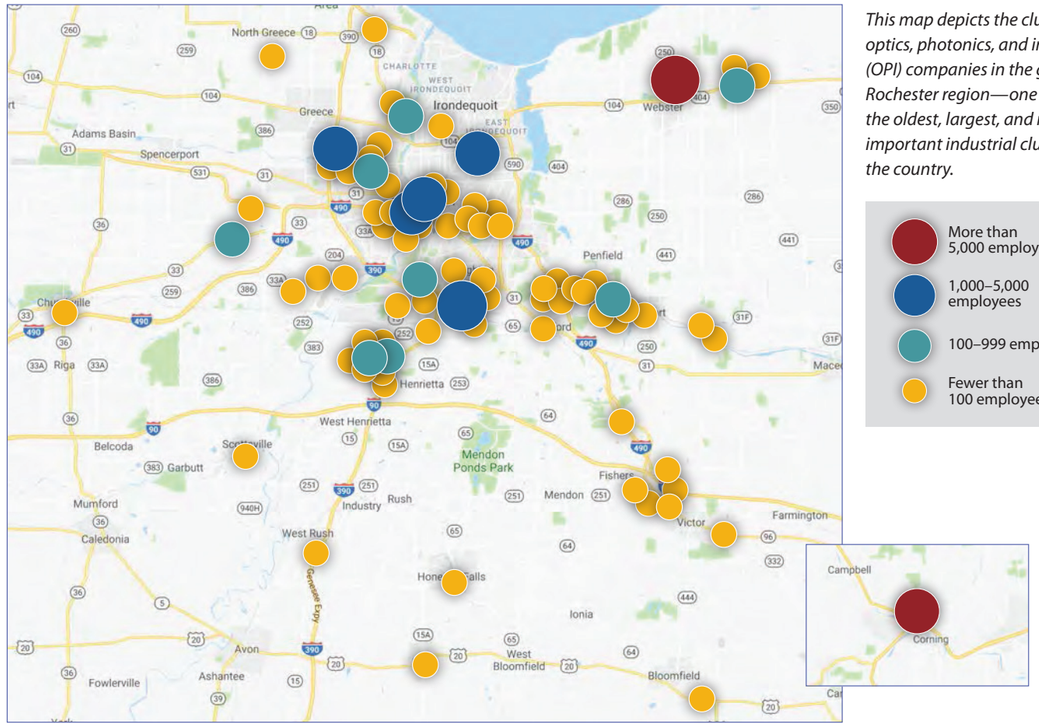
Ellen Kosik-Williams
Corning, Inc.

Ryne Raffaelle
Rochester Institute of Technology



Ed White
AIM Photonics

THE OPI CLUSTER



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

- More than 5,000 employees
- 1,000–5,000 employees
- 100–999 employees
- Fewer than 100 employees

SUPPORTERS

The accomplishments of CEIS would not be possible without the partnerships and support of the many local, state, and federal agencies and organizations listed here.

AIM photonics
U.S. Department of Energy
U.S. Department of Labor
EASTMAN Business Park
U.S. Department of Commerce Economic Development Administration
GOERGEN INSTITUTE FOR DATA SCIENCE AT THE UNIVERSITY OF ROCHESTER
GREATER ROCHESTER Chamber of Commerce
GRE GREATER ROCHESTER ENTERPRISE
LUMINATE
MEP • MANUFACTURING EXTENSION PARTNERSHIP
nextcorps
NIST National Institute of Standards and Technology U.S. Department of Commerce
NEW YORK PHOTONICS PHOTONICS ROCHESTER
NEW YORK STATE OF OPPORTUNITY. Division of Science, Technology & Innovation
ROCHESTER INSTITUTE OF TECHNOLOGY R·I·T 1829
SBA U.S. Small Business Administration
The Entrepreneurs Network

OUTREACH INITIATIVES

This past academic year, CEIS has supported or led a number of outreach activities that have helped grow optics, photonics, and imaging companies as well as companies in associated industries such as virtual reality. Our annual University Technology Showcase, held in April, featured 46 posters highlighting some of the applied research at the University of Rochester and Rochester Institute of Technology that is relevant to local industry. Many of those posters were about collaborations supported by CEIS, while others were presented to spark new interest on the part of industry. More than 175 people attended the event.

In September 2017, CEIS put on the first Light and Sound Interactive® Conference. LSI highlights two areas for which Rochester is most well known: imaging and music. There were eight tracks, including virtual and augmented reality, games, music, film, imaging, photonics, and the use of light- and sound-based technologies in health care. These also happen to be the basis for some of the fastest-growing markets in the world and great opportunities for local economic development. There were also entertainment events at the four major local museums, a tradeshow, screenings of major motion pictures, and a keynote address by two-time Academy Award–winning director Ang Lee. LSI is designed to shine the international spotlight on Rochester's strength in these areas and raise local awareness of light and sound resources and programs. The idea is to inspire people to take advantage of local assets, including starting new companies. The ultimate goal of LSI is to expand the local economy by incubating, growing, and attracting companies. LSI is also a great example of cooperation among the University of Rochester, RIT, local industry, and the state.

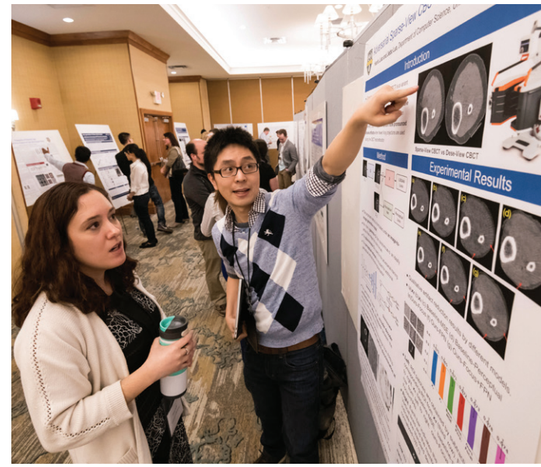
More than 1,000 people attended the inaugural LSI, and the feedback received through a follow-up survey indicated that 95 percent of the attendees were likely to attend again. At least one company, VeRacity VRcade, was started as a result of presentations and networking at LSI 2017. The company now employs five people. Another important outcome of LSI 2017 grew out of a networking event hosted by AIM Photonics, the American Institute for Manufacturing Integrated Photonics. AIM Photonics is headquartered in Rochester and is where the Test, Automation, and Packaging facility (TAP) is located. New York State is investing $250 million into the TAP facility, and there is a major effort to get local companies involved with AIM. The LSI Photonics event helped AIM set up one-on-one follow-up meetings with 28 local companies to discuss becoming members of the consortium. Given this success and broad-based interest, CEIS has handed over management of LSI to a community coalition of industry, university, and state leaders. The next LSI is being planned for June 25–27, 2019, to coincide with the CGI Rochester International Jazz Festival.

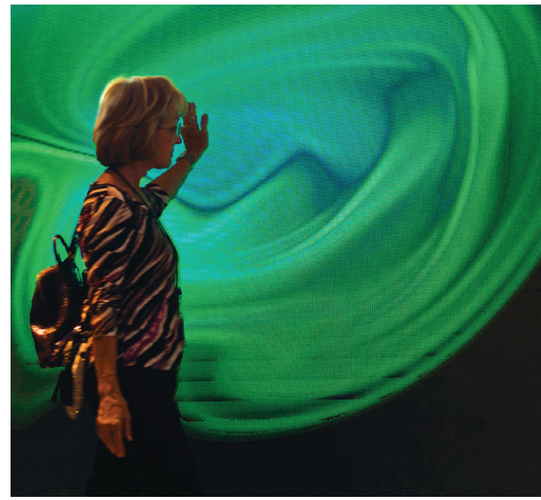
The virtual and augmented reality market is expected to exceed $100 billion by 2022*. To help Rochester capture some of this growth, CEIS, in collaboration with the University of Rochester's College, organized a VR/AR conference in October of this year. This was the second of what is planned to be an annual event. The conference focused on the research and capabilities in VR/AR at the University of Rochester and RIT and drew more than 100 people from the two universities and industry. This effort is already paying off. As of October, Facebook Reality Lab has entered into collaborative research agreements with both the University of Rochester and RIT and is funding projects in the areas of optics, visual neuroscience, and optical materials and metamaterials. We hope that this is a sustained and productive relationship between the University of Rochester and one of the leaders in the emerging area of virtual and augmented reality.

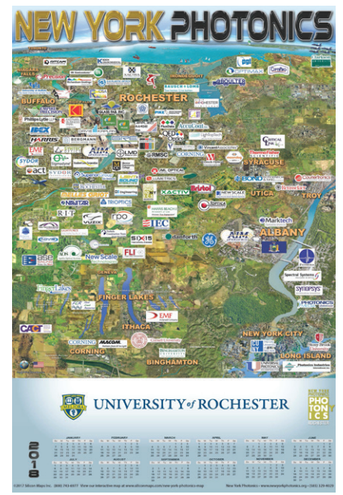
Other outreach activities included CEIS's support for the New York Photonics Calendar, shown on this page, which helps promote the 100-plus photonics companies in the region and is considered to be the cluster's number one marketing tool. And CEIS was successful in helping a team of semiconductor designers find a new home with a major international consumer electronics company.

In the coming year we look forward to continuing such initiatives that bring our academic and industry communities together to inspire and enable creative activities that will help to grow the economy of the Finger Lakes region and the entire state of New York.

Source: Average forecast by Market Research Engine, Markets and Markets, and Statistica.







