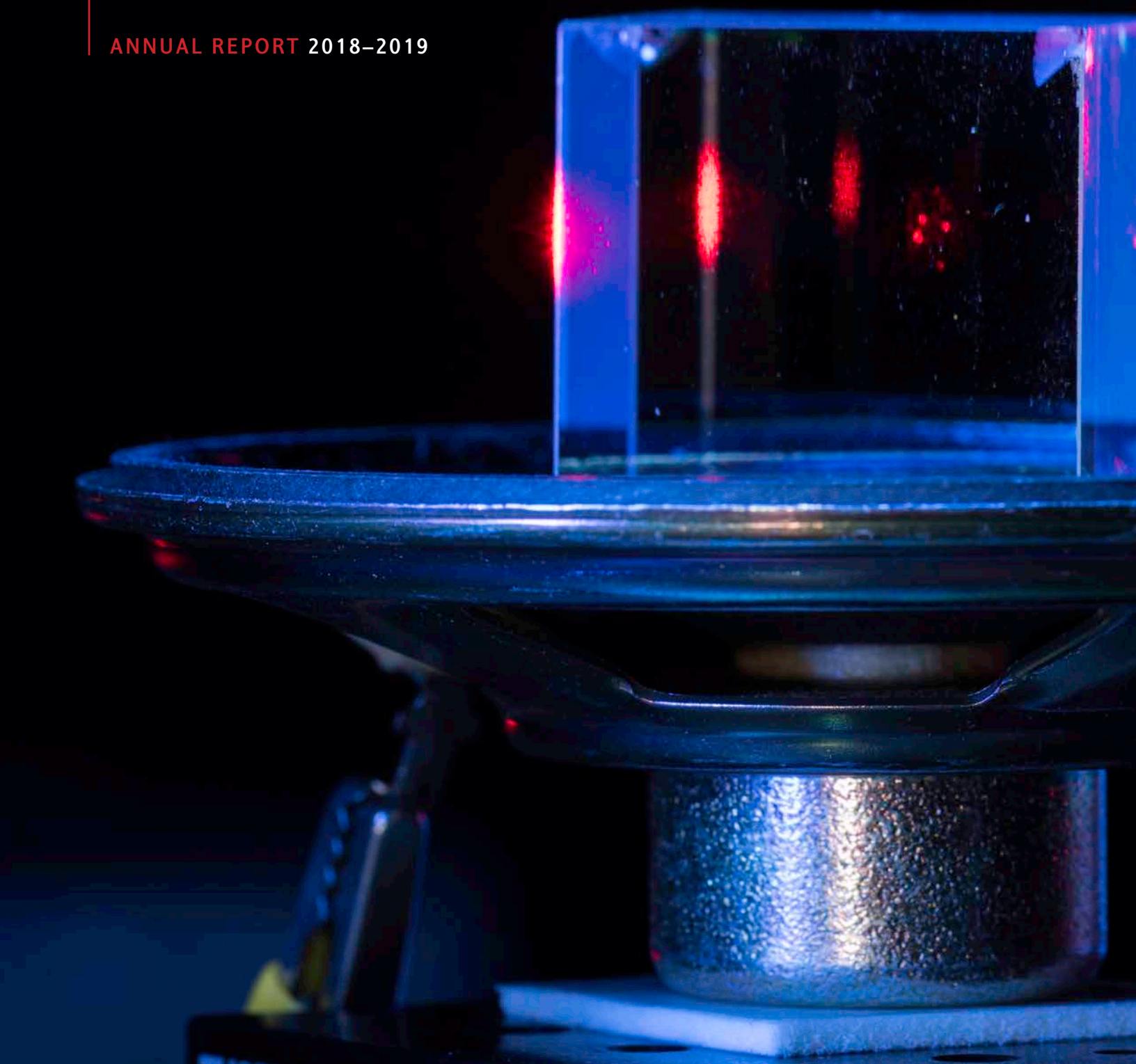
CEIS

Center for
Emerging and
Innovative Sciences

ANNUAL REPORT 2018–2019



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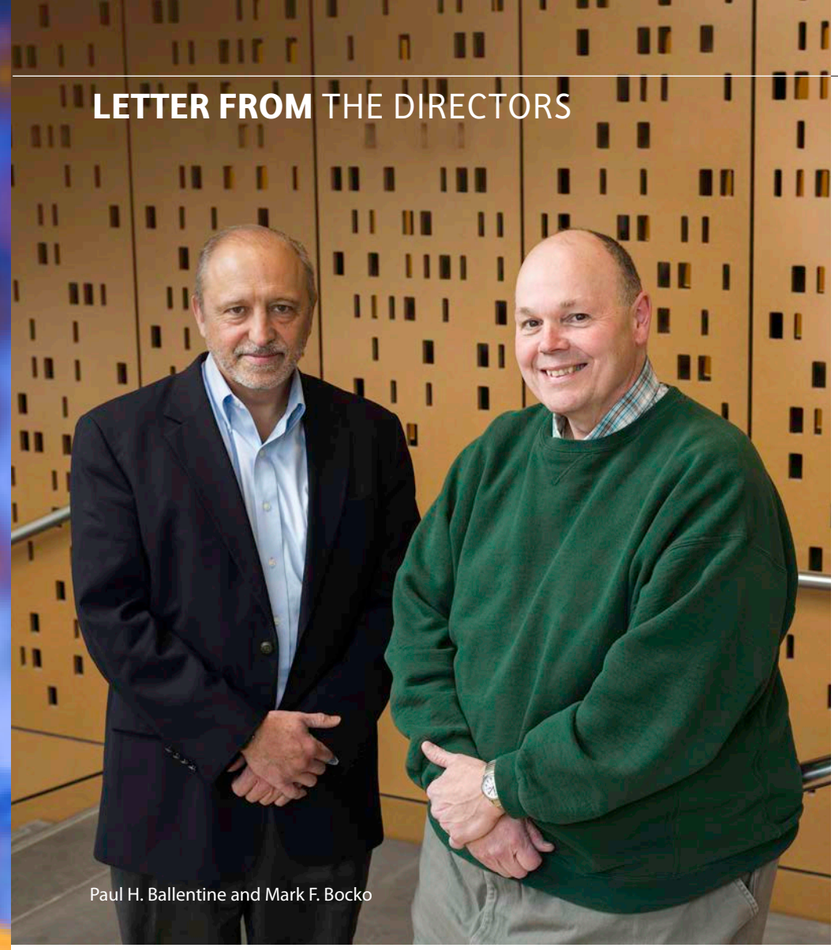
Cover: Chunlei Guo, a University of Rochester professor and CEIS faculty researcher, and PhD student Billy Lam recently developed at the Institute of Optics this wedged reversal shearing interferometer used to measure beams of light.

Deborah Fowell is a professor in the Center for Vaccine Biology and the Dean's Professor in the Department of Microbiology and Immunology at the University of Rochester Medical Center. Her lab recently received $12 million to explore strategies to better fight infections and overactive immune responses in diseases like rheumatoid arthritis and lupus. The latest infusion of funds will enable scientists in immunology, vaccine biology, biomedical engineering and physics to investigate the workings of the immune system in real time using imaging technologies. The team will work at UR's Multiphoton Core Facility, which provides cutting-edge imaging and image analysis capabilities to further biomedical and bio-optical research.

LETTER FROM THE DIRECTORS



Paul H. Ballentine and Mark F. Bocko

When CEIS was founded in 1992, the acronym stood for the "Center for Electronic Imaging Systems." Electrophotography, charge-coupled device image sensors, inkjet printing, new flat-panel display technologies, and the recently invented digital camera were the hot technology areas of the day, and the Rochester region led the world in research and the development of imaging technologies. Over time, changes in Rochester's corporate landscape led to fewer University-Industry research collaboration opportunities in electronic imaging, and previous center leadership rebranded CEIS as the "Center for Emerging and Innovative Sciences," greatly expanding the scope of the research supported by the center. Trillions of digital images later, the field has come full circle, and electronic imaging systems are once again at the forefront as computing, data science, communications, audio, and imaging intersect in our personal computing and communication device—the smartphone.

The convergence of these technologies defines how we interact with information and one another. Today, the ubiquitous smartphone, with sales in excess of 1.5 billion units last year, is the dominant human-computer interface. Smartphones would not be possible without thin, low-power, high-resolution displays, such as OLEDs, or compact digital cameras—two technologies that were invented here in Rochester. The smartphone didn't exist 20 years ago, so we are led to question if the smartphone of today will still be around in another 20 years and if not, then what will take its place?

Making technology predictions is always a risky business, but perhaps the personal computing interface of the future will be a hands-free device, no more obtrusive than a pair of eyeglasses or possibly even contact lenses with a voice control interface—maybe like the augmented reality (AR) systems being developed and sold today. Perhaps not. It would be foolhardy to predict what the next human-computer interface is going to look like in much detail. Nonetheless, it is the goal of CEIS to keep Rochester in the conversation and to contribute to the development of whatever comes next. So, CEIS's legacy in imaging, the tremendous resources our region has in this field as well as in the related areas of audio, data science, communications, and computing has never been more important to the economic future of our region.

CEIS endeavors to shine a light on our region and its many capabilities through activities like the Light and Sound Interactive conference. This past year, CEIS worked with the greater Rochester community to organize and support LSI 2019. By nearly all measures, the 2019 LSI conference was an even greater success than our 2017 inaugural event. LSI 2019 attracted the participation of major technology companies, including Microsoft, Amazon, and Facebook as well as many smaller companies, such as Harman, Bose, Magic Leap, VeRacity VRcade, and others. This gave us an opportunity to bring our regional strengths and capabilities to the world's attention and to forge new connections and collaborations that will stimulate the growth and creation of businesses in the Rochester region and New York State. In the upcoming year, all of us at CEIS look forward to continuing to build these relationships and to undertaking new initiatives to help our region's businesses and universities maintain an important role in the ongoing evolution of the next human-computer interface and the applications, from health care to entertainment, that will benefit and enrich people's lives. Electronic imaging has never been as important as it is today. Stay tuned.

As always, we would like to thank the staff at CEIS, including our business manager, Cathy Adams, our center administrator, Margaret Urzetta, and our many undergraduate program assistants. Finally, we gratefully acknowledge the continued support of NYSTAR and the State of New York in all of our endeavors.

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.

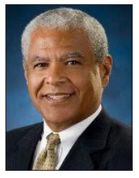
Bob Naum
Chair

Bob Fiete
Harris Corporation

Ryne Raffaelle
Rochester Institute of Technology

Ian Cox
IGC Consulting Group

Ellen Kosik-Williams
Corning, Inc.



Ed White
AIM Photonics

New York has hundreds of optics, photonics, and imaging companies clustered into active regional collaborations. These regions are home to abundant organizations and companies that can deliver complete R&D, engineering, and manufacturing capabilities, providing entrepreneurial vision combined with next-edge research. This map shows the entities—from public and private universities to corporations and governmental agencies—involved in the New York Photonics initiative.

OUTREACH ACTIVITIES

OUTREACH TO THE LOCAL COMMUNITY IS AN IMPORTANT PART OF CEIS'S MISSION; IT COMPLEMENTS THE WORK WE DO IN SUPPORTING INDUSTRY/ UNIVERSITY PARTNERSHIPS.

Mike Kennerknecht, left, assistant director for state relations at the University of Rochester, and John Loury, right, Cause+Effect Strategy's president and recipient of this year's Partner Appreciation recognition

While funded research supports specific activities that involve established industry/university collaboration, our outreach activities are targeted at a broader segment of the community. In some cases, such as our annual University Technology Showcase, the intent is to establish or expand industry/university collaborations. Others are aimed at "making things happen" in the community by making people aware of the rich resources at the universities, at local companies, and of the local talent.

TECHNOLOGY SHOWCASE

The 2019 University Technology Showcase was held on April 4. This unique event brings faculty and graduate-level researchers from the University of Rochester and Rochester Institute of Technology together with people from the local business community to spark industry/ university collaboration and technology transfer. There were 51 poster presentations segmented into the areas of optics, biomedical, microelectronics, software and communication, energy and materials, and data science. This is the third year this event was cosponsored by the Data Science COE at the University of Rochester. The event drew 200 attendees with 18 exhibitor tables of companies and economic development organizations. This year the showcase featured a panel discussion with startup company leaders Sharon Samjitsingh of Health Care Originals, Mike Molaire of Molecular Glasses, and Moondog Labs' Julie Gerstenberger. A Partner Appreciation Award was presented to John Loury of Cause + Effect Strategy and Marketing, and Erik Michael Patak won the poster award for the presentation "Image-Based Biomarker for Cancer Recurrence Predication Using SHG Imaging."

The second Light and Sound Interactive conference was held June 25–27 and is the vision to be a catalyst for growth in the Rochester area by shining an international spotlight on two of the region's major strengths: imaging and music.

LSI CONFERENCE

The second Light and Sound Interactive conference was held June 25–27 in conjunction with the CGI Rochester International Jazz Festival. The vision for LSI is to be a catalyst for growth in the Rochester area by shining an international spotlight on two of the region's major strengths: imaging and music. LSI highlights the technology and art of light and sound and explores how they combine to form the basis of some of the most dynamic developments of our time. These include games and interactive media; music and audio engineering; cinema; and optics, photonics, and imaging. In addition to bringing international attention to the region, LSI is also intended to help the local community become aware of the artistic and technical strengths in these areas and of the opportunities they create for local economic and cultural growth. The objective of LSI is to inform, entertain, and inspire attendees. The goal is to grow the economy by attracting companies to the region, helping established local businesses grow, and helping to incubate new companies. This year LSI attracted more

WetWare BioSystems team is interviewed by local reporter at Light and Sound Interactive 2019

than 900 attendees, nearly 60 percent of whom were from outside of the Rochester region. The conference consisted of five topical tracks, a company demonstration area, a series of talks and networking events aimed at helping local companies do business with the Department of Defense, and a totally unique, first-of-its-kind esports event. There were numerous connections made at LSI 2019 that demonstrate the effectiveness of the format and focus of the conference. One example is WetWare BioSystems, a local startup company founded by UR students that is addressing traumatic brain injury in the defense and civilian sectors. While exhibiting at LSI 2019, they were interviewed by a local news station. Shortly thereafter, Pentagon representatives as well as the CEO of a major helmet company, who were interested in exploring WetWare's capabilities further, contacted the company.

CEIS AND VR/AR

As highlighted in the directors' message, a major thrust of CEIS continues to be to build an ecosystem for virtual and augmented reality in Rochester and across the state. Three of the major VR/AR manufacturers were represented: Facebook, Microsoft, and Magic Leap. Based on their involvement with LSI 2019, Facebook's interest in this region's capabilities are expanding. They want to build upon their initial investment of more than $3.5 million in optics and vision science with the University of Rochester and RIT. More than a keynote speaker, Facebook expressed interest in AIM Photonics as well as local activities in data science, integrated sensors, and audio. In addition, Facebook has indicated plans to hold an innovation summit during LSI 2020. Magic Leap demonstrated its revolutionary mixed reality gear based on spatial computing. The company came away with a great impression of the Rochester area and is engaged in ongoing discussions with CEIS and Empire State Development to initiate new activities in New York State.

Magic Leap demonstrated its revolutionary mixed reality gear based on spatial computing.

RESEARCH PARTNERS

Our university research partners are also involved in community outreach. Professor Kara Maki from the RIT School of Mathematical Sciences is the director of the Summer Math Applications in Science with Hands-On (SMASH) Experience for Girls. Held the week of July 16, 39 middle school girls participated in the experience. The participants came from 15 school districts within the greater Rochester community. SMASH provided need-based scholarships to 46 percent of the participants. The goal of SMASH is to show participants the connections between science and math. The participants must complete a mini math-modeling project during the week. They must identify a problem impacting their community and then propose how they could use mathematics to quantitatively address some aspect of the problem.

We are grateful to NYSTAR that CEIS has been enabled to help leverage the vast resources of our region's academic institutions to provide outreach activities that are having a positive impact on our regional community and ultimately on the economy of the State of New York.

ECONOMIC IMPACT

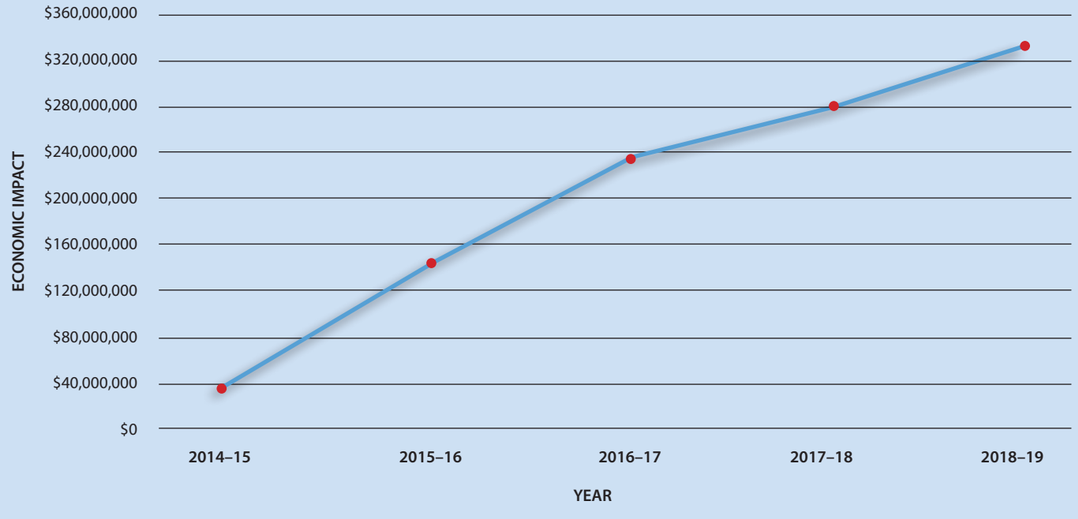
For the fiscal year July 1, 2018, to June 30, 2019, the total documented dollar value of the economic impact of CEIS-supported research and outreach was more than $58 million. This self-reported data (new and retained jobs, increased sales, cost savings, capital investments, and additional funds acquired) from 23 of our partners provides a snapshot of the region's economic successes.

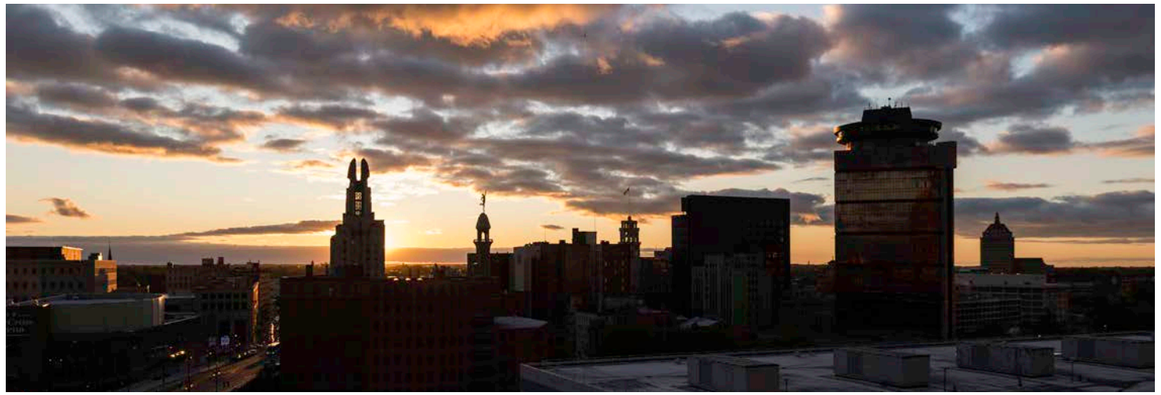
A shout-out goes to the AIM Photonics initiative, which led the way in non-job impacts, reporting more than $30 million in monetary impacts. Clerio Vision, a local start-up company, reported eight new jobs and five retained jobs along with more than $12.9 million in non-job impacts. Other noteworthy impacts are reported by OptiPro Systems, with increased revenue over $3.6 million, and Kitware, with almost $1.7 million in federal funds acquired.

FIVE-YEAR SUMMARY OF ECONOMIC IMPACT

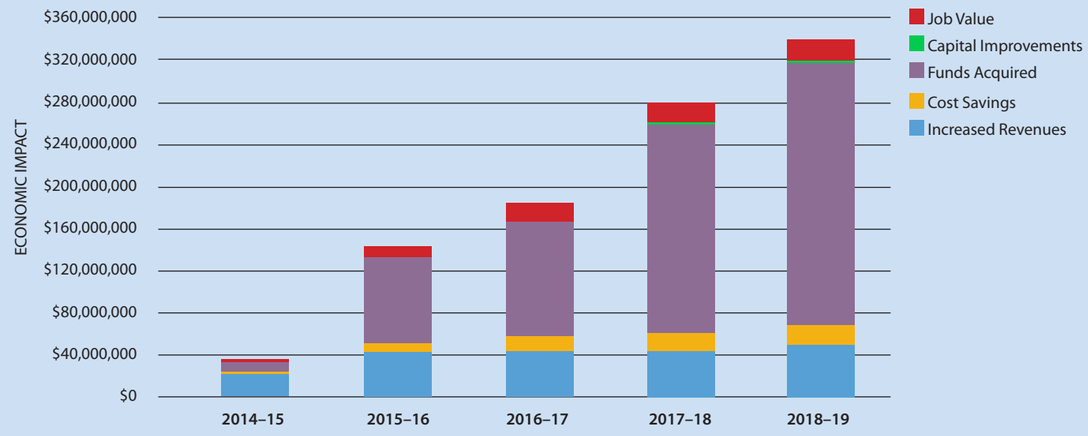
Year	2014–15	2015–16	2016–17	2017–18	2018–19	Total
Increased Revenues	$22,548,794	$18,635,000	$1,276,127	$1,563,699	$4,620,662	$48,644,282
Cost Savings	$1,989,100	$3,927,488	$4,586,060	$6,536,372	$4,809,079	$21,848,099
Funds Acquired	$8,050,720	$81,269,321	$77,548,500	$34,250,633	$46,289,697	$247,408,871
Capital Improvements	$263,421	$204,549	$113,000	$263,377	$38,439	$882,786
Job Value	$2,944,601	$6,106,332	$4,075,292	$5,147,237	$2,361,460	$20,634,922
New Jobs	20	61	37.75	30.25	26.5	176
Retained Jobs	26	28	23.5	45.25	12.5	135
Total Impact	$35,796,636	$110,142,690	$87,598,979	$47,761,318	$58,119,337	$339,418,960
Total Cumulative Impact	$35,796,636	$145,939,326	$233,538,305	$281,299,623	$339,418,960	$339,418,960

TOTAL CUMULATIVE ECONOMIC IMPACT





FIVE–YEAR ECONOMIC IMPACT



CAT PROGRAM FINANCIAL INFORMATION

July 1, 2018–June 30, 2019

FUNDING FROM NYSTAR

Personnel Related	
Research and Center Management	$573,018
Non-Personnel Related	
Research and Center Management	$225,664
Total NYSTAR Contribution	$798,682

OTHER SOURCES OF FUNDS—Cash from Companies

Personnel Related	$500,242
Non-Personnel Related	$258,501
Total Other Resources	$758,743

COMPANIES REPORTING ECONOMIC IMPACT IN 2018–19 FROM CEIS INTERACTIONS

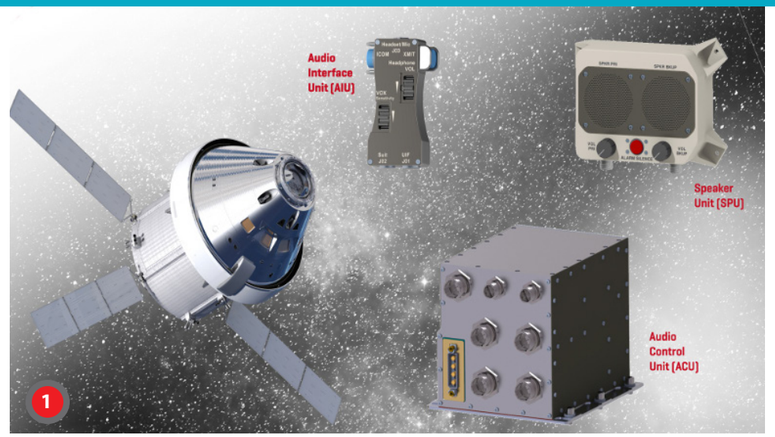
AIM Photonics
AlchLight
Arcum Therapeutics
Bausch + Lomb
Carestream Health
Clerio Vision, Inc.
Corning, Inc.
Envision Solutions LLC
Harris Space & Intelligence Systems
Harris RF Communications
HYPRES, Inc.
Imaginant
Kitware
Kodak Alaris
Light and Sound Interactive
LighTopTech Corporation
Molecular Glasses, Inc.
OptiPro Systems, LLC
O-Vitz Corporation
SiMPore, Inc.
Thermo Fisher Scientific
VeRacity VRcade
VisualDx

A YEAR **IN REVIEW**

JULY 2018

CEIS announces 2018–19 funding awards for 14 projects with 18 faculty researchers from RIT and UR partnering with 10 New York State companies.

1 Harris is selected by Lockheed Martin, the prime contractor for Orion, to deliver the audio system for Exploration Mission-2, the first crewed flight for the Orion spacecraft targeted for 2022. Orion is NASA's first spacecraft designed for long-duration, deep-space exploration by humans.

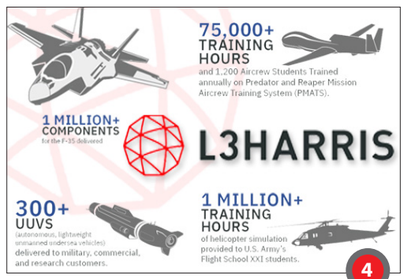


OCTOBER 2018

2 CEIS and RIT cohost the 2nd annual AR/VR Initiative Meeting on October 1. With 100 attendees, this event engaged faculty from both institutions around four facilitated breakout group topics: visual, audio, platform, and applications.

3 Clerio Vision announces its plan to commercial LIRIC—a novel, noninvasive method to correct human vision following success in treating five subjects in their in-human study. Clerio is leveraging technology developed at the University of Rochester that was recently recognized with a Nobel Prize. The core technology, refined for noninvasive ophthalmic applications, has been in development for more than 15 years.

4 L3 and Harris announce their intent to merge into a new company, called L3 Harris Technologies, which would become the seventh-largest defense firm in the world.



DECEMBER 2018

5 In 2018 Carestream is granted 42 new patents from the U.S. Patents and Trademark Office and 37 European and Asian patents. All this innovation coupled with their customer service earns Carestream the top rating in MD Buyline's User Satisfaction Ratings. It is no wonder that Carestream continues to install systems worldwide, including the Italian–French Concordia scientific station in Antarctica.

6 CEIS research partner Jim Zavislan is inducted as a fellow of the National Academy of Inventors. Zavislan holds 63 U.S. and 151 foreign patents. His inventions have helped protect the integrity of the ballot box, preserve great works of art, and assess the damage mobile screens do to our eyes.

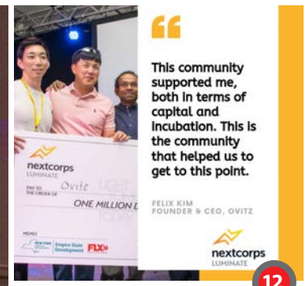
JANUARY 2019

7 Harris Corp. is awarded a $75-million-dollar order from the U.S. Marine Corps for upgrades to its Falcon III manpack radios, manufactured in Rochester. The Mobile User Objective System (MUOS) narrowband satellite communication upgrades to the Falcon III AN/PRC-117G manpack radios will help extend the life of the Marine Corps' existing radios by upgrading and modernizing the radio's software.

APRIL 2019

8 The World Intellectual Property Organization ranks the University of Rochester fourth among US universities for the period 2011–15 for the percentage of patent holders who are women.

9 CEIS and the CoE in Data Science host the annual University Technology Showcase on April 4. The poster session had more than 50 posters representing current research happening at UR and RIT. Erik Patak was the student selected as winner of "best poster" as judged by attendees for a CoE project with Harmonigenic Corporation.



MAY 2019

10 Homegrown startup WetWare BioSystems (founded by UR undergrads, including two recently graduated CEIS student employees) is a finalist in the 2019 Mark Ain Business Model Competition. This provides the company with space at NextCorps through 2022 and access to NextCorps resources.

WETWARE

JUNE 2019

11 Light and Sound Interactive (LSI) 2019, is held June 25–27, bringing 700 attendees and 90 presenters to downtown Rochester and generating more than $500,000 in travel, food, lodging, and entertainment, according to Visit Rochester, the official tourism promotion agency for Monroe County. Attendees represented 33 states and 6 countries; 58 percent were from outside Rochester/Monroe County. LSI featured an esports event and six tracks in the areas of Augmented and Virtual Reality, Audio and Music, Cinema, Games and Interactive Media, Optics/Photonics/Imaging, and the Department of Defense.

12 CEIS partner Ovitz Corporation wins the million-dollar top prize in Round II of the Luminate NY competition. The company uses its state-of-the-art autorefractor device and its own proprietary software algorithms to diagnose individuals with abnormal corneas and provide prescription data for individualized contact lenses.

2019–20

ABSTRACTS

Professor Karl Hirschman, a CEIS faculty researcher and a professor in Rochester Institute of Technology's electrical and microelectronic engineering department and the director of RIT's Semiconductor and Microsystems Fabrication Laboratory, is shown at left. Ongoing upgrades to the lab's clean room are enhancing RIT's research capabilities in photonics, quantum technologies, and smart systems. The lab contains equipment rarely found in university settings.
Photo by Elizabeth Torgerson-Lamark, RIT University Photographer

Femtosecond Laser-Based Fabrication of Photonic Waveguides toward Wavelength Lasers
Jie Qiao
Rochester Institute of Technology
Aktiwave LLC

This proposed project demonstrates femtosecond-laser-fabricated waveguides in crystalline dielectric materials. The influence of focal conditions and laser parameters on waveguide quality and geometry will be experimentally investigated via sensitivity studies. The index modulation will be evaluated and compared for the three major waveguide-design configurations using matrices of laser parameters. This innovation will enable the fabrication of low-loss optical waveguides for integrated photonic circuits with the integrated active and passive devices on the micron scale. It will provide weight, power, and cost reductions for telecommunications, advanced data centers, and free-space communications.

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 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.

Compressive Beamforming for Portable Ultrasound
Zeljko Ignjatovic
University of Rochester
Carestream

We propose a compressive 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. 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 speed up 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.

Refining and Validating a Model to Characterize Shape Changes Due to Liric Writing on Cornea
Paul D. Funkenbusch and Amy Lerner
University of Rochester
Clerio Vision, Inc.

We propose to continue our research on modeling the effects of Laser Induced Refractive Index Change (LIRIC) on corneal shape and resulting optical corrections. It appears that LIRIC causes localized changes in both refractive index and the overall effects of LIRIC as well as the contributions from each component. The proposed work will include refinements of the model, material property characterization, and a validation of the model through to an ex vivo experiment.

Multiphoton Liric: Modeling, Scaling, and Material Modification Studies
Wayne H. Knox
University of Rochester
Clerio Vision, Inc.

We propose to investigate LIRIC writing into a range of new hydrogel materials, including high-oxygen transport hydrogels, strongly hydrophobic acrylates, hydrogels with optimized multiphoton activators, etc. Our new multiphoton photochemical model will be tested, including new material saturation models. New writing conditions will be tested in the predominantly three-photon limit with a newly available fiber laser in hydrogels and cornea. High-resolution confocal Raman studies and newly developed techniques such as ultra-thin cross-sections and thermogravimetric analysis of LIRIC changes will be investigated. A new two-wavelength phase-shifting micro-Mach Zehnder Interferometer will be developed for high-resolution phase calibrations.

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, non-ablative 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 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.

MicroLED Display Technology Development

Karl Hirschman
Rochester Institute of Technology
Corning, Inc.

Adoption of microLED displays requires addressing both manufacturing and device design challenges for this emerging technology. Considering large-area, high-resolution displays, primary challenges include the realization of: (1) Efficient mass transfer of microLED arrays from the growth wafer to the display substrate, (2) Active matrix backplanes designed for microLED sub-pixels, (3) Backplane interconnects that enable top-emission displays with underlying controller driver boards. This project targets advances and learnings in these areas through fabrication of high-resolution functional devices on glass substrates. Specific focus is placed on the transfer of microLEDs onto glass substrates with fabricated TFT active matrix backplanes.

Efficacy of Visual Training for Recovering Sight in Stroke Patients

Steven Feldon
University of Rochester
Envision Solutions LLC

Every year, a half-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.

Integrated Optical Frequency Detection and Weak Value Amplification

Jaime Cardenas
University of Rochester
AN Jordan Scientific

Professor Cardenas and Professor Jordan will collaborate to design, fabricate, and test an integrated optical chip that implements weak value amplification. 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 and Professor Jordan's LLC will be used to support a graduate student in Professor Cardenas' group and to purchase 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.

Global Surveillance Augmentation for Deep Learning

Andreas Savakis and Emmett Ientilucci
Rochester Institute of Technology
Kitware, Inc.

In this project we continue to develop deep learning methods for global surveillance applications, focusing on change detection in satellite imagery. During Phase III of our project, we explore deep architectures for change detection and leverage DIRSIG-generated datasets for training and testing our deep networks. Our new LambdaNet architecture, inspired by Siamese networks and semantic segmentation, consists of CNN feature extraction on the target and reference images, a fusion node, and a deconvolution network trained to produce a change detection output map. We propose to train and test LambdaNet under a variety of conditions and develop additional architectures for improved change detection.

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

Wendi Heinzelman and Cristiano Tapparello
University of Rochester
L3Harris Technologies

Performing communication and computation in an ad hoc network of mobile devices is challenging yet critical for next-generation military networks. In order to ensure that data can be securely communicated where it is needed and when it is needed, even in the face of network dynamics, the following techniques will be investigated: 1) automatically initializing and maintaining connectivity in a multi-hop ad hoc network; 2) optimizing UAV placement for providing off-loading of data from a multi-hop ad-hoc network; and 3) creating a generic mathematical model for energy and delay given different protocol parameters to optimize protocol selection. The developed protocols will be implemented on Raspberry Pi and Virtual Machine testbeds to verify performance.

Optical Phased Array for Adaptive Free-Space Optical Imaging

Hui Wu
University of Rochester
L3Harris Technologies

We propose to exploit the latest advances in integrated silicon photonic optical phased array (OPA) technologies to meet the challenges in free-space optical (FSO) imaging systems. Integrated OPAs are becoming the critical building block for future FSO applications, such as lidars for autonomous vehicles, thanks to their advantages in size, weight, and power consumption, as compared to conventional solutions. We seek to leverage silicon photonic devices, 3-D integration, and supporting optics and circuits to develop an OPA system for adaptive free-space optical imaging. The target application is satellite-to-satellite optical links at a distance up to tens of kilometers. We expect that the proposed project will result in technological breakthroughs for FSO imaging and communications and generate significant economic impacts.

Techniques and Methods for Gabor-Domain Optical Coherence Elastography

Jannick Rolland and Kevin Parker
University of Rochester
LighTopTech Corp.

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 (GDOCM) with the capability of measuring elastic properties with elastography will yield unprecedented high-resolution functional imaging capability.

Adaptive Nulling for Steep Aspheres using a Holographic Reference Surface

Tom Brown
University of Rochester
Optimax

Steep aspheres generally require expensive null optics (such as a computer-generated hologram). These can be difficult to align and, even when well aligned, can be subject to severe retrace errors. We propose to demonstrate and evaluate the use of a real-time photopolymer exposure as an adaptive nulling reference and use a Fizeau geometry to measure steep aspheres.

Image Processing for Optical Weld-Joint Failure Prediction

Drew Maywar
Rochester Institute of Technology
RAM Photonics

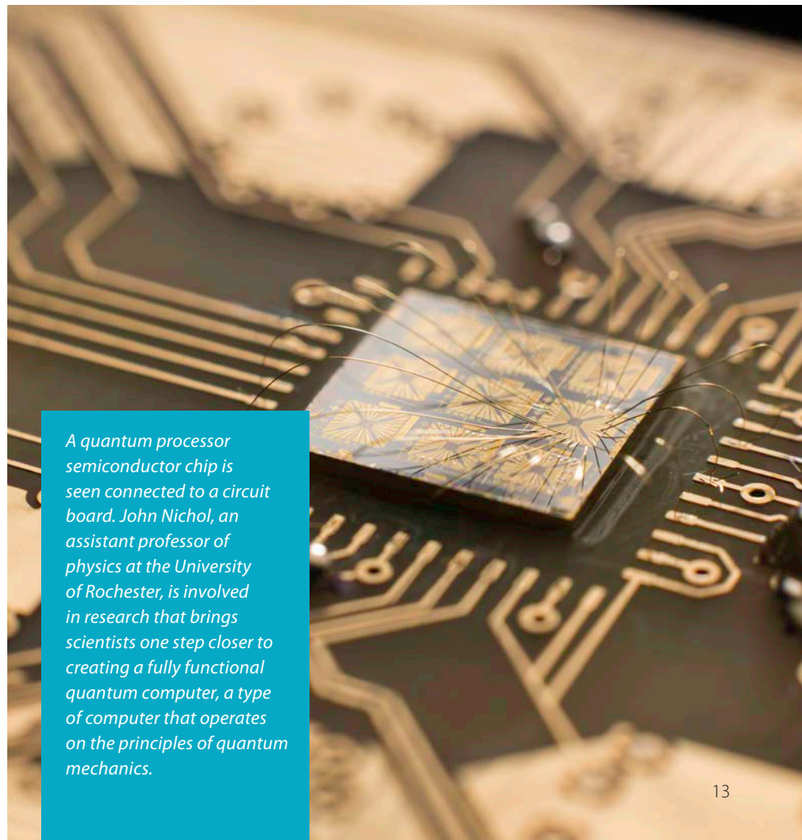
Optical welds that affix optical fiber to glass substrates are critical to a range of applications, including optical-signal demultiplexing, image formation, and photonic interconnects. Robust welds that withstand vibrational forces are required for some environments. We will research and develop imaging-processing techniques to identify weld features that predict the weld failure due to vibration. Such techniques will help screen products before testing, saving resources and aiding in the development of the manufacturing process.

Development of Quantum Dot–Coated Detector Arrays

Zoran Ninkov
Rochester Institute of Technology
Thermo Fisher Scientific CIDTEC

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 there are 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. Ink jet printing is being used together with a new ink formulation to permit the deposition of QDs in a MgF2 lattice structure on substrates and commercial sensor arrays. This technique is now making good WD-coated arrays. The plan is to now evaluate the devices at NASA GSFC and NIST Gaithersburg and prepare performance specifications for these devices. With this information, the devices will be able to be marketed commercially.

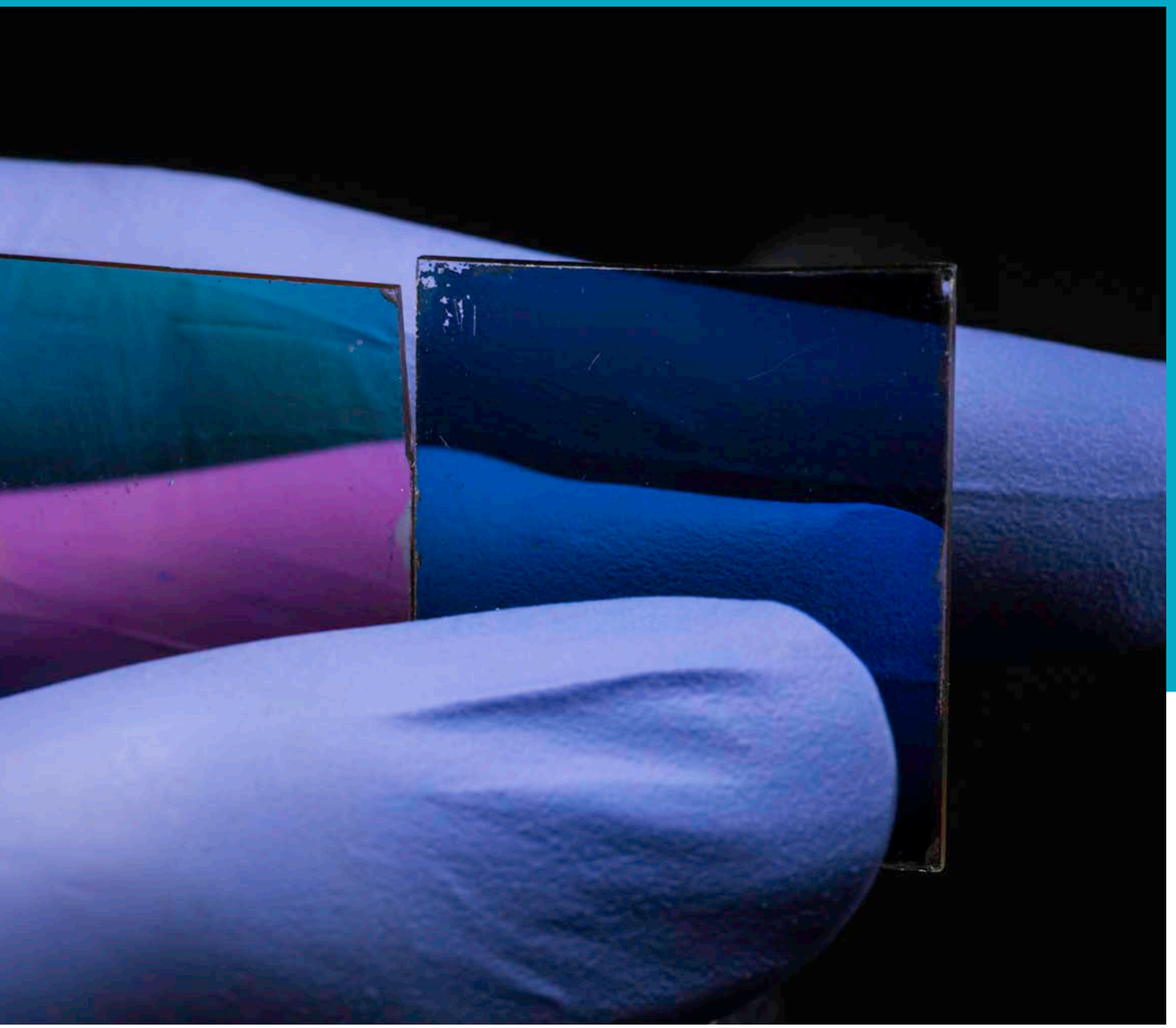
Aaron Bauer, a senior research engineer at the University of Rochester's Center for Freeform Optics (CeFO), received his PhD in optics in 2016 and remained at the University to continue working on a project he began while a graduate student. The head-worn display and method he designed for his PhD thesis will help speed the design and development of optical devices that use freeform surfaces.



A quantum processor semiconductor chip is seen connected to a circuit board. John Nichol, an assistant professor of physics at the University of Rochester, is involved in research that brings scientists one step closer to creating a fully functional quantum computer, a type of computer that operates on the principles of quantum mechanics.

2018–19

ABSTRACTS



Mohamed El Kabbash, a postdoctoral associate in the lab of Professor Chunlei Guo, has developed an optical coating that exhibits the same color in reflection and in transmission.

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 microbubbles 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 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. 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.

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 Wi-Fi 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.

On-Chip Diffractive Optical Elements for Optical Signal Processing in Coherent Imaging Systems

Zeljko Ignjatovic
University of Rochester
Harris Space & Intelligence Systems

Diffractive optical elements (DOEs) are important components contributing to the success of optical microsystems. In this pilot project, we propose to explore the use of sub-wavelength feature size metal layers in advanced CMOS integrated circuit technologies to design and build a multilevel diffractive optics located on-chip and over the standard CMOS pixel array for coherent imaging applications. This project will investigate various challenges involved in the design of optimized DOE in terms of efficiency, amplitude, and phase control of input waveforms for various coherent imaging scenarios.

Optical Phased Array for Adaptive Free-Space Optical Imaging

Hui Wu
University of Rochester
Harris Space & Intelligence Systems

We propose to exploit the latest advances in integrated silicon photonic optical phased array (OPA) technologies to meet the challenges in free-space optical (FSO) imaging systems. Integrated OPAs are becoming the critical building block for future FSO applications, such as lidars for autonomous vehicles, thanks to their advantages in size, weight, and power consumption, as compared to conventional solutions. We seek to leverage silicon photonic devices, 3-D integration, and supporting optics and circuits to develop an OPA system for adaptive free-space optical imaging. The target application is satellite-to-satellite optical links at a distance up to tens of kilometers. We expect that the proposed project will result in technological breakthroughs for FSO imaging and communications and generate significant economic impacts.

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.

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

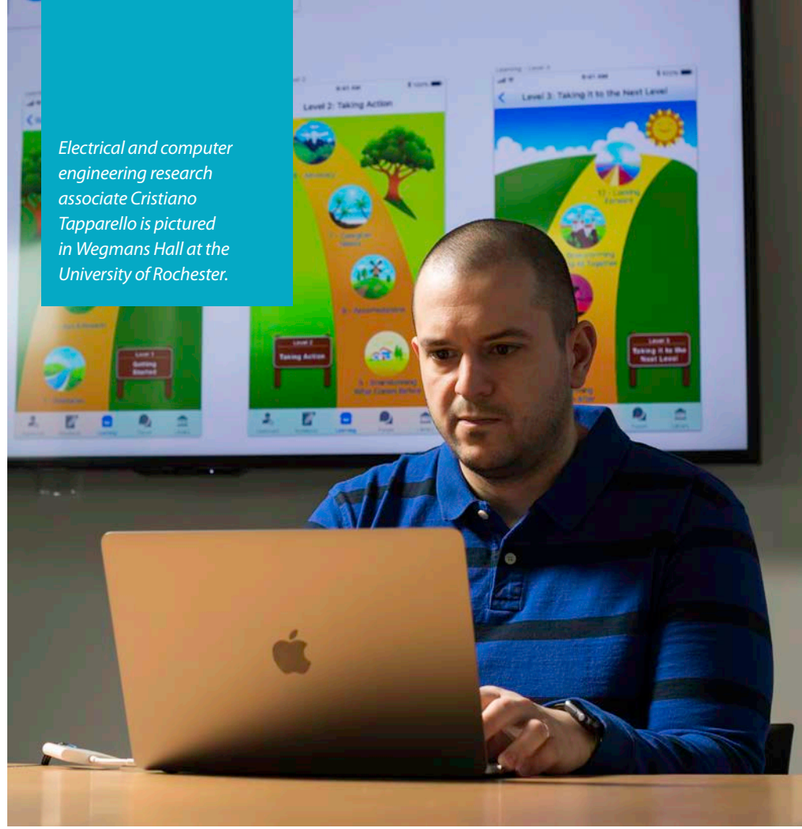
James McGrath
University of Rochester
SiMPore, Inc.

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.

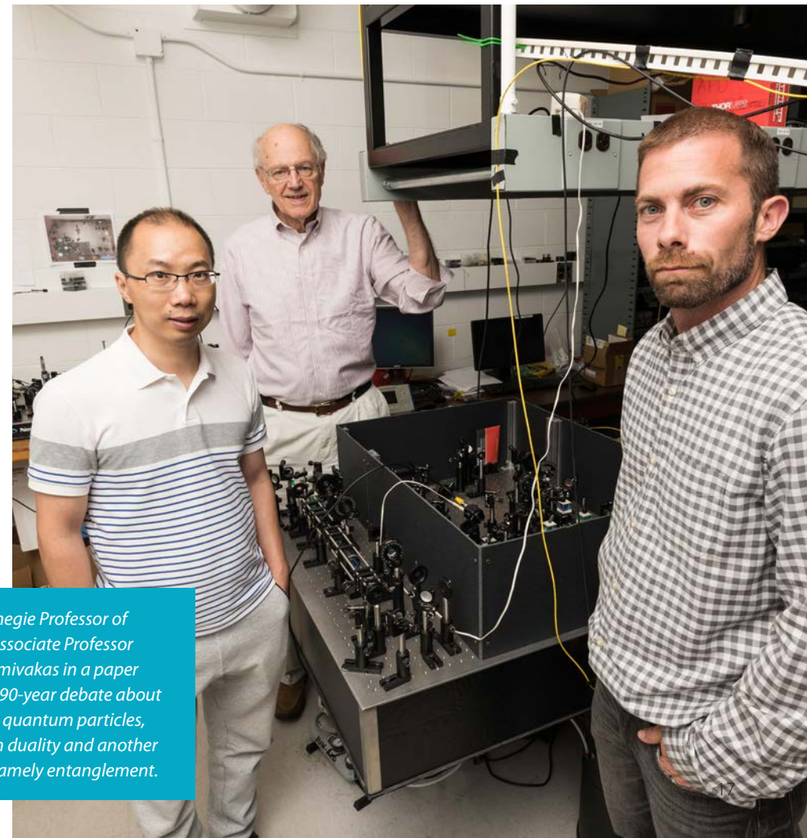
Development of Quantum Dot Coated Detector Arrays

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.



Electrical and computer engineering research associate Cristiano Tapparello is pictured in Wegmans Hall at the University of Rochester.



Research Associate Xiaofeng Qian, Andrew Carnegie Professor of Physics and Professor of Optics Joe Eberly and Associate Professor of Quantum Optics & Quantum Physics Nick Vamivakas in a paper published in Optica, they say they've resolved a 90-year debate about the wave-particle duality of electrons and other quantum particles, by discovering the intimate connection between duality and another equally weird feature of quantum mechanics, namely entanglement.

CORPORATE PARTNERS

Corporate partner Oculus Research has been renamed the Facebook Reality Lab and will work on new types of VR hardware as well as foundational AR/VR software and environment-tracking technology.

AKTIWAVE LLC
www.aktiwave.com

Aktiwave LLC is dedicated to providing customized optical components and consulting services in optical technologies. Our beam shapers and coronagraphs have been used in a large variety of applications, such as astronomy and laser engineering. We have experience in a wide range of domains, such as optical system design and modeling/optical pulse diagnostic for ultrafast and telecommunication systems/spatial and temporal shaping/intellectual property analysis.

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.

ENVISION SOLUTIONS, LLC
www.envisionvrt.com

Envision Solutions, LLC is a vision therapy medical device company with its initial product being EnVision. This vision restoration therapy (VRT) system for stroke victims who have suffered peripheral vision loss, stroke in the eye leading to being cortically blind, with hemianopia or quandrantanopia.

FACEBOOK REALITY LABS
research.fb.com/category/augmented-reality-virtual-reality/

Facebook has created a platform to help create community and connect people around the world and is now applying that same mission to the next generation of technology: virtual and augmented reality. The distinguished R&D team at Facebook Reality Labs (FRL) is developing all the technologies needed to enable breakthrough AR glasses and VR headsets, including optics and displays, computer vision, audio, graphics, brain-computer interface, haptic interaction, eye/hand/face/body tracking, perception science, and true telepresence.

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.

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.

A.N. JORDAN SCIENTIFIC

A.N. Jordan Scientific is a scientific consulting company based in Rochester, New York, with a focus on precision measurements with optics as well as developing new sensors.

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.

L3HARRIS TECHNOLOGIES
www.l3harris.com

L3Harris Technologies is an agile global aerospace and defense technology innovator, delivering end-to-end solutions that meet customers' mission-critical needs. We provide advanced defense and commercial technologies across air, land, sea, space, and cyber domains. We bring speed, innovation, and flawless execution together with our commitment to make the world safer and more secure.

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.

MAGIC LEAP, INC.
www.magicleap.com

Magic Leap, Inc. is a startup company that released a head-mounted virtual retinal display called Magic Leap One, which superimposes 3-D computer-generated imagery over real-world objects by "projecting a digital light field into the user's eye," involving technologies potentially suited to applications in augmented reality and computer vision. Our goal is to construct a light-field chip using silicon photonics.

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.

OPTIMAX SYSTEMS, INC.
www.optimaxsi.com

Founded in 1991, Optimax continues to enhance its unique capabilities for fast, reliable delivery of precision optics with superior quality and service, enabling customer success and employee prosperity. We leverage our optics manufacturing technology for programs that benefit mankind and projects that defend our freedom. Our know-how, innovation, and speed enable quicker production of precision optics to meet emerging market needs. Some of the most sophisticated programs in the world trust Optimax to produce the most complex optics reliably.

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.

RAM PHOTONICS, LLC
www.ramphotonics.com

RAM Photonics, LLC, was founded in 2009 for the express purpose of transitioning high-risk technology into commercial hardware. The company portfolio includes specialty optical and optoelectronic systems for defense, commercial, and industrial applications, including advanced signal processing, high-power laser, and instrumentation systems. Our company focuses on translational R&D, developing commercial-grade modules for technical risk reduction and technology demonstrations, intellectual property directly coupled with targeted technologies, and robust and reliable commercial hardware for sale to the general public.

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.

THERMO FISHER SCIENTIFIC INC.
www.thermofisher.com

Thermo Fisher Scientific Inc. 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.

VERACITY VRCADE
www.veracityvrcade.com

VeRacity VRcade was formed in 2017—a direct result of the inaugural Light & Sound Interactive event. VeRacity is Rochester's immersive entertainment center featuring virtual reality experiences for all. Our mission is to showcase virtual reality in a safe, inclusive, ADA compliant environment. Additionally, we have gotten more entrenched in the Rochester technology community, which has created a greater ability to exchange ideas and is leading to our growth in a wider spectrum of VR applications. Specifically, in the health care space, providing support to disabled populations and seniors.

VISUALDX
www.visualdx.com

When unsure of a diagnosis, VisualDx is the go-to tool for fast, accurate decision making. Quickly build a differential to evaluate the possibilities, compare variations, and improve diagnostic accuracy at the point of care. VisualDx is the leader in clinical decision support, used in more than 1,500 hospitals and institutions and more than 50 percent of U.S. medical schools. Trusted by physicians and nurses all over the world, VisualDx is utilized across several professional specialties.

WETWARE BIOSYSTEMS, LLC
www.wetwarebiosystems.com

WetWare BioSystems, LLC is an early-stage biotechnology firm located in Rochester, New York, dedicated to the invention, research, and distribution of technologies aimed at addressing traumatic brain injury (TBI) in the defense and civilian sectors. Our portfolio of devices provides a potential means to arrest TBI in a number of use scenarios, including improvised explosive device (IED) blast, first response to blunt impacts, and explosive munitions training in soldiers.

FACULTY RESEARCHERS

University of Rochester Medical Center Professor of Ophthalmology Krystel Huxlin works with eye-tracking equipment in her lab at the Flaum Eye Institute.

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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govind.agrawal@rochester.edu

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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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 Adaptive nulling for steep aspheres using a holographic reference surface, 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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JAIME CARDENAS

Assistant Professor, The Institute of Optics, University of Rochester

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

Research Interests Photonic packaging, 2D materials, Integrated photonics, Nonlinear photonics, On-chip quantum photonics

Recent Research Projects Integrated optical frequency detection and weak value amplification, Fiber-to-chip fusion splicing for low-loss photonic packaging, Carrier envelope offset detection via simultaneous supercontinuum and second-harmonic generation in a silicon nitride waveguide, A reconfigurable nanophotonics platform for sub-millisecond, deep-brain neural stimulation

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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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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 Efficacy of visual training for recovering sight in stroke patients, 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 Refining and validating a model to characterize shape changes due to LIRIC writing on cornea, Optical probing for freeform optics metrology

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THOMAS GABORSKI

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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CHUNLEI GUO

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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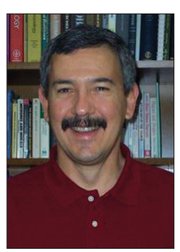

Associate Professor of Microbiology and Immunology and in the Center for Oral Biology, University of Rochester Medical Center

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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WENDI HEINZELMAN

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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 Support for distributed computing and network management in mobile ad hoc networks, 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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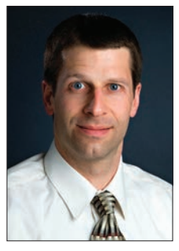
KARL HIRSCHMAN



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 MicroLED display technology development, 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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KRYSTEL HUXLIN

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 Biological impact of LIRIC in the cornea, 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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EMMETT IENTILUCCI

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

Education PhD, Rochester Institute of Technology, Imaging Science, 2005; MS, Rochester Institute of Technology, Imaging Science, 1999; BS, Rochester Institute of Technology, Imaging Science, 1996; AAS, Optical Engineering, Monroe Community College, 1989

Research Interests Global surveillance augmentation for deep learning, low-light-level (LLL) modeling, Incorporation of LiDAR and physics-based (target) modeling into structured hybrid hyperspectral sub-pixel detection algorithms with the addition of a geometric infeasibility metric

Recent Research Projects Global surveillance augmentation for deep learning, Atmospheric and radiative transfer modeling, Scattering from small particles related to bio-aerosols, Long-wave spectral variability, Remote sensing instrumentation and sensor calibration, Advanced atmospheric compensation, Spectral bi-directional reflectance (BRDF) measurements and modeling from objects such as vehicles

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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 Compressive beamforming for portable ultrasound, Developing and investigating focal plane compression techniques where majority of multiplication computations required by the compression are rendered unnecessary

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JOHN KEREKES

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 Multiphoton LIRIC: modeling, scaling, and material modification studies, Femtosecond micromachining of ophthalmic polymers

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AMY LERNER

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

Education PhD, University of Michigan, Mechanical Engineering, 1996; BS, University of Delaware, Mechanical Engineering, 1990; BS, Cornell University, Textile Science and Apparel Design, 1983

Research Interests Role of gender, obesity, ethnicity, activities, and meniscal injuries in the development of osteoarthritis, Using models based on medical imaging techniques such as micro-computed tomography and magnetic resonance

Recent Research Projects Refining and validating a model to characterize shape changes due to LIRIC writing on cornea, Biomechanical modeling of the human cornea, Characterizing growth of the knee joint, Finite element models of the knee meniscus, Knee flexion mechanics, Modeling vision correction with LIRIC writing modalities, MR imaging of musculoskeletal joints and bone properties, Understanding the risks for knee osteoarthritis

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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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KARA MAKI

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 Improved mathematical modeling and computer simulation of contact lens dynamics, Effect of contact lens distortion on exchange of tears, Model for suction pressure under a contact lens

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Education PhD, University of Rochester, Optical Engineering, 2000; MS, University of Rochester, Optical Engineering, 1997; BS, University of Rochester, Optical Engineering, 1993; BA, University of Rochester, Religion, 1993

Research Interests Fiber-optic communications systems, Optical and photonic components, Optical phenomena and physical processes

Recent Research Projects Image processing for optical weld-joint failure protection, Avionic fiber-optic networks, Improved RF-signal propagation over fiber, Terabit-per-second fiber-optic system, Metamaterial distributed feedback lasers, All-optical data-wavelength converters, All-optical digital gates, Optical-domain RF spectrum analyzer, Nonlinear dynamics of polarization rotation, Time transformation, Adiabatic wavelength conversion, Self-phase modulation, Four-wave mixing

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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

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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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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 quantum-dot-coated detector arrays, 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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KEVIN PARKER

Professor of Electrical and Computer Engineering, of Biomedical Engineering, and of Radiology, University of Rochester

Education PhD, Massachusetts Institute of Technology, Electrical Engineering (Biomedical Concentration), 1981; MS, Massachusetts Institute of Technology, Electrical Engineering, 1978; BS, State University of New York at Buffalo, 1976

Research Interests Medical imaging, Image processing, Novel scanning techniques, Fundamentals of wave propagation with signal and image processing techniques

Recent Research Projects Techniques and methods for Gabor-domain optical coherence elastography, Blue Noise Mask, Development of sonoelastography, Development of crawling waves, Tissue biomechanics and the microchannel flow model, H-scan for identification of scatterers, Reverberant shear wave fields, Needle pulse, OCT elastography, Enhanced resolution, Advanced 3D-4D analytics, New view of tissue scattering

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ANTHONY PIETROPAOLI

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

Education MPH, University of Rochester, Clinical Investigations/Clinical Research, 2008; MD, SUNY Upstate Medical University, Medicine, 1990; BA, College of the Holy Cross, English and Premed, 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, Cornell University, Astronomy, 1971; MS, Cornell University, Astronomy, 1970; BS, University of Toronto, Physics and Astronomy, 1962

Research Interests Infrared observations of star-forming regions, Infrared detector array development and applications to astronomy and to persistent surveillance

Recent Research Projects Teledyne HgCdTe 10 micron cutoff detector arrays for use in future space experiments, with particular emphasis on NEOCam (Near Earth Object Camera), Characterization of Raytheon long wavelength HgCdTe detector arrays, FIRE spectrometer development, Persistent surveillance-driven projects

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RAYMOND PTUCHA

Assistant Professor of Computer Engineering, Rochester Institute of Technology

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

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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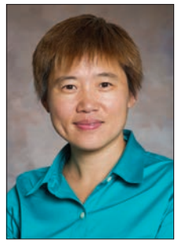

Associate Professor of Imaging Science, Rochester Institute of Technology

Education PhD, University of Texas at Austin, Electrical and Computer Engineering, 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 Femtosecond laser-based fabrication of photonic waveguides toward wavelength lasers, 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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JANNICK ROLLAND

Brian J. Thompson Professor of Optical Engineering, Professor of Optics, of Biomedical Engineering, and in the Center for Visual Science, University of Rochester

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 Techniques and methods for Gabor-domain optical coherence elastography, 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 Improved mathematical modeling and computer simulation of contact lens dynamics, Effect of contact lens distortion on exchange of tears, Model of suction under contact lens

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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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Education PhD, University of Padova (Italy), Information Engineering, 2012; MSc, University of Padova (Italy), Computer Engineering, 2008; BSc, University of Padova (Italy), Computer Engineering, 2005

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

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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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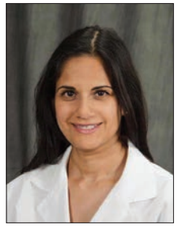

Assistant Professor of Ophthalmology, University of Rochester

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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HUI WU

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Education PhD, California Institute of Technology, Electrical Engineering, 2003; MS, Tsinghua University (Beijing), Microelectronics, 1998; BS, Tsinghua University (Beijing), 1998

Research Interests Wireless sensors for smart health care, Spintronic and nanoelectric integrated circuits, On-chip interconnect and power distribution for high performance microprocessors, Silicon photonics, Optical interconnect and electronic-photonic integrated circuits, High-performance clock generation and distribution, High-speed and ultra-wideband integrated circuits, High-speed passive devices and on-chip interconnect

Recent Research Projects Optical phased array for adaptive free-space optical imaging, Free-space optical interconnect for future microprocessors, Transmission-line based shared-medium on-chip electrical interconnect, Ultrafast pulse generation, Filtering and modulation, Ultrafast pulse shaping for Omega Laser System, Injection-locked clocking, High-speed silicon photodetectors in standard CMOS, Ultra-wideband (UWB) impulse radios, CMOS-compatible on-chip transmission lines, Integrated microwave passive devices

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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 Developing a Brillouin scattering microscope to quantify mechanical properties, Peripheral visual quality and its impact on myopia development and control, Large stroke adaptive optics for correcting highly aberrated eyes, Investigation of accommodation and presbyopic lenses (multifocal and accommodative intraocular lenses)

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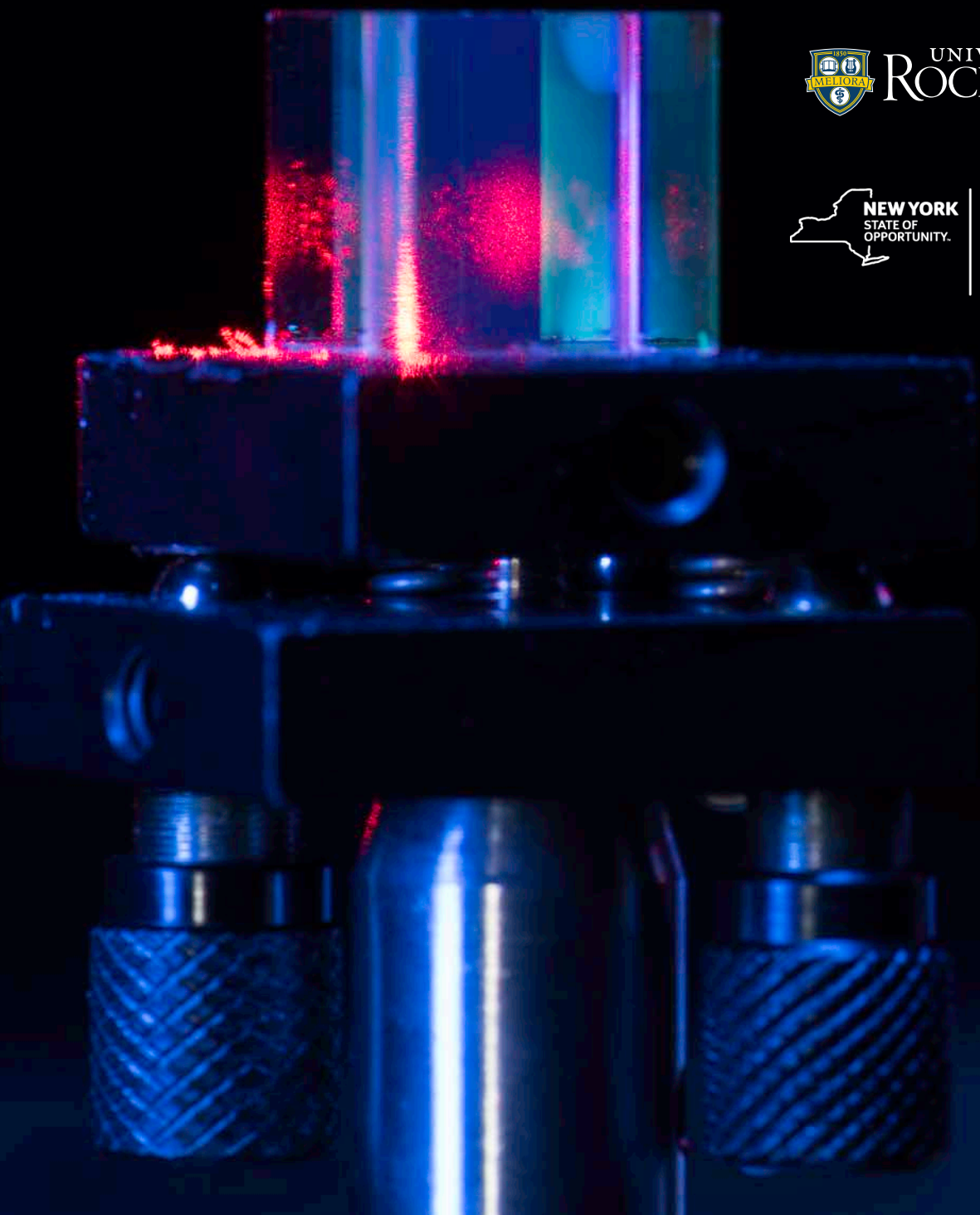

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