CENTER FOR **EMERGING AND INNOVATIVE SCIENCES**

IMPACT REPORT 2019–2022

CEIS

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Cover image *A photonic chip is pictured in the lab of Jaime Cardenas, assistant professor of optics at the University of Rochester. The lab, for the first time, has found a way to package on a 1 mm by 1 mm photonic chip a new way of using light in an interferometer for extremely precise measurements and sensing.*
Photo credit: J. Adam Fenster, University of Rochester

CEIS DIRECTORS' MESSAGE

The year 2022 marked the 30th anniversary of CEIS. Founded in 1992 as the "Center for Electronic Imaging Systems" by Professor Nicholas George at the University of Rochester's Institute of Optics, CEIS focused on the optical and electronic imaging technologies that formed the foundation of Rochester industry powerhouses Kodak, Xerox, and Bausch & Lomb. As the regional economy evolved, by necessity so did CEIS. Throughout the early 2000s, Professor Eby Friedman from the University of Rochester's electrical and computer engineering department led the center and embraced the changing industry landscape through visionary initiatives such as creation of the Microelectronic Design Center, a distributed statewide "Center" dedicated to the design of microchips, which has become a pillar of the state-wide economy. In the latter 2000s, Professor Gaurav Sharma led CEIS and continued the diversification of CEIS's portfolio of industrial collaborations, even redefining the acronym CEIS to stand for the "Center for Emerging and Innovative Sciences" to reflect the broad scope of CEIS activities. In 2010 we assumed leadership of the center, and throughout our tenure we have strived to continue serving the evolving needs of regional industry, to shine a bright light on the amazing innovation ecosystem of our region through initiatives such as the Light and Sound Interactive Conference founded in 2017 and to initiate and support new initiatives, such as the AIM Photonics Test and Packaging (TAP) facility in Rochester.

After a two-year pandemic-induced slowdown, we are restarting the CEIS Annual Report to bring our partners and stakeholders up to date on the center's recent accomplishments and our longer-term plans and initiatives. Within the pages of the current report, we describe pandemic-era projects that leveraged integrated optical technology to rapidly detect the presence of contagions, ongoing efforts to expand the photonic packaging capabilities of our region to serve the broader semiconductor industry, and emerging initiatives at the intersection of the arts and technology.

As always, we would like to thank the staff at CEIS, including our business manager, Cathy Adams; our center administrator, Margaret Urzetta; and our undergraduate program assistant, Jack Ager. We gratefully acknowledge the continued support of NYSTAR, New York State Assembly Representative Harry Bronson, and Governor Kathy Hochul for their continued advocacy and support. Primarily, CEIS owes a debt of gratitude to our many faculty Principal Investigators at the University of Rochester and Rochester Institute of Technology and to our industry partners who have made investments in the innovative research that continues to fuel the regional economy.

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

The advisory board and CEIS leadership meet and discuss strategies to expand new technologies and enhance the connection between academic research and corporate product development. The entire CEIS team would like to acknowledge and thank the advisory board for their leadership, expertise, and forward-focused ideas:

Bob Naum
Chair

Bob Fiete
L3Harris Corporation

Ryne Raffaelle
Rochester Institute of Technology

Ian Cox
IGC Consulting Group

Ellen Kosik-Williams
Corning, Inc.

THE WAY **IT WAS**

The CEIS team held its 8:30 a.m. Tuesday staff meetings via Zoom throughout the pandemic as a way to plan and communicate. We saw undergraduate student office staff graduate and move on during this time and also successfully recruited our newest student employee, Jack Ager.

OTHER CEIS **INITIATIVES**

TECHNOLOGY SHOWCASE

CEIS and the Center of Excellence in Data Science cohosted the University Technology Showcase on April 21, 2022, at the Memorial Art Gallery. Although COVID was still a factor, attendees were happy for the opportunity to network in person.

Assemblymember Harry Bronson was on hand for opening remarks and participated in the panel discussion. The opening panel session centered on the role of arts and innovation in revitalizing downtown Rochester. The panelists included Rachel Roberts, director of the Institute for Music Leadership at the Eastman School of Music; Victoria Van Voorhis, founder and CEO of Second Avenue Learning; and James Senall, president of NextCorps.