CEIS University Technology Showcase *(top)*

Light and Sound Interactive® Conference *(middle)*

New York Photonics Calendar *(left)*

ECONOMIC IMPACT

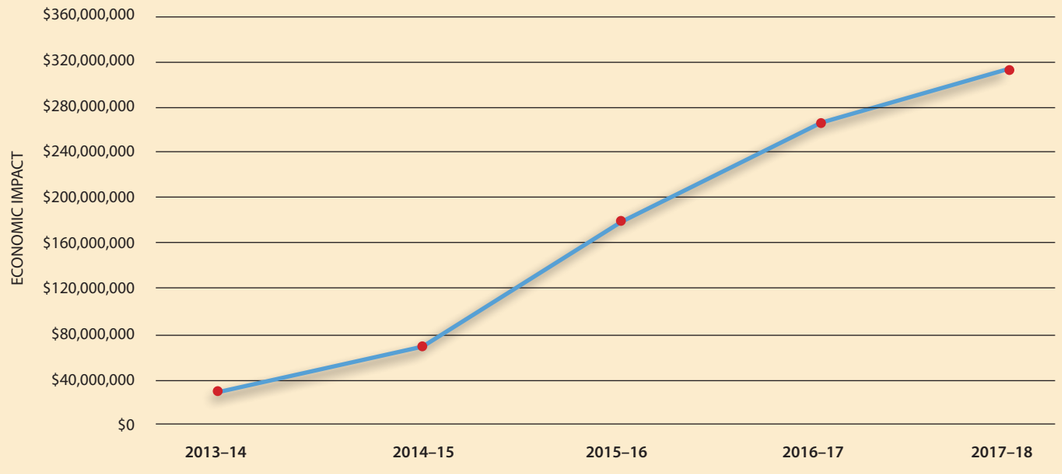
For the fiscal year July 1, 2017, to June 30, 2018, the total documented dollar value of the economic impact of CEIS-supported research and outreach was more than $47 million. This self-reported data (new and retained jobs, increased sales, cost savings, capital investments, and additional funds acquired) from 24 of our partners provides a snapshot of the region's economic successes.

A shout-out goes to the AIM Photonics initiative, which led the way in non-job impacts, reporting close to $30 million in monetary gains. The local start-up company Clerio Vision reported nine new jobs and six retained jobs along with more than $2.2 million in non-job impacts. Special recognition goes as well to VeRacity VRcade, a virtual reality arcade that was conceptualized as a direct result of the first-ever Light and Sound Interactive conference! In its first year, VeRacity reported five new jobs as well as non-job impacts.

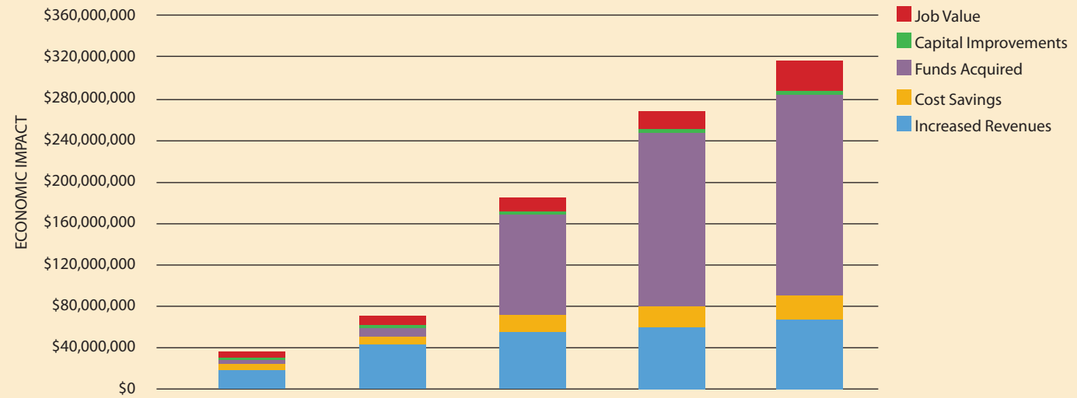
FIVE-YEAR SUMMARY OF ECONOMIC IMPACT

Year	2013–14	2014–15	2015–16	2016–17	2017–18	Total
Increased Revenues	$20,816,657	$22,548,794	$18,635,000	$1,276,127	$1,563,699	$64,840,277
Cost Savings	$6,276,553	$1,989,100	$3,927,488	$4,586,060	$6,536,372	$23,315,573
Funds Acquired	$3,103,808	$8,050,720	$81,269,321	$77,548,500	$34,250,633	$204,222,982
Capital Improvements	$792,806	$263,421	$204,549	$113,000	$263,377	$1,637,153
Job Value	$4,245,605	$2,944,601	$6,106,332	$4,075,292	$5,147,237	$22,519,067
New Jobs	21	20	61	37.75	30.25	170
Retained Jobs	40	26	28	23.5	45.25	163
Total Impact	$35,235,429	$35,796,636	$110,142,690	$87,598,979	$47,761,394	$316,535,128
Total Cumulative Impact	$35,235,429	$71,032,065	$181,174,755	$268,773,734	$316,535,128	$316,535,128

TOTAL CUMULATIVE ECONOMIC IMPACT



FIVE–YEAR ECONOMIC IMPACT



CAT PROGRAM FINANCIAL INFORMATION

	July 1, 2017– June 30, 2018
FUNDING FROM NYSTAR	
Research Expenditures	
Personnel Related	$388,255
Non-Personnel Related	$184,887
Operational Expenditures	
Personnel Related	$441,429
Non-Personnel Related	$280,247
Total NYSTAR Contribution	$1,294,818
OTHER SOURCES OF FUNDS	
Cash from Companies	
Personnel Related	$959,872
Non-Personnel Related	$463,648
Other Contributions	
Personnel Related	$0
Non-Personnel Related	$0
Total Other Sources	$1,423,520

COMPANIES REPORTING ECONOMIC IMPACT IN 2017–18 FROM CEIS INTERACTIONS

AIM Photonics
AlchLight
Arcum Therapeutics
Bausch + Lomb
BOCES 2 WEMOCO
Carestream Health
Clerio Vision, Inc.
Corning, Inc.
Envision Solutions LLC
Harris Space & Intelligence Systems
Harris RF Communications
HYPRES
Imaginant
Kitware
Kodak Alaris
LighTopTech Corporation
OptiPro Systems, LLC
O-Vitz Corporation
SiMPore, Inc.
Synaptics/Sony Electronics
Thermo Fisher Scientific
UR Ventures Technology Development Fund
VeRacity VRcade
VisualDx

A YEAR **IN REVIEW**

Interactive wall at LSI 2017 event

JULY 2017

CEIS awarded 29 faculty researchers more than $570,000 for CAT projects with 14 NYS companies, including 6 new researchers and 4 new company partners.

SEPTEMBER 2017

Light and Sound Interactive (LSI) conference held at the Rochester Riverside Convention Center. More than 1,000 people attended the 2-1/2 day event featuring 130 presenters and 45 exhibitors representing 9 areas of interest: VR/AR, Games, Cinema, Music/Audio, Imaging, Displays, Healthcare, Optics & Photonics, and Start-ups.

Film critic Jack Garner and his wife enjoying the 3-D action (on left)

NOVEMBER 2017

Carestream joined Zebra Medical Vision's AI1 campaign. This collaboration allows radiologists to access Zebra-Med's AI algorithms though the Diagnostic Carestream Workstation. Zebra-Med's engine can automatically detect various medical findings in imaging scans, and the deep-learning engine will help radiologists deliver a more comprehensive quantitative and consistent reporting in an effort to improve patient care.

HARRIS FALCON III® AN/PRC-117G(V)1(C)

Harris shipped its 50,000th PRC-117G Falcon III manpack radio—a groundbreaking technology developed with the University of Rochester's Professor Wendi Heinzelman. The 117G was introduced in 2007 and allowed soldiers to connect a screen to the manpack to send email, images, and videos. It has provided soldiers with enhanced battlefield situational awareness capability and has increased Harris's market share to 85 percent.

DECEMBER 2017

CEIS partner Professor Wayne Knox elected as a fellow of the National Academy of Inventors. Professor Knox has been awarded 50 US patents and another 150 worldwide.

DECEMBER 2017

VisualDx expanded operations in Rochester's Downtown Innovation Zone. The innovative medical diagnostic company added 5,000 square feet to its current lease with plans to create up to 21 new jobs and retain 39 jobs. Art Papier, VisualDx CEO, stated, "We believe Rochester is an ideal spot for technical innovation and are proud to bring two of the city's best assets together —imaging and health care—to improve medial decision making. We appreciate the support to expand our operation and retain the local talent available."

MOLECULAR GLASSES

JANUARY 2018

Molecular Glasses received a patent for "Charge-transporting molecular glass mixtures, luminescent molecular glass mixtures, or combination thereof or organic light-emitting diodes and other organic electronics and photonics applications."

MARCH 2018

The first Carestream OnSight 3D Extremity System was installed at Cobalt Health's Imaging Centre in Cheltenham, UK. This first installment will allow professionals to use a cone beam technology, which will provide 3-D images at the point of care. There are minimal site and installation requirements, which will allow faster and more convenient imaging and therefore enabling more timely diagnosis and treatment.

APRIL 2018

Forty-six posters touting an array of technologies were presented at the University Technology Showcase. J. Mikael Totterman, CEO of Clerio Vision, was given the CEIS Partner Appreciation Award. Kaitlin Wozniak won the poster prize for the presentation of Clerio Vision–related research: "Scattering properties of ultrafast laser-induced refractive index shaping lenticular structures in hydrogels."

Award recipient Mike Totterman (right) with CEIS director Mark Bocko

MAY 2018

Renovations began on a hands-on AR/VR lab to be located in the Carlson Science and Engineering Library. The new lab will give students and faculty the opportunity to create and explore with augmented and virtual reality.

FEBRUARY 2018

VeRacity VRcade opened its doors. The business idea was born when the founder attended the 2017 Light and Sound Interactive conference. VeRacity VRcade offers a VR experience that is fun and affordable.

MAY 2018

Harris Corp awarded a five-year, up to $130 million contract with the US Air Force for Hand Held Video Data Link (HH-DVL) radios.

MCC Monroe Community College
STATE UNIVERSITY OF NEW YORK

JUNE 2018

Google partners with MCC to offer a new IT Support Professional Certificate program. The eight-month course will prepare students to enter this well-paying high-tech field. Google reports there are approximately 150,000 open IT jobs that do not require a college education but do require experience.

Luminate's first cohort poses at NextCorps offices in the Sibley Building.

Luminate NY announced Double Helix Optics as the winner in its first round of competition. CEIS partners Molecular Glasses, Inc., Positive Science LLC, and LighTopTech Corporation were finalists in the OPI competition.

2018–19 **ABSTRACTS**

University of Rochester students experiment with an augmented reality table built by a chemical engineering PhD student in Andrew White's lab. The platform allows students to simulate the reactions that occur in a chemical plant.

2018–2019 PROJECT ABSTRACTS

Improved Mathematical Modeling and Computer Simulation of Contact Lens Dynamics

David S. Ross and Kara L. Maki
Rochester Institute of Technology
Bausch & Lomb

We propose to advance the modeling of contact lens dynamics. We have established the model of asymmetric lens motion, and we have developed a computer simulation of such motion based on the model. Over the next year we plan to improve the model's representations of lid pressure, blinking, tear film shape and rheology, and toric lens shapes. In addition, we plan to transfer the established lens centration model to Bausch & Lomb researchers; in collaboration with B&L, we will tailor the existing computer code to their requirements.

Peripheral Visual Quality and Its Impact on Myopia Development and Control

Geunyoung Yoon
University of Rochester
Bausch & Lomb

The population of myopia (or nearsightedness) patients has been booming worldwide. Although myopia can be easily corrected with optical and surgical interventions, pathological myopia is known to increase the risk of eye diseases such as cataracts, glaucoma, and macular degeneration, which cause large socioeconomic burden worldwide. The genesis of myopia remains uncertain but is generally considered to have a multifactorial origin composed of optical, genetic, and environmental factors. The hypothesis to be tested in the proposed study is that peripheral optical and visual quality of the eye influences myopia development, i.e., eye elongation. This hypothesis will be tested by characterizing the impact of bifocal contact lens designs, attempting to reduce myopia progression by increasing myopic defocus and depth of focus in the peripheral visual field. We will use the state-of-the-art wide-field scanning ocular wavefront sensor to quantify aberration profiles at the peripheral retina eccentricities, which will then be used to simulate retinal image quality.

Defining and Modeling LIRIC Writing Modalities

Paul D. Funkenbusch and Amy Lerner
University of Rochester
Clerio Vision, Inc.

We propose to continue and extend current research on Laser Induced Refractive Index Change (LIRIC) to better define, model, and control the process. In addition to changing the refractive index to produce gradient index optical corrections, LIRIC can also subtly alter the cornea shape, providing a potential second modality for producing optical corrections. The proposed work includes two elements. First, differentiating process conditions that produce primarily refractive index change from those that also provide significant shape change. Second, enabling controlled use of the shape change effect by modeling the effects of LIRIC on shape.

Power-efficient LIRIC Scaling and Study of Limits

Wayne H. Knox
University of Rochester
Clerio Vision, Inc.

We propose to expand current studies of Laser Induced Refractive Index Change (LIRIC) into new regimes of low-laser repetition rates (5–15 MHz) and wavelength simultaneously (810 and 405 nm). A newly developed theoretical model for LIRIC writing predicts that LIRIC structures can be written at much lower average powers than currently. For development of eye-safe procedures, these factors are most critical. These studies are being made possible with a new custom fiber laser. Furthermore, we will study damage limits to the LIRIC writing process in cornea and hydrogels with a newly developed high-resolution confocal Raman microscope.

Biological Impact of LIRIC in the Cornea (continuation)

Krystel R. Huxlin
University of Rochester
Clerio Vision, Inc.

LIRIC (Laser-Induced Refractive Index Change) is being developed as a new, nonablative form of refractive correction in humans. In the last grant period, we discovered that LIRIC can exist in two different regimes: (1) a lower-power laser regime where pure refractive index (RI) change is induced, and (2) a higher-power laser regime where both RI and micro-bubbles are induced. These two regimes open up separate application possibilities for humans, but their relative biological characteristics and safety profiles now need to be investigated before this technology can be applied to patients, where it stands to revolutionize the field of refractive correction.

Developing a Brillouin Scattering Microscope to Quantify Mechanical Properties

Geunyoung Yoon
University of Rochester
Clerio Vision Inc.

The human cornea exhibits a relatively simple geometric structure, exposed primarily to stable intraocular pressure. However, the optical and biomechanical behaviors are highly sensitive to variations in individual geometry such as the diameter and thickness as well as the three-dimensional distribution of material properties such as extracellular matrix modulus and fibrillar organization. The organization and density of the collagen fibrils within the extrafibrillar matrix contribute to highly complex material properties, which are nonlinear, anisotropic, and nearly incompressible and viscoelastic. The overarching goal of the project is to model the biomechanical behavior of the cornea and its influence on optical quality based on individual patients' anatomic geometry, material characteristics, and loading conditions. Such a model, once validated, could be used to investigate responses to refractive surgery, risk for disease, and, potentially, responses to treatment. To achieve this goal, here we propose to develop a Brillouin scattering microscope as a potential in-vivo imaging modality that can quantify the three-dimensional distribution of material properties of cornea and soft contact lens material with and without optical manipulations.

Efficacy of Visual Training for Recovering Sight in Stroke Patients

Steven Feldon
University of Rochester
Envision LLC

Every year, half a million stroke patients become cortically blind in the US. This blindness impairs the ability to read, drive, and navigate, impacting other rehabilitation efforts and the capacity to live independently. Yet, there is a complete lack of validated vision rehabilitation treatments available to those afflicted. Here, we propose to continue the first randomized, blinded, placebo-controlled study to test the efficacy of a visual discrimination training treatment developed at the University of Rochester for eliciting visual recovery in the blind field of stroke patients. Validating this treatment in the proposed trial is a critical first step for deploying this technology clinically.

2018–2019 PROJECT ABSTRACTS

Support for Distributed Computing and Network Management on Mobile Ad Hoc Networks
Wendi Heinzelman and Cristiano Tapparello
University of Rochester
Harris Corporation

The goal of this research is to develop technologies and approaches for achieving robust data connections in heterogeneous network platforms using a mixture of ad-hoc and hierarchical networks. Techniques that will be investigated include combining the advantages of point-to-multipoint access systems such as WiFi and/or commercial cellular systems with mobile ad-hoc networking (MANET) technology. Network hierarchy, heterogeneous assets, and cognitive networking will be considered in the solution space.

Smart Sensors for Classical and Quantum Data Links
Roman Sobolewski
University of Rochester
HYPRES, Inc.

The project is devoted to development of the next-generation photon smart sensors, based on superconducting single photon detectors (SSPDs) integrated with Josephson-junction–based, mixed-signal circuits to provide readout, tuning, and control of the detector. These digitally assisted detectors will have performance characteristics far surpassing traditional, analogue-type SSPDs and will unlock their scalability into large SSPD arrays. We will target high-value applications in optical quantum networks and quantum information applications including high data rate quantum key-distribution schemes. We will also pursue SSPD applications by interfacing optics with digital superconducting electronics as well as study novel SSPDs, based on superconductor/ferromagnet bilayer nanostripes.

Global Surveillance Augmentation for Deep Learning
Andreas Savakis and John Kerekes
Rochester Institute of Technology
Kitware, Inc.

In this project, we will continue to explore deep learning algorithms for global surveillance applications, focusing on change detection in satellite imagery. During the first two phases of the project, we generated a dataset of vehicle and helicopter images using DIRSIG and used them to train deep convolutional neural networks (CNNs) as object detectors and two channel Siamese networks for change detection. In the third year of the project, we will focus on generating more realistic DIRSIG imagery for training our algorithms, and we will test our change detection methods on real data.

Integrated Optical Frequency Detection and Weak Value Amplification
Jaime Cardenas
University of Rochester
Leonardo DRS

We will collaborate to design, fabricate, and test an integrated optical chip. This chip's purpose will be precise optical frequency measurement using a combination of dispersive elements and weak value-based phase readout. Funds provided by the CEIS will be used to support a graduate student in our group and to buy time and materials for the Cornell nanofabrication facility. This effort is part of the larger effort in collaboration with Leonardo DRS, a defense-related company with a national scope.

Fluorescence Gabor-Domain Optical Coherence Microscopy (GD-OCM)
Jannick Rolland
University of Rochester
LighTopTech Corporation

A multimodal instrument for simultaneous, noninvasive structural and functional assessment of biological environments will be developed. Coupling the high-definition imaging capability in 3D of Gabor-Domain Optical Coherence Microscopy (GD-OCM) with the capability of studying biochemical evolution with laser scanning confocal fluorescence microscopy is unprecedented.

Custom Anterior Surfacing of Scleral Lens Prosthetic Devices for Vision Quality Improvement in Patients with Corneal Ecstasia
Tara Vaz
University of Rochester
Ovitz Corporation

Corneal ecstasia is a group of ophthalmic conditions involving severe degradation of a patient's visual acuity and quality of life. We propose a double blinded clinical study for evaluating visual performance of custom anterior surface wavefront correction in ecstasia patients wearing scleral lens prosthetic devices. Previous research conducted by the Flaum Eye Institute and Boston Sight show improvements in visual performance using this method when performed with research-grade diagnostics. A similar method will be evaluated using a commercial prototype wavefront sensor developed by Ovitz Corporation. This study would demonstrate the effectiveness of the improved technique using a diagnostic setup that could be made available to standard clinics.

Computational Models of Nanomembrane Fouling
James McGrath
University of Rochester
SiMPore Inc.

The emergence of oncolytic viruses that target and kill cancers has profound implications for health care. A major cost driver in the production of viruses as medical products is titer losses as high as 80 percent during sterile filtration. SiMPore's precision slit-pore membranes can sterile filter oncolytic viruses without loss; however, they have only been tested in small formats. In this project, we will use computational models of membrane clogging by viruses to understand the area requirements and flow conditions needed to meet the demands of industrial production. Results will be used in an NIH Phase II SBIR application to development tangential flow nanomembrane devices for oncolytic virus production.

Development of Quantum Dot Coated Detector Arrays
Zoran Ninkov
Rochester Institute of Technology
Thermo Fisher Scientific

Improving the sensitivity of silicon-based CMOS and CCD in the deep-UV is an area of interest. Lumogen has been previously used for this purpose but has limitations in its use in both vacuum and radiation harsh environments. Quantum Dots (QD) offer a robust alternative to Lumogen. The fluorescence wavelength of QDs is tunable and can match the peak sensor quantum efficiency. Aerosol jet printing (AJP) is being used at Rochester Institute of Technology for the deposition of QDs on substrates and commercial sensor arrays. Insights obtained and improvements in the equipment will permit commercially ready devices to be fabricated and tested this year.

This wedged reversal shearing interferometer is used to measure beams of light and was recently developed by University of Rochester Institute of Optics professor Chunlei Guo and PhD student Billy Lam.

2017–18 ABSTRACTS

2017–2018 PROJECT ABSTRACTS

Phase I: Black Metals and Superwicking Surfaces

Chunlei Guo
University of Rochester
AlchLight

This project will develop techniques to mass-produce black metals for broad band solar energy absorbers and superwicking polymer surfaces for evaporative cooling. The incorporation of the black metal to the hot end and the superwicking surface to the cold end of thermoelectric generators (TEGs) is projected to enhance current module efficiency by more than 95 percent, which represents a breakthrough in the renewable energy generation and waste heat management. Superwicking surfaces will be produced by manipulating the surface topography of a polymer material through femtosecond laser processing and a newly developed imprinting technique.

Development of Novel Topical Antimicrobial Therapeutics

Paul Dunman
University of Rochester
Arcum Therapeutics, Inc.

We are facing a catastrophic health care crisis—antibiotic resistance has jeopardized the use of drugs that have previously cured deadly bacterial infections. Current antibiotics are no longer working. Arcum Therapeutics Inc. has developed agents for therapeutic intervention of the most problematic bacterial species that physicians encounter. The current proposal will extend the preclinical development of one of those products and directly create job growth in Rochester, New York.

Mathematical Model and Computer Simulation of the Motion of a Toroidal Contact Lens

Kara L. Maki
David Ross
Rochester Institute of Technology
Bausch & Lomb

In recent work with Bausch and Lomb, we have developed and applied models of the coupled fluid mechanics and solid mechanics of a contact lens on an eye: a model of suction pressure induced by a radially symmetric lens conformed to a rigid eye and a model of concentration of a perturbed contact lens. Here we propose to develop a model of the stresses the eyelid exerts on a contact lens during a blink. We will couple this model with the concentration model and simulate the displacement of a lens and its recentering under the influence of suction pressure gradients.

Understanding On-Eye Performance of Presbyopia Correcting Contact Lens

Geunyoung Yoon
University of Rochester
Bausch & Lomb

Presbyopia is a visual condition that is faced by all adults over the age of approximately 40 years. Individuals with presbyopia lose the ability to focus on nearby objects, which significantly impacts quality of life. Although extending depth of focus via a multifocal contact lens to overcome presbyopia is increasingly popular, clinical outcomes with these lenses are variable and often unpredictable. A better understanding of the role of practical factors when a multifocal lens is worn by patients improves our ability to predict its performance and moreover to develop advanced designs. The project is aimed toward the evaluation of through-focus performance of multifocal contact lens designs in which these realistic factors such as decentration and conformation of presbyopia-correcting contact lenses imaged by a real-time pupil camera and high-resolution optical coherence tomography.

Compressive Beamforming for Portable Ultrasound

Zeljko Ignjatovic
Vikram Dogra
University of Rochester
Carestream Health, Inc.

We propose a Compressive Parallel-Beamforming ultrasound imaging method that is a dramatic departure from conventional approaches and has the potential to disrupt the state of the art in ultrasound imaging. Rather than using an expensive linear array with hundreds of transducer elements and associated electronics, the new method eliminates the expensive electronic components (amplifiers, A/D and D/A converters) connected to each element of the array and replaces them with a single channel that is shared by the entire array, to significantly reduce array complexity and allow genuinely portable implementations. The proposed system uses unfocused imaging of the target medium via a binary-coded aperture, which gives much improved spatial resolution and reduces the sidelobe artifacts commonly seen in traditional ultrasound systems, and allows a significant speedup of image acquisition. This method could have a profound impact on health and quality of life for humans by providing a compact, portable, and easy-to-use ultrasound imaging system with improved performance.

Deep Learning for High-Resolution 3D Cone Beam CT Medical Image Analyses

Jiebo Luo
University of Rochester
Carestream Health, Inc.

Traditional approaches in medical image analysis rely on handcrafted features that are not effective and robust when the image analysis task is complicated. In contrast, deep learning, which has made significant progress in recent years, can learn feature representations automatically. For this reason, deep learning has recently gained much attention in the medical image analysis community. In this study, we investigate a deep learning approach to analyzing images of multiple medical imaging modalities, ranging from CT and X-ray to 2D and 3D ultrasound. In particular, we intend to demonstrate the effectiveness of deep learning through a number of sub-projects that involve different medical imaging modalities. To ensure that the algorithms will be robust for data from diverse clinical sources, we will rely on large-scale and diverse datasets with detailed annotations in collaboration with Carestream Health. The developed algorithms will be integrated with the existing Carestream systems, when possible, to validate the benefit of deep learning–driven image analysis.

Towards Automated Clinical Evaluation of Tendon through Shear Wave Elastography

Stephen McAleavey
Mark Buckley
University of Rochester
Carestream Health, Inc.

Musculoskeletal (MSK) conditions, including rotator cuff and ACL injuries, are the leading cause of disability in the US. The realignment of health care delivery in the US toward "accountable care" necessitates the development of effective yet low-cost methods to diagnose MSK conditions. Ultrasound technologies, including shear wave elastography (SWE), Acoustic Radiation Force Impulse Anisotropy, and Quantitative Angular Backscatter, have high potential to address this need. Building on our expertise in SWE and tendon biomechanics, we will experimentally validate these methods in ex vivo tendon and perform pilot human in vivo evaluation and comparison with invasive methods.

Plane Wave and Elastographic Imaging of AAA and Carotid Arteries

Michael S. Richards
Mark Buckley
University of Rochester
Carestream Health, Inc.

The continuing goal of the proposed research is to improve the patient-specific assessment of the pathological severity associated with the onset of cardiovascular diseases such as aneurysms and atherosclerosis. The recent development of clinical ultrasound (US) based tissue mechanical property measurements (e.g., elastography) has motivated the use of these technologies to measure the spatial variations of in-vivo vascular mechanical properties in real time or pseudo real time. This patient-specific information gathered in a diagnostic or screening mode can then be used to improve treatment recommendations for a variety of life-threatening vascular diseases. This second year will expand upon our previous work in which we developed computational tools that allowed us to accurately measure pulse velocities and material properties in vessel-mimicking phantoms. In year two, our goal is to test our methods in a limited patient population and consider more quantitative model-based approaches to estimating the material properties of vessels with complicated geometries.

Assessing the Link between Refractive Change and Mechanical Properties in IRIS Contact Lenses

Paul Funkenbusch
University of Rochester
Clerio Vision Inc.

Our 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 understanding the optical and now mechanical changes induced in the sample once treated with IRIS. We have used previous CEIS support to develop a scalable manufacturing platform for manufacturing clinically relevant refractive devices and demonstrated the visual acuity of the refractive correction. The goal of this research is to understand the link between optical and mechanical properties.

Biological Impact of LIRIC in the Cornea

Krystel R. Huxlin
University of Rochester
Clerio Vision Inc.

LIRIC (Laser-Induced Refractive Index Change) is being developed as a new method for refractive correction in humans and a less-damaging alternative to traditional laser refractive surgeries (e.g., PRK, PTK, and LASIK). The proposed preclinical study will assess the safety of LIRIC at 405 nm in living rabbit corneas. Aim 1: use optical coherence tomography and in vivo confocal imaging to assess how LIRIC alters the macro microscopic structure of the cornea and the lens. Aim 2: assess whether LIRIC induces inflammation or other cellular/tissue of ocular health (transparency, intraocular pressure, epithelial integrity). These aims are critical to translate this technology to humans, where it stands to revolutionize the field of refractive correction.

High-Power Femtosecond Ytterbium-Doped Fiber Laser-Based System for Optimization of Femtosecond Micromachining Ophthalmic Devices

Wayne H. Knox
University of Rochester
Clerio Vision Inc.

Our ultimate goal is to use femtosecond micromachining as a nondamaging method of custom-correcting refractive error in human cornea and intraocular lenses (IOLs). The proposed experiments will investigate new regimes of low repetition rate (10–40 MHz), wavelengths of 1030 nm and 515 nm and high-power scaling (<30W) to achieve ultrafast writing speeds in ophthalmic materials such as hydrogels and cornea.

Computer Modeling of Telecom Signals in Multimode Optical Fibers

Govind P. Agrawal
University of Rochester
Corning Inc.

In this project my research group will work with Dr. William Wood of Corning, Inc. to develop a comprehensive computer model for studying transmission of optical pulses through multicore and/or multimode fibers capable of supporting several optical modes. A computer model will be developed in stages and tested through experimental verification whenever possible. This work is important to Corning because multimode and multicore fibers are likely to be used in the near future for implementing the technique of space-division multiplexing.

Light Diffusing Fiber as a Disinfectant and/or Antimicrobial Agent

Paul Dunman
University of Rochester
Corning Inc.

Blue-violet (405 nm) light displays antimicrobial activity toward bacteria of health care concern. However, product development has been hampered by the absence of an applicable light delivery system. Corning® Fibrance® Light-Diffusing Fiber may overcome light-delivery issues. In studies made possible by an earlier CEIS Collaborative Innovative Research award, we characterized the antimicrobial spectrum of activity and established the safety profile of the Fibrance technology. Remarkable antibacterial effect was seen against two important Gram-positive pathogens. The current goal is to explore a broader range of pathogens and to define the cellular mechanism of action with which 405 nm light kills bacteria.

Efficacy of Visual Training for Recovering Sight in Stroke Patients

Steven Feldon
University of Rochester
Envision Solutions LLC

Every year, half a million stroke patients become cortically blind in the US. This blindness impairs the ability to read, drive, and navigate, impacting other rehabilitation efforts and the capacity to live independently. Yet there is a complete lack of validated vision rehabilitation treatments available to those afflicted. Patients are told that recovery is improbable, and that they should learn to live with their blindness. Here, we propose the first randomized, blinded, placebo-controlled study to test the efficacy of a visual discrimination training treatment developed at the University of Rochester for eliciting visual recovery in the blind field of stroke patients. Validating this treatment in the proposed trial is a critical first step for deploying this technology clinically.

2017–2018 PROJECT ABSTRACTS

Support for Distributed Computing and Network Management in Mobile Ad Hoc Networks

Wendi Heinzelman
University of Rochester
Harris Communication Systems

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 securely communicated where it is needed, when it is needed, even in the face of network dynamics, but we must also ensure that computation can be accomplished quickly using available resources within the network. The goal of this research is to develop technologies and approaches for achieving robust data connections in heterogeneous network platforms using a mixture of ad-hoc and hierarchal networks. Techniques that will be investigated include combining the advantages of point-to-multipoint access systems such as WiFi and/or commercial cellular systems with mobile ad-hoc networking (MANET) technology. Network hierarchy, heterogeneous assets, and cognitive networking will be considered in the solution.

Further Development of THz Imager Array in Support of Harris' Commercial THz Imaging Development

Zeljko Ignjatovic
University of Rochester
Harris Space and Intelligence Systems

Our group at the University of Rochester proposes to conduct a variety of THz measurements and parameter characterization and develop design methodologies for THz focal plane arrays in standard CMOS technologies in support of Harris's (formerly ITT Exelis, Inc.) THz imaging initiative. The proposed work is a continuation of our current efforts with Harris. Preliminary experimental results indicate that our technology shows a great deal of promise in detecting THz radiation up to 2 THz with responsivities that far exceed that of more expensive and less scalable pyroelectric detector. During the 2017–18 academic year, we will begin tests on the CMOS THz prototype imagers fabricated during 2016–17. The results of this analysis will be used to model and optimize noise performance of our THz focal plane array, which will be fabricated and tested subsequently.

Developing THz Detector Technology for Inspection Applications

Zoran Ninkov
Rochester Institute of Technology
Harris Space and Intelligence Systems

The THz region provides a means of using nonionizing radiation to perform a variety of noninvasive sensing tasks. Commercial camera systems are available that utilize microbolometer or pyroelectric detectors (e.g., from Gentec and IMO), but these devices lack sensitivity, stability, or readout speed. The proposed collaborative development by Harris/RIT/UR seeks to design, fabricate, and test suitable CMOS-based devices that, through iteration, will result in a commercial product marketed by Harris. The CMOS devices are fabricated in commercial foundries using standard chip manufacturing techniques to keep costs low. The ultimate goal of this multiyear effort is to develop a room temperature, compact, inexpensive THz imaging system that our sponsor (Harris) can market to commercial (e.g,. package inspection, crowd monitoring) and military (e.g., on aerial drones for short-range imaging) customers.

Further Development of THz Detector Arrays and Extension to the IR

Judith L. Pipher
University of Rochester
Harris Space and Intelligence Systems

In collaboration with RIT PI Ninkov, ECE PI Ignjatovic, and Harris Space and Intelligence Systems, our group in PAS has been developing THz and long-wave IR arrays exploiting thermionic emission in CMOS Si arrays. Currently, Generation 6 designs have been submitted to MOSIS foundry by the ECE group, the first of "smart" chips with memory, an A/D converter and S/H circuity on-chip. We will concentrate on noise reduction of the more recent generation chip deliverables, IR characterization of the ~10-micron devices, and on conducting the necessary experiments on the new Gen 6 arrays. Our group specializes in array technology and measurement. We will obtain array data after finding the optimal values of Vgs for each of the 90 pixels in the Gen 6 array, saving them to memory and operating the array with optimum Vgs for the purposes of imaging. We have already developed routines to determine noise characteristics, dark current, and quantum efficiency as well as other salient parameters.

Smart Sensors for Classical and Quantum Data Links

Roman Sobolewski
University of Rochester
HYPRES, Inc.

The project is devoted to development of novel optical smart sensors, based optical, superconducting single photon detectors (SSPDs) integrated with the Josephson junction–based mixed-signal circuits to provide readout, tuning, and control of the detector. These digitally assisted detectors will have performance characteristics far surpassing those of the traditional analogue-type SSPDs and will unlock their scalability to larger SSPD arrays. We will target high-value applications in quantum networks for quantum information applications including high-data-rate quantum key distribution. We will also pursue SSPD applications in interfacing optics with digital superconducting electronics and study novel SSPDs based on superconductor/ferromagnet nanobilayer stripes.

High-Frequency Quantitative Ultrasound Systems for Tissue Engineering

Diane Dalecki
Denise Hocking
University of Rochester
Imaginant

Technologies for monitoring engineered tissues quantitatively are critically needed to advance the field of tissue engineering. The overall goal of this project is to develop and implement high-frequency quantitative ultrasound systems for nondestructive characterization of engineered tissue constructs. These ultrasound technologies will (i) provide important quantitative tools for monitoring the functionality of tissue engineered products, (ii) offer rapid feedback for optimizing construct design and fabrication parameters, and importantly (iii) circumvent destructive testing. Imaginant is a world leader in high-frequency, nondestructive ultrasound instrumentation. This project will unite experts in biomedical ultrasound and tissue engineering (Dalecki and Hocking) with Imaginant's technical expertise.

Global Surveillance Augmentation for Deep Learning

Andreas Savakis
John Kerekes
Rochester Institute of Technology
Kitware Inc.

In this project we will continue to explore deep-learning algorithms for global surveillance applications, including object detection and change detection in satellite imagery. Our goal is to train various architectures of deep networks and compare them with graph-based change detection methods. To that end, we will generate additional datasets of augmented data that are sufficiently large and diverse to train our deep networks. We will develop, test, and compare both supervised and unsupervised change detection methods to identify important changes in panchromatic or color satellite imagery taken at different times.

Nondestructive/Noninvasive Three-Dimensional Imaging with Gabor-domain

Jannick Rolland
University of Rochester
LightTopTech Corporation

Real-time, high-resolution nondestructive inspection methods are needed to characterize materials through their depth, including plastics, glass, and human tissue. Fast, accurate metrology brings value to the manufacturing industry by improving quality, increasing productivity, and reducing costs. This project will supplement the development of Gabor-domain optical coherence microscopy (GD-OCM) instrument, the Explorer4D, to explore a long working distance for industrial and medical imaging applications.

Host/Emitter Interactions in OLED Emitter Layers

Lewis Rothberg
University of Rochester
Molecular Glasses

Molecular Glasses, Inc. is developing a novel class of noncrystallizable organic semiconductors for OLED application. We have already demonstrated significant increase in OLED device lifetime in yellow phosphorescent OLEDS using our material as a host. One key OLED problem is the short life of high-efficiency blue emitters. Our materials have the potential to help solve this problem. This project will help us develop the necessary hosts for long-life blue emitters. Photophysical characterization of hosts/emitters interaction is essential for choosing the most promising host candidates.

Augmented Reality Display Exploiting Advanced Optical Surfaces

Jannick Rolland
Nick Vamivakas
University of Rochester
Oculus

Augmented reality display optics exemplify extreme challenges in designing and packaging complex optical surfaces when a sunglass format is sought. In this project we explore how advanced optical surfaces such as freeform or diffractive surfaces may enable the technology of tomorrow.

Electrical Monitoring of Exosome Capture on Nanomembranes

James McGrath
University of Rochester
SiMPore Inc.

Our work on compact hemodialysis devices has revealed an unexpected benefit: the ability of nanomembranes to capture 30–100 nm vesicles that naturally occur in biological fluids. These vesicles, called exosomes, are powerful diagnostic markers for cancers and other disease. We wish to develop a robust exosome capture system and propose that transmembrane electrical resistance (TMER) can be used as a real-time measure of the capture process. We will first develop a nanomembrane capture device with integrated electrodes. We will then test the hypothesis that TMER increases in proportion to the fraction of pores occupied by exosomes.

Development of Quantum Dot Coated Detector Arrays

Zoran Ninkov
Rochester Institute of Technology
Thermo Fisher Scientific

Improving the sensitivity of silicon-based CMOS and CCD in the deep-UV is an area of interest. Lumogen has been previously used for this purpose but has limitations in its use in both vacuum and radiation harsh environments. Quantum Dots (QD) offer a robust alternative to Lumogen. The fluorescence wavelength of QDs is tunable and can match the peak sensor quantum efficiency. Aerosol jet printing (AJP) is being used at RIT for the deposition of QDs on substrates and commercial sensor arrays. Insights obtained and improvements in the equipment will permit commercially ready devices to be fabricated and tested this year.

CORPORATE **PARTNERS**

At the Corning Museum of Glass in Corning, New York, visitors can learn about the science and technology of glass and optics through hands-on exhibits.

CORPORATE PARTNERS

ALCHLIGHT
www.alchlight.com

Alchlight, based in Rochester, New York, is the leading developer and distributor of advanced and proprietary laser-fabricated materials. Acclaimed by the *New York Times* as "optical alchemy," Alchlight uses femtosecond laser processing to etch proprietary nanostructures on materials. The procedure doesn't coat the materials; instead, it changes the intrinsic properties of the materials. Alchlight's topographies can change the color of titanium to blue, make silicon attract water, or even make water bounce off brass.

ARCUM THERAPEUTICS
www.arcumtherapeutics.com

Arcum is developing an antibiotic platform for the prevention and elimination of resistant bacterial infections. Arcum's mission is to save lives and prevent a return to the days when simple infections were a common cause of death. We create combination drugs that target the Arcum proprietary resistance pathway, utilizing the FDA 505b2 accelerated approach to bring products to market faster with less risk for our investors.

BAUSCH AND 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.

CARESTREAM
www.carestream.com

Carestream is a dynamic global company with more than 100 years of leadership. In today's rapidly changing global health care environment, where the mandate to provide better outcomes has never been greater, we add value by delivering personalized, affordable, and practical options to help our customers advance. Medical providers large and small, from clinics and single hospitals to large networks and even entire countries, are upgrading their radiology and IT systems using Carestream's latest solutions.

CLERIO VISION
www.cleriovision.com

Clerio Vision is developing a novel vision correction procedure based on technology licensed from the University of Rochester. Instead of changing the shape of the cornea, as current LASIK-based approaches do, its approach is to use a femtosecond laser to change the refractive index of the cornea with small pulses to "write" a corrective prescription onto the cornea noninvasively. Because this approach doesn't thin the cornea, it can be repeated as needed to correct vision changes over a person's lifetime. The approach, called LIRIC, is being commercialized by some of the original architects of the world's first LASIK systems. Clerio's core technology has been in development for over a decade and is based on more than 40 issued and pending patents.

CORNING INCORPORATED
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.

CORPORATE PARTNERS

ENVISION SOLUTIONS LLC

ENVISION SOLUTIONS, LLC

Envision Solutions, LLC is company that has been working to build efficacy of visual training for recovering sight in stroke patients.

FLINT CREEK RESOURCES
www.flintcr.com

Flint Creek Resources is a unique company that offers services to make used rare earth and zirconia glass polishing compounds better than new. Spent polishing compounds are processed through a proprietary system that removes glass, polishing pad fragments, and contamination from the slurry. The resulting clean polishing particles are then custom formulated to produce excellent stock removal, surface finish, suspension, and cleanability.

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, New York. FluxData's imaging and system integration expertise helps guide customers from camera specification to delivery of the final system. Our staff of imaging experts works 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.

HARRIS CORPORATION
www.harris.com

Harris provides advanced technology-based solutions that solve government and commercial customers' mission-critical challenges. The company has approximately $8 billion in annual revenue and about 23,000 employees—including 9,000 engineers and scientists—supporting customers in more than 125 countries. Harris Corporation is a top-10 defense contractor providing mission-critical solutions through its Communication Systems, Critical Networks, Electronic Systems, and Space and Intelligence Systems segments.

HYPRES, INC.
www.hypres.com

HYPRES, Inc. manufactures superconducting microelectronics, including superconducting Integrated Circuits (ICs). Its products include voltage standard circuits and systems, wide bandwidth semiconductor-based amplifiers, and superconducting circuit foundry service. The company was founded in 1983 and is based in Elmsford, New York.

IMAGINANT
www.jsrultrasonics.com

Imaginant is a manufacturer of high-resolution digital cameras, ultrasonic NDT instruments, and handheld and robotic coating thickness measurement systems.

KITWARE
www.kitware.com

Kitware, Inc. is a leader in the creation and support of open-source software and state-of-the-art technology. Through our long-standing commitment to open source, detailed in our open source mission statement, we have become one of the fastest growing software companies in the country. By fostering extended collaborative communities, Kitware is able to provide flexible, cost-effective visualization, computer vision, medical imaging, data publishing, and quality software process solutions to a variety of academic and government institutions and private corporations worldwide.

KODAK ALARIS
www.kodakalaris.com/en-us

We're a company born from one of the world's most iconic brands. A company that is passionate about using technology to transform organizations and improve people's lives across the planet. From our digital scanners and intelligent state-of-the-art software services that power some of the world's largest companies to our photographic paper production, printing kiosks, and suite of consumer apps, we help people capture and connect with the emotional moments that define all our lives. Kodak Alaris is on a mission to unlock the power of images and information for the world. We work behind the scenes, making the connections, pushing the boundaries of technology, and helping you make sense of and exploit the ever-expanding volume of data that is the hallmark of the 21st century.

LIGHTOPTECH
www.lightoptech.com

LighTopTech Corporation is a women-owned optical technology company founded in 2013 and based in Rochester, New York. Our goal is to build innovative optical instruments to improve noninvasive imaging in medical and manufacturing fields.

MOLECULAR GLASSES, INC.
www.molecularglasses.com

Molecular Glasses, Inc. focuses on proprietary NONcrystallizable™ molecular glasses for stable and long-lived OLED and other organic electronics. Their unique technology enables them to design NONcrystallizable™ molecular glasses for superior performance. They have the ability to take their clients' favorite material sets and convert them to NONcrystallizable™ and soluble materials without affecting their original photophysical properties.

OCULUS
www.oculus.com

Oculus Rift and the Oculus-powered Samsung Gear VR provide the most immersive VR experiences and environments available, from games and movie scenes to exotic destinations and beyond. Founded in July 2012 by Palmer Luckey, Brendan Iribe, Nate Mitchell, and Michael Antonov, Oculus began as a Kickstarter campaign that raised $2.4 million in the first month and was acquired by Facebook in 2014.

CORPORATE PARTNERS

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

OVITZ
www.o-vitz.com

Ovitz Corporation is an exciting medical device company specializing in developing, manufacturing, and marketing novel and portable ophthalmic equipment and accessories that facilitate the delivery of ophthalmic care in eye doctors' and primary care physicians' offices, and in schools, rural areas and developing nations.

SIMPORE INC.
www.simpore.com

SiMPore is a Rochester, New York–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.

SOLID CELL
www.solidcell.com

Solid Cell is a developer of stationary and portable solid-oxide fuel cell technologies for residential, commercial, industrial, and other critical off-grid applications. The company's headquarters is located in New York City; its principal product development and manufacturing center is in Rochester, New York. Solid Cell's products provide clean energy using state-of-the-art fuel cell technology at commercially competitive costs. The company has targeted several specific applications to satisfy a wide variety of global power requirements. Widespread use of Solid Cell's fuel cells will reduce reliance on scarce natural resources like natural gas and oil.

SYNAPTICS INC.
www.synaptics.com

We are the pioneers and leaders of the human interface revolution, bringing innovative and intuitive user experiences to intelligent devices. From usability and R&D to supply chain and support, we collaborate with our partners to invent, build, and deliver human interface solutions that integrate seamlessly and optimize system value. The improved ease of use, functionality, and aesthetics of Synaptics-enabled products help make the digital lives of people more productive, secure, and enjoyable.

THERMO FISHER SCIENTIFIC INC.
www.thermofisher.com

Thermo Fisher Scientific Inc. (NYSE: TMO) is the world leader in serving science, with revenues of $17 billion and 50,000 employees in 50 countries. Our mission is to enable our customers to make the world healthier, cleaner, and safer. We help our customers accelerate life sciences research, solve complex analytical challenges, improve patient diagnostics, and increase laboratory productivity. Through our four premier brands—Thermo Scientific, Life Technologies, Fisher Scientific, and Unity Lab Services—we offer an unmatched combination of innovative technologies, purchasing convenience, and comprehensive support.

UR VENTURES
www.rochester.edu/ventures

UR Ventures develops University of Rochester innovations into valuable products and services to make the world ever better. Technology transfer functions are mandated by federal law. Even if they weren't, we would still do it because it's the right thing to do. Not only does the transfer of technologies make the world a better place, but the revenues generated are unrestricted and support the amazing research of the future. By rewarding our inventors, we also motivate them to solve real-world problems. Finally, the relationships we create help to attract and maintain industrial support for research.

VISUALDX
www.visualdx.com

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FACULTY **RESEARCHERS**

This year, CEIS partner Professor Wane Knox of the University of Rochester was elected as a fellow of the National Academy of Inventors.

FACULTY RESEARCHERS

GOVIND AGRAWAL

James C. Wyant Professor of Optics, Professor of Physics, and Senior Scientist at LLE, University of Rochester

Education PhD, Indian Institute of Technology, Physics, 1974; MS, Indian Institute of Technology, Physics, 1971; BS University of Lucknow, Physics and Statistics, 1969

Research Interests Quantum electronics, Nonlinear photonics, Fiber-optic communications

Recent Research Projects Transmission of optical pulses, Semiconductor lasers, Nonlinear fiber optics, Optical communications

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MARK BOCKO

Distinguished Professor and Chair of Electrical and Computer Engineering, Professor of Physics, 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 Multimedia signal processing, Imaging microelectronics, Wireless sensors

Recent Research Projects Digital audio watermarking and steganography, Image sensors with built-in image compression, Digital CMOS image sensor read-out circuits

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mark.bocko@rochester.edu

THOMAS BROWN

Professor of Optics, 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 Focusing and coherence properties of polarization vortex beams, Stress-engineered optical elements, Polarization properties of nanostructures, Waveguide mode resonances in SOI waveguides

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MARK BUCKLEY

Assistant Professor of Biomedical Engineering, University of Rochester

Education PhD, Cornell University, Physics, 2010; BS, Haverford College, Physics, 2001

Research Interests "Viscoelastic" soft biological tissues; Soft tissue aging, disease, and repair

Recent Research Projects Diseases of the musculoskeletal system, Plane wave and elastographic imaging

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FACULTY RESEARCHERS

JAIME CARDENAS

Assistant Professor of Optics, University of Rochester

Education PhD, University of Alabama in Huntsville, Optical Science and Engineering, 2005; BS, ITESM–Monterrey Institute of Technology, Physics, 1998

Research Interests Novel optical materials and devices, Bionanophotonics

Recent Research Projects Integrated optical frequency detection and weak value amplification, Photonic needles for light delivery in deep-tissue-like media

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DENIS CORMIER

Earl W. Brinkman Professor of Industrial and Systems Engineering and Director of AMPrint Center (CAT), Rochester Institute of Technology

Education PhD, North Carolina State University, Industrial Engineering, 1995; MS, State University of New York at Buffalo, Industrial Engineering, 1991; BS, University of Pennsylvania, Systems Engineering, 1989

Research Interests Additive manufacturing and multifunctional printing

Recent Research Projects Integration of 3D printed lens with InGaN light-emitting diodes with enhanced light extraction efficiency, Cu ink adhesion solutions

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DIANE DALECKI

Distinguished Professor and Chair of Biomedical Engineering, Professor of Electrical and Computer Engineering, Director of Rochester Center for Biomedical Ultrasound, University of Rochester

Education PhD, University of Rochester, Electrical Engineering; MS, University of Rochester, Electrical Engineering; BS, University of Rochester, Chemical Engineering

Research Interests Diagnostic ultrasound imaging, Therapeutic applications of ultrasound, Low-frequency underwater sound fields

Recent Research Projects Mechanisms for wound healing with ultrasound, Ultrasound technologies for tissue engineering, Effects of underwater sound on biological tissues

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VIKRAM DOGRA

Professor of Imaging Sciences, of Urology, and of Biomedical Engineering, University of Rochester

Education Diagnostic Radiology Residency, SUNY Buffalo, 1999; MD, Medicine, St. Vincent Medical Center, 1994; MD, Medicine and Surgery, Jawaharlal Institute (India), 1977

Research Interests MR, CT, and GU radiology, Ultrasound

Recent Research Projects In-vivo photoacoustic and ultrasound imaging probe for human thyroid cancer detection

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PAUL DUNMAN

Associate Professor of Microbiology and Immunology, University of Rochester

Education PhD, University of Medicine and Dentistry–NJ (UMDNJ), Microbiology, 1999; BS, Delaware Valley College, Arts & Sciences, 1992

Research Interests Novel strategies for the therapeutic intervention of bacterial infections, Modulation of mRNA turnover

Recent Research Projects Light-diffusing fiber as a disinfectant or antimicrobial agent, Efflux pumps and inhibitors of serum-grown *Acinetobacter baumannii,* Identifying new antimicrobial agents against *Mycobacterium tuberculosis,* Terfendine as a new *S. aureus* antibiotic

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STEVEN FELDON

Professor and Chair of Ophthalmology, Professor of Visual Sciences, and Director of the Flaum Eye Institute, University of Rochester

Education MBA, University of Southern California, 1997; MD, Albert Einstein College of Medicine, 1973; BA, University of California, Los Angeles, Psychology, 1969

Research Interests Neuro-ophthalmology, Oculofacial plastics and orbital surgery

Recent Research Projects Thyroid-associated eye disease

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JAMES FERWERDA

Associate Professor of 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

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PAUL FUNKENBUSCH

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

Education PhD, Michigan Technological University, Metallurgical Engineering, 1984; BS, Michigan Technological University, Metallurgical Engineering, 1979

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

Recent Research Projects Optical probing for freeform optics metrology

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FACULTY RESEARCHERS

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Associate Professor of Biomedical Engineering, 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

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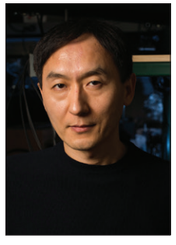

Professor of Optics, University of Rochester

Education PhD, University of Connecticut, Physics, 1999; BS, Changchun Institute of Optics and Fine Mechanics, Physics, 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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CONSTANTINE HAIDARIS

Professor of Oral Biology and Associate Professor of Microbiology and Immunology, University of Rochester

Education PhD, University of Cincinnati College of Medicine, Microbiology, 1982; MS, Miami University, Microbiology, 1976; BA, Wittenberg University, Biology, 1974

Research Interests Mechanisms of pathogenesis, Host-microbe interactions and approaches to therapy

Recent Research Projects Infections in the immunocompromised host, Treatment of infections through photodynamic therapy

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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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Micron Professor of Microelectronic Engineering and Director of Semiconductor and Microsystems Fabrication Laboratory, 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, Development of bipolar and MOS high-power microwave transistors

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DENISE HOCKING

Professor of Pharmacology and Physiology and of Biomedical Engineering, University of Rochester

Education PhD, Albany Medical College, Physiology, 1992; MS, Albany Medical College, Physiology, 1990; BS, Hartwick College, Medical Technology, 1983

Research Interests Extracellular matrix, Fibronectin

Recent Research Projects Extracellular matrix protein, fibronectin, and wound repair; Tissue engineering; Therapy for tissue regeneration in chronic wounds

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Professor of Ophthalmology, of Neurobiology and Anatomy, of Brain and Cognitive Science, of Optics, and in the Center for Visual Science, 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 micro-machining 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

Associate Professor of 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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Professor of Imaging Science and Director of the Digital Imaging and Remote Sensing Laboratory, Rochester Institute of Technology

Education PhD, Purdue University, Electrical Engineering, 1989; MS, Purdue University, Electrical Engineering, 1986; BS, Purdue University, Electrical Engineering, 1983

Research Interests Remote sensing, system modeling, and analysis; Pattern recognition; Digital imaging; Image processing

Recent Research Projects Global surveillance augmentation for deep learning

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WAYNE KNOX

Professor of Optics, of Physics, of Materials Science, and in the Center for Visual Science, University of Rochester

Education PhD, University of Rochester, Optics, 1984; BS, University of Rochester, Optics, 1979

Research Interests Ultrafast laser physics and prototyping; Femtosecond micromachining and applications in vision science; Dispersion micromanagement in holey and photonic crystal fibers; Ultra-short pulse lasers; Novel fiber components based on fiber tapering; Dispersion compensation devices; High nonlinearity fiber devices; Ultrafast mid-infrared sources; Dispersion—limits, measurements, compensation schemes; Biomedical optics

Recent Research Projects Femtosecond micromachining of ophthalmic polymers

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JIEBO LUO

Professor of Computer Science, University of Rochester

Education PhD, University of Rochester, Electrical Engineering, 1995; MS, Electrical Engineering, University of Science & Technology (China), 1992; BS, Electrical Engineering, University of Science & Technology (China), 1989

Research Interests Computer vision, Machine learning, Social media, Data mining, Human computer interaction, Biomedical informatics, Mobile and pervasive computing, Computational photography, Ubiquitous and mobile computing

Recent Research Projects Fine-grained user profiling from multiple social multimedia platforms, Wine recommendation for grocery shoppers

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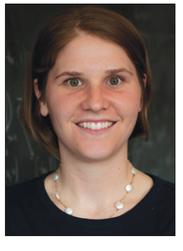

Associate Professor, School of Mathematical Sciences, Rochester Institute of Technology

Education PhD, University of Delaware, Applied Mathematics, 2009; MS, University of Delaware, Applied Mathematics, 2006; BS, University of New Hampshire, Mathematics, 2003

Research Interests Physical systems and industrial problems pertaining to flows of biological and complex fluids, Modeling, Ordinary and partial differential equations, Scientific computing

Recent Research Projects Effect of contact lens distortion on exchange of tears, Model for suction pressure under a contact lens

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STEPHEN MCALEAVEY

Associate Professor of Biomedical Engineering, of Electrical and Computer Engineering, and in the Rochester Center for Biomedical Ultrasound, University of Rochester

Education PhD, University of Rochester, Electrical and Computer Engineering, 2002; MS, University of Rochester, Electrical and Computer Engineering, 1998; BS, University of Rochester, Electrical and Computer Engineering, 1996

Research Interests Use of motion-tracking techniques to enhance the contrast of ultrasound images, Acoustic Radiation Force Impulse (ARFI), Magnetically induced vibration of brachytherapy seeds

Recent Research Projects Development of novel, clinically applicable ultrasound imaging techniques, Acoustic radiation force imaging techniques, Spatially Modulated Ultrasound Radiation (SMURF) imaging, Single tracking location (STL), Shear wave elastography imaging (SWEI)

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JAMES MCGRATH

Professor of Biomedical Engineering, University of Rochester

Education PhD, Division of Health Sciences and Technology, Harvard/MIT, 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, Biological tissue models, Small-format hemodialysis, Biosensors, Electrokinectic devices

Recent Research Projects Interaction of nanoparticles with cells and protein mixtures, Ultrathin silicon-based nano-membranes for filtration of molecules and nanoparticles, Ultrathin silicon-based nanomembranes for biological co-cultures

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DAVID MESSINGER

Professor and Xerox Chair of Chester F. Carlson Center for Imaging Science, Rochester Institute of Technology

Education PhD, Rensselaer Polytechnic Institute, Physics, 1998; BS, Clarkson University, Physics, 1991

Research Interests Investigation of physical and geophysical processes and properties through analysis of remotely sensed data and image exploitation, Advanced mathematical approaches for spectral image processing, Target detection in hyperspectral imagery

Recent Research Projects Spatial segmentation of multi/hyperspectral imagery by fusion of spectral-gradient textural attributes, Knowledge-based automated road network extraction system using multispectral images

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BENJAMIN MILLER

Professor of Dermatology, of Optics, of Biomedical Engineering, and of Biochemistry and Biophysics, University of Rochester

Education PhD, Stanford University, Organic Chemistry, 1994; BS, Chemistry, BA, Mathematics, German, Miami University, 1988

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

Recent Research Projects Control of biomolecular interactions through the synthesis of new small-molecule probes and the observation of biomolecular interactions through the development of novel optical sensing technologies. In the area of control The AIR Flu Chip: A Multiplex Optical Biosensor of Influenza Serology

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FACULTY RESEARCHERS

ZORAN NINKOV

Professor of Imaging Science, Rochester Institute of Technology

Education PhD, University of British Columbia, Geophysics and Astronomy, 1985; MSc, Monash University, Physical Chemistry, 1980; BSc, 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

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ANTHONY PIETROPAOLI

Professor of Medicine and of Pulmonary and Critical Care, University of Rochester

Education MPH, Clinical Investigations/Clinical Research, University of Rochester, 2008; MD, Medicine, SUNY Upstate Medical University,1990; BA, English and Premed, College of the Holy Cross, 1986

Research Interests Critical care translational research, Epidemiology of critical care medicine, Noninvasive measurements of microvascular function

Recent Research Projects Hyperspectral imaging for noninvasive, comprehensive measurement of microvascular function in humans, Protocols and hospital mortality in critically ill patients: the United States Critical Illness and Injury Trials Group Critical Illness Outcomes Study

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JUDITH PIPHER

Professor Emeritus of Physics and Astronomy, University of Rochester

Education PhD, Astronomy, Cornell University, 1971; MS, Astronomy, Cornell University, 1970; BS, Physics and Astronomy, University of Toronto, 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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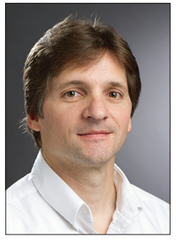

Assistant Professor of Computer Engineering, Rochester Institute of Technology

Education PhD, Computer Science, Rochester Institute of Technology, 2013; MS, Imaging Science, Rochester Institute of Technology, 2002; BS, Computer Science, SUNY/Buffalo, 1988: BS, Electrical Engineering 1989

Research Interests Machine learning, Computer vision and robotics, Embedded control

Recent Research Projects Computer vision algorithms for portable vision diagnostic devices

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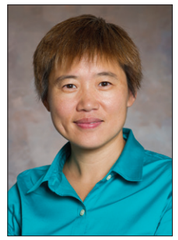

JIE QIAO

Associate Professor of Imaging Science, Rochester Institute of Technology

Education PhD, Electrical and Computer Engineering, University of Texas at Austin, 2001; MBA, Simon Business School, University of Rochester, 2012; MS, Tsighua University (Beijing), Precision Instruments and Fine Mechanics, 1997

Research Interests Optical metrology, Optical instrumentations, Adaptive and active optics, Segmented large-scale optics alignment and testing, Pulse compression, ultrafast laser systems and applications, Optical system design and performance evaluation

Recent Research Projects Development and investigation of an integrated laser-based optics polishing and manufacturing technology, Laser polishing for additive manufacturing

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MICHAEL RICHARDS

Research Assistant Professor, Department of Surgery, Division of Vascular Surgery, University of Rochester

Education PhD, Boston University, Biomedical Engineering, 2007; BS, University of Rochester, Biomedical Engineering, 2001

Research Interests Biomechanics of soft tissues and measuring the change in mechanical properties of diseased tissues using clinical imaging modalities

Recent Research Projects Development, validation, and implementation of elasticity imaging, or elastography, for diagnosing vascular diseases

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Education PhD, University of Arizona Tucson, Optical Science, 1990; MA, University of Arizona–Tucson, Optical Science, 1987; Diplôme Grandes Ecoles, Institut d'Optique (France), 1984

Research Interests Optical system design for imaging and nonimaging optics, Physics-based modeling, Image quality assessment

Recent Research Projects Gabor-domain optical coherence microscopy for detection of defects in manufacturing, Optical coherence tomography for quantification of contact lens properties

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DAVID ROSS

Professor, School of Mathematical Sciences, Rochester Institute of Technology

Education PhD, New York University, Mathematics, 1985; BA, Colombia University, Mathematics, 1980

Research Interests Statistical physics of protein mixtures, Cell signaling dynamics, Fluid mechanics and solid mechanics of contact lenses and tear film

Recent Research Projects Effect of contact lens distortion on exchange of tears, Model of suction under contact lens

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FACULTY RESEARCHERS

LEWIS ROTHBERG

Professor of Chemistry and of Chemical Engineering, University of Rochester

Education PhD, Harvard University, Physics, 1984; BS, University of Rochester, Physics, 1977

Research Interests Organic electronics, Organic device science, Metal nanoparticle enhanced spectroscopy and imaging, Bio-molecular sensing

Recent Research Projects Molecular glasses, 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, Small fragment removal for next-generation sequencing

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CARL SALVAGGIO

Professor of Imaging Sciences, Rochester Institute of Technology

Education PhD, SUNY ESF, Environmental Resource Engineering, 1994; MS and BS, Rochester Institute of Technology, Imaging Sciences, 1987

Research Interests Three-dimensional geometry extraction from multiview imagery; Material optical properties measurement and modeling; Still and motion image processing for various applications; Thermal infrared phenomenology, exploitation, and simulation

Recent Research Projects Signatures Modeling, Derivation, and Exploitation; RIT Immersive Living Room; START-X ISP Signatures and SWIR Measurement Support

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ANDREAS SAVAKIS

Professor of Computer Engineering, Rochester Institute of Technology

Education PhD, North Carolina State University, Electrical Engineering, 1991; MS, Old Dominion University, Electrical Engineering, 1986; BS, Old Dominion University, Electrical Engineering, 1984

Research Interests Real-time computer vision, Multimedia systems, Medical imaging

Recent Research Projects Global surveillance augmentation for deep learning; Real-time systems for object tracking and activity recognition; Algorithms and systems for robust scene categorization and object classification in consumer photographs; Document processing algorithms for thresholding, compression, and rendering in high-speed scanners

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Education ScD, Polish Academy of Sciences, Physics, 1992; PhD, Polish Academy of Sciences, Physics, 1983; MS, Warsaw Technical University, 1975

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

Recent Research Projects Quantum key distribution using polarized infrared single photons for practical quantum cryptography and deep space optical communications; Subpicosecond electro- and magneto–optic characterization of electronic, optoelectronic, and spintronic materials and systems; Smart sensor for classical and quantum data links

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Research Interests Wireless communication and networking, Mobile cloud computing, Smart and connected healthcare solutions, Stochastic modeling and optimization, Design of novel techniques to facilitate the development and diffusion of smart and connected healthcare solutions

Recent Research Projects Design and optimization of large ad-hoc networks

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NICK VAMIVAKAS

Associate Professor of Optics, of Physics, and of Materials Science, University of Rochester

Education PhD, Boston University, Electrical Engineering, 2008; BS, Boston University, Electrical Engineering, 2001

Research Interests Light-matter interaction at the nanoscale, Quantum optics, nano-photonics and condensed matter physics

Recent Research Projects Solid-state and photonic approaches to quantum science

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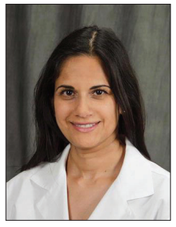
TARA VAZ



Assistant Professor of Ophthalmology, University of Rochester

Education Fellowship, SUNY College of Optometry, 2002; OD, SUNY College of Optometry, 2001; BS, McMaster University, Biochemistry, 1996

Research Interests Contact lenses, Lens solution, Ophthalmic drops

Recent Research Projects High- and low-contrast visual acuity measurements in spherical and aspheric soft contact lens wearers, Continued development of portable low-cost wavefront sensors

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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)

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Imaginant

MOLECULAR GLASSES

Adarza
BioSystems

iCardiac
TECHNOLOGIES

This microdialysis prototype is printed from ABS plastic and contains layers of silicone and nanomembrane filters for use in portable hemodialysis. It was developed by University of Rochester associate professor of biomedical engineering James L. McGrath.

Center for Emerging and Innovative Sciences

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Photo credit: J. Adam Fenster, University of Rochester

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