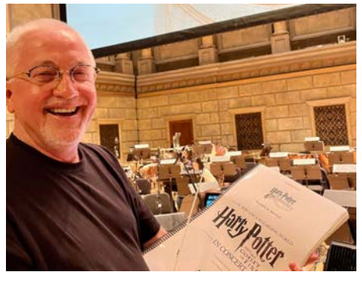
Thirty-two posters that covered topics in augmented/virtual reality; biomedical technology; data science; optics, photonics, and imaging; and sensors, acoustics, and materials were presented by faculty and students from RIT and the University of Rochester. Thirteen organizations that support technology were also represented.

Concurrently, the Western New York Augmented and Virtual Reality (AR/VR) Mini-Conference was held. This event, organized by a group of Professor Mujdat Cetin's PhD students, brought together AR/VR researchers and professionals to discuss immersive technologies. The program highlighted speakers from Immersitech, Vuzix, RIT, UR, and Cornell.

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.

Outreach to the local community is an important part of CEIS's mission, complementing the work we do through our funding of industry/university research collaborations. While funded research supports specific activities that involve established industry/university collaborations, 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 our universities and companies, including the local talent pool.

CEIS GOES TO THE MOVIES

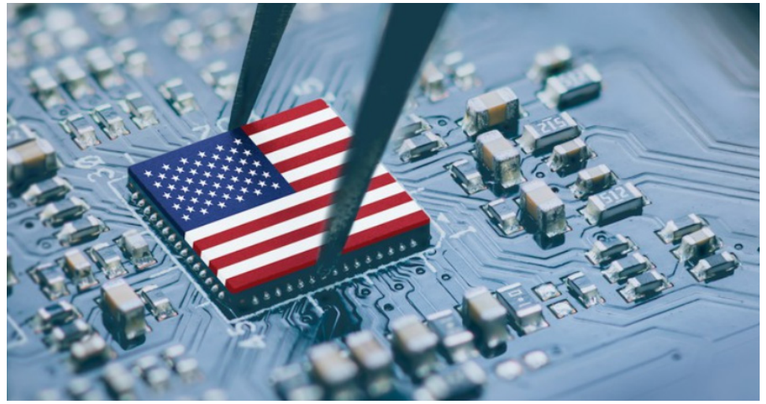


In 2017 CEIS founded the "Light and Sound Interactive" Conference and Exposition to bring the world's attention to the trove of technical and artistic creative resources in the Rochester community. The conference was highly successful, attracting more than 1,000 attendees in 2017 and again in 2019, but, unfortunately, LSI was discontinued during the pandemic.

Building on this earlier success, CEIS is combining efforts with the University of Rochester's Eastman School of Music to launch a new event, the "Rochester Film Music Festival," a celebration of music in visual media from feature films to games. This will be the only such event in North America, and it is a perfect fit for our region, which is home to the University of Rochester's world-famous Eastman School of Music and its audio and music engineering program as well as leading programs in film, gaming, and audio at Rochester Institute of Technology. Rochester also has a vital video game industry and an emerging industry cluster of audio technology and media production companies. The new event will encompass all artistic and technical facets of music in media. Planned events will include live orchestral accompaniment to screenings of full-length feature films; other live accompaniment to screenings of films, short videos, and games; creative workshops on music composition and sound design; juried competitions; and technical sessions covering emerging technologies, from immersive sound to interactive music creation.

To launch the concept, this past May CEIS teamed up with the Eastman School's Beal Institute for Film Music and Contemporary Media to bring Scottish film composer Patrick Doyle to Rochester for the Rochester Philharmonic Orchestra's live accompaniment to a screening of *Harry Potter and the Goblet of Fire,* for which Doyle composed the music. Doyle held "meet the composer" sessions in Kodak Hall at Eastman Theatre prior to both performances by the RPO, and he hosted a screening of the 2015 film Cinderella, for which he also composed the score. This was followed by a master class on composing for film and Doyle's highly entertaining recollections of his career as a film composer. All events throughout the weekend attracted capacity audiences, which bodes well for the success of a future Rochester Film Music Festival. CEIS is looking forward to helping make the new film music festival, planned for 2024, a success and to encouraging growth of the emerging regional cluster at the intersection of music, media, and technology.

OTHER CEIS **INITIATIVES**



A HUB FOR THE SEMICONDUCTOR MANUFACTURING SUPPLY CHAIN

This year CEIS has focused its efforts on a major regional and state-wide effort to make Rochester a hub for the semiconductor manufacturing supply chain. Semiconductors touch our lives daily in countless ways; they are critical to the national defense and are an important part of the global economy. They are at the heart of all electronic devices, from toys and appliances to automobiles and medical devices to the data centers that power the internet. Lately the US semiconductor industry has been receiving a lot of attention from both New York State and federal governments.

New York has been making a strategic push for decades to expand semiconductor manufacturing in the state. For example, the state funded the development of the nanotechnology complex in Albany and incentivized semiconductor manufacturers GlobalFoundries and Wolfspeed to build plants in Upstate New York. Recently, with the help of the state's Green Chips program, Micron has decided to invest $100 billion in building multiple semiconductor manufacturing plants in Syracuse over the next 20 years, and Edwards Vacuum has announced plans to build a plant to produce vacuum pumps for the industry in the Science and Technology Advanced Manufacturing Park (STAMP) in Genesee County. Importantly, through NYSTAR, Empire State Development's Division of Science, Technology and Innovation, the state invests millions of dollars into semiconductor research and development. The state also invested $250 million in the AIM Photonics Test, Assembly, and Packaging (TAP) facility in Rochester. We are grateful to Governor Kathy Hochul and regional elected representatives for their leadership.

At the federal level, the CHIPS + Science Act, which was led by Senator Chuck Schumer and strongly supported by Congressman Joe Morelle, was signed into law in August. The CHIPS Act will bolster US chip manufacturing and protect the nation from being overly reliant on foreign chip production. It provides $52 billion in support for the industry, with $39 billion in direct support for companies building manufacturing plants in the US, and another $11 billion for research and development.

Recognizing these developments, CEIS, in collaboration with other leading regional institutions, including the University of Rochester, Rochester Institute of Technology, Greater Rochester Enterprise, AIM Photonics, and NextCorps, has been leading an effort to establish Rochester as a major hub for semiconductor packaging. Much of the focus of the CHIPS Act is on integrated circuit (IC) fabrication, which takes place in large cleanroom factories like the GlobalFoundries plant in Malta, New York; the Albany Nanofabrication Complex; and what will be the Micron mega-factories in Syracuse. But ICs cannot be used until they are packaged to protect the sensitive circuitry from the environment and provide an interface to printed circuit boards (PCBs). While the share of IC fabrication in the US has fallen from 37 percent in 1990 to just 13 percent today, the US only accounts for 3 percent of semiconductor packaging. And there is zero manufacturing of IC substrates, which are the interface between the IC and the PCB and an increasingly critical part of the semiconductor industry. Semiconductor packaging, and in particular IC substrates, are seen as the Achilles heel of the US semiconductor industry.

Rochester has the core assets that make it a logical place to establish a semiconductor packaging cluster. We have two leading research universities with large engineering programs, and Monroe Community College, which has two advanced manufacturing programs. These schools are sources of both technology and well-trained employees. We have a large manufacturing base that provides support as well as talent, we have a very active entrepreneur ecosystem anchored by NextCorps, and we have great physical infrastructure, including Eastman Business Park and STAMP. We also have the TAP facility, which is the only federally funded center for integrated photonics packaging in the nation. These combined resources make Rochester one of the most desirable places in the country for packaging companies to locate.

With our partners, CEIS is working on two fronts to build a packaging cluster. One is to establish a public/private partnership R&D center with partial funding from the CHIPS Act. This could take the form of expanding the AIM Photonics TAP facility and/or establishing a center focused on a broader set of packaging and substrate technologies. A second is to incubate, grow, and attract packaging companies with help from the Incentives portion of the CHIPS act. To that end, CEIS hired one of the world's leading consultants in the packaging industry to help identify candidate companies that might locate in Rochester, and that effort is already paying off.

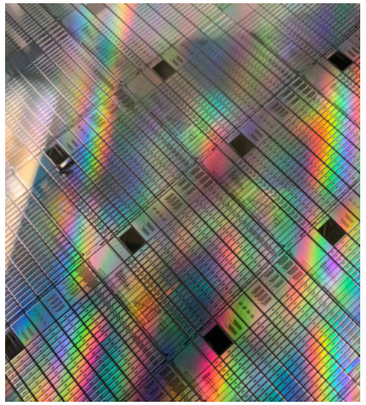
CEIS is proud to contribute to our community's efforts to expand regional economic activity through this exciting technology and unique opportunity.

CEIS PARTNERS SUPPORT COVID-19 INITIATIVES

Since the onset of the pandemic, two faculty supported in part by CEIS have developed technologies that aid in the detection of COVID-19.

Optical chip that can detect antibodies to viruses
Professor Benjamin Miller in the Department of Dermatology at the University of Rochester Medical Center has developed a tiny photonic chip, housed in a disposable card, that can detect the presence of antibodies to viruses, including COVID-19, from a single drop of blood. This new method developed by Miller's team in cooperation with AIM Photonics is faster than the more general RNA testing—and less complicated. The chip has separate sensors with proteins that attract the antibodies of eight unique viruses, revealing what exposures the patient might have had. All this came from academic, government, and commercial cooperation, resulting in a potentially potent tool for commercial testing. The chip also has the potential capacity to aid clinics in investigating further relationships between COVID-19 and previous infections.

Ultrathin nanomembranes to improve SARS-CoV-2 testing
Professor James McGrath in the department of Biomedical Engineering at the University of Rochester and his team, in collaboration with SiMPore, have developed a method to detect active virus in a patient's sample of sputum, mucus, or blood. Developed as a response to the need for improved COVID testing, the method involves using 400 nm-thick silicon membranes with micron-sized pores. The pores are lined with antibodies to the virus and trap the virus as it enters. This, in turn, causes a rerouting of fluids injected into the microfluidic platform, which can then be detected by the user. The membranes could also allow for further research into the deadly behavior of the virus, in particular how it attacks patients' lungs. With the prediction that COVID will be a seasonal problem for many years to come, this kind of testing, which requires no power source, is a real asset, especially for low-resource communities.



JUDITH PIPHER REMEMBERED AS A TRAILBLAZER IN THE FIELD OF INFRARED ASTRONOMY

CEIS remembers and celebrates the life of Judith Pipher, a professor emerita of physics and astronomy who taught at the University of Rochester from 1971 to 2002. She was a longtime principal investigator collaborating on CEIS-supported research projects. Pipher passed away on February 21, 2022, at the age of 81. She was inducted into the national Women's Hall of Fame in 2007 for the exceptional advances she made in the study of astronomical objects by observing the infrared light they emit. Widely considered "the mother of infrared astronomy," Pipher served in leadership positions in many organizations, including the International Astronomical Union, the Universities Space Research Association, NASA, and the American Astronomical Society. Learn more about her life and legacy online at **rochester.edu/newscenter/judith-pipher-remembered-as-a-trailblazer-in-the-field-of-infrared-astronomy**.

ECONOMIC IMPACT **2021–2022**

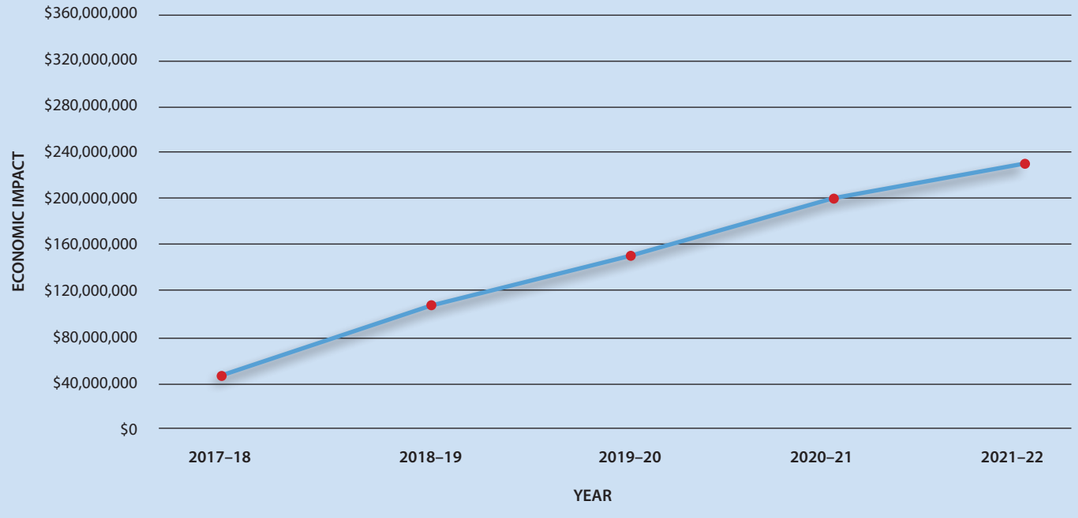
For the fiscal year July 1, 2021, to June 30, 2022, the total documented dollar value of the economic impact of CEIS-supported research and outreach was close to $31 million. This self-reported data (new and retained jobs, increased sales, cost savings, capital investments, and additional funds acquired) from 15 of our partners provides a snapshot of the region's economic successes. The five-year cumulative economic impact effect of CEIS investments in New York State entities is nearly $318 million.

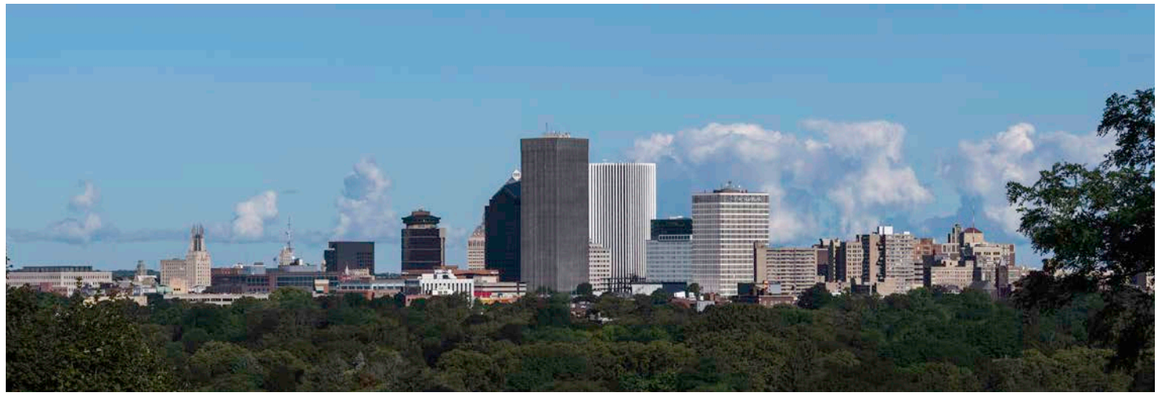
A shout-out to the AIM Photonics initiative, which led the way in non-job impacts, reporting over $17 million in monetary impacts. Clerio Vision, the local start-up company, reported four new jobs and four retained jobs, along with over $3.2 million in non-job impacts. Our partner OptiPro reported two new jobs and two retained jobs as well as over $4.2 million in non-job impacts.

FIVE-YEAR SUMMARY OF ECONOMIC IMPACT

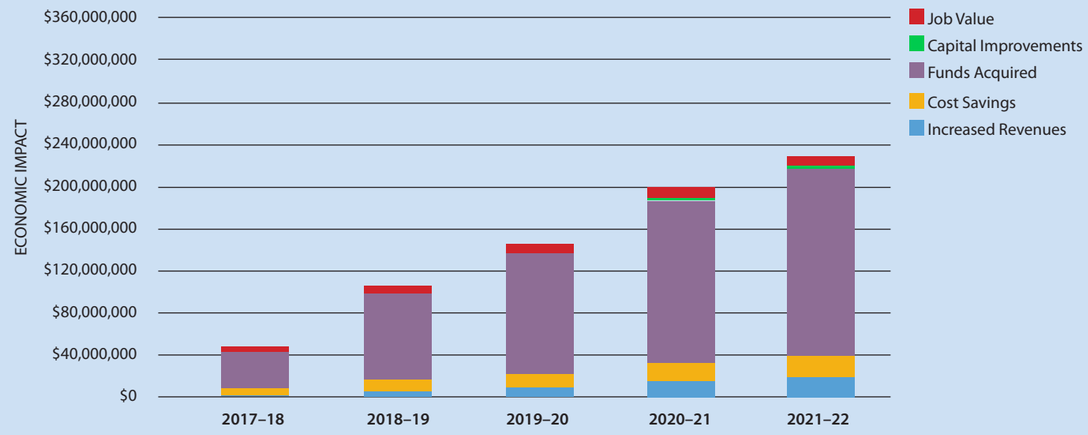
Year	2017–18	2018–19	2019–20	2020–21	2021–22	Total
Increased Revenues	$1,563,699	$4,620,662	$1,916,467	$4,051,507	$3,972,963	$16,125,298
Cost Savings	$6,536,372	$4,809,079	$2,807,309	$5,143,669	$2,931,593	$22,228,022
Funds Acquired	$34,250,633	$46,289,697	$37,067,808	$37,205,718	$22,700,043	$177,513,899
Capital Improvements	$263,377	$38,439	$53,000	$720,000	$80,000	$1,154,816
Job Value	$5,147,237	$2,361,460	$2,226,413	$2,308,974	$1,234,327	$13,278,411
New Jobs	30.25	26.5	20.25	17	11	105
Retained Jobs	45.25	12.5	14	18	9	99
Total Impact	$47,761,318	$58,119,337	$44,070,997	$49,429,868	$30,918,926	$230,300,446
Total Cumulative Impact	$47,761,318	$105,880,655	$149,951,652	$199,381,520	$230,300,446	$230,300,446

TOTAL CUMULATIVE ECONOMIC IMPACT





FIVE–YEAR ECONOMIC IMPACT



CAT PROGRAM FINANCIAL INFORMATION

July 1, 2021–June 30, 2022

FUNDING FROM NYSTAR

Personnel Related	
Research and Center Management	$656,433
Non-Personnel Related	
Research and Center Management	$166,720
Total NYSTAR Contribution	$823,153

OTHER SOURCES OF FUNDS—Cash from Companies

Personnel Related	$442,428
Non-Personnel Related	$210,173
Total Other Resources	$652,601

COMPANIES REPORTING ECONOMIC IMPACT IN 2021–22 FROM CEIS INTERACTIONS

AIM Photonics
Aktiwave, LLC
AlchLight
AN Jordan Scientific
Clerio Vision, Inc.
Corning, Inc.
DinamicOR
Imaginant
Kitware
L3Harris Technologies
LighTopTech Corporation
OptiPro Systems, LLC
RAM Photonics
Thermo Fisher Scientific
VisualDx

ECONOMIC IMPACT **2020–2021**

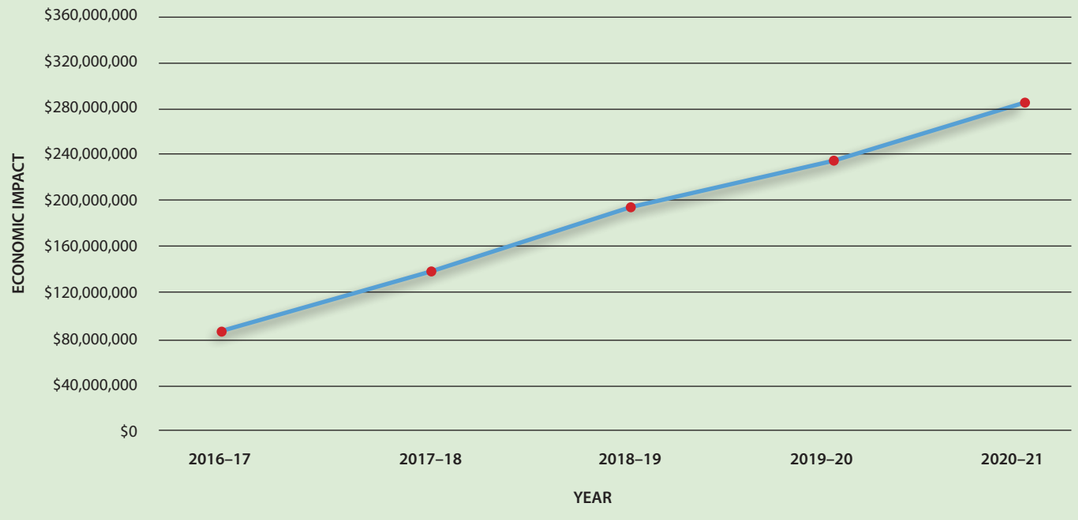
For the fiscal year July 1, 2020, to June 30, 2021, the total documented dollar value of the economic impact of CEIS-supported research and outreach was over $49 million. This self-reported data (new and retained jobs, increased sales, cost savings, capital investments, and additional funds acquired) from 22 of our partners provides a snapshot of the region's economic successes. The five-year cumulative economic impact effect of CEIS investments in New York State entities is nearly $287 million.

A shout-out to the AIM Photonics initiative, which led the way in non-job impacts, reporting over $15 million in monetary impacts. Clerio Vision, the local start-up company, reported seven new jobs and seven retained jobs, along with over $19 million in non-job impacts.

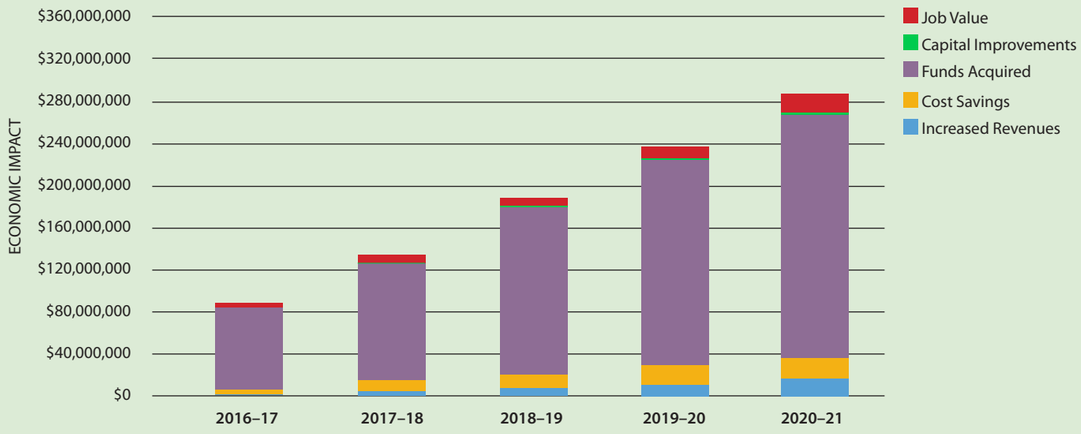
FIVE-YEAR SUMMARY OF ECONOMIC IMPACT

Year	2016–17	2017–18	2018–19	2019–20	2020–21	Total
Increased Revenues	$1,276,127	$1,563,699	$4,620,662	$1,916,467	$4,051,507	$13,428,462
Cost Savings	$4,586,060	$6,536,372	$4,809,079	$2,807,309	$5,143,669	$23,882,489
Funds Acquired	$77,548,500	$34,250,633	$46,289,697	$37,067,808	$37,205,718	$232,362,356
Capital Improvements	$113,000	$263,377	$38,439	$53,000	$720,000	$1,187,816
Job Value	$4,075,292	$5,147,237	$2,361,460	$2,226,413	$2,308,974	$16,119,376
New Jobs	37.75	30.25	26.5	20.25	17	132
Retained Jobs	23.5	45.25	12.5	14	18	113
Total Impact	$87,598,979	$47,761,318	$58,119,337	$44,070,997	$49,429,868	$286,980,499
Total Cumulative Impact	$87,598,979	$135,360,297	$193,479,634	$237,550,631	$286,980,499	$286,980,499

TOTAL CUMULATIVE ECONOMIC IMPACT



FIVE–YEAR ECONOMIC IMPACT



CAT PROGRAM FINANCIAL INFORMATION

July 1, 2020–June 30, 2021

FUNDING FROM NYSTAR

Personnel Related	
Research and Center Management	$487,131
Non-Personnel Related	
Research and Center Management	$112,838
Total NYSTAR Contribution	$599,969

OTHER SOURCES OF FUNDS—Cash from Companies

Personnel Related	$279,272
Non-Personnel Related	$159,328
Total Other Resources	$438,600

COMPANIES REPORTING ECONOMIC IMPACT IN 2020–21 FROM CEIS INTERACTIONS

AIM Photonics
Aktiwave, LLC
AlchLight
AN Jordan Scientific
Bausch + Lomb
Carestream Health
Clerio Vision, Inc.
Corning, Inc.
DinamicOR
Envision Solutions LLC
Imaginant
Kitware
L3Harris Technologies
LighTopTech Corporation
OptiPro Systems, LLC
O-Vitz Corporation
RAM Photonics
SiMPore, Inc.
SunDensity
Thermo Fisher Scientific
VeRacity VRcade
VisualDx

ECONOMIC IMPACT **2019–2020**

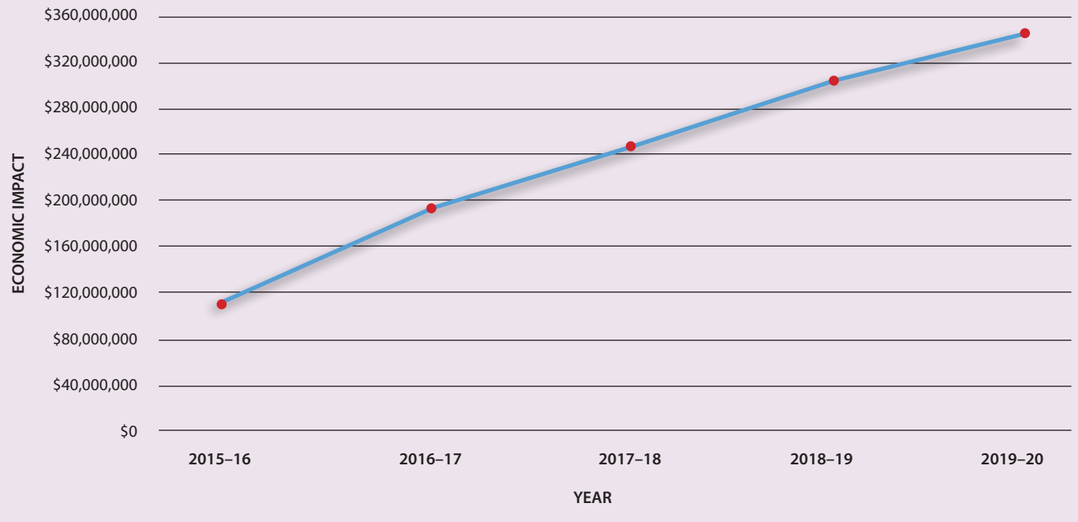
For the fiscal year July 1, 2019, to June 30, 2020, the total documented dollar value of the economic impact of CEIS-supported research and outreach was over $44 million. This self-reported data (new and retained jobs, increased sales, cost savings, capital investments, and additional funds acquired) from 23 of our partners provides a snapshot of the region's economic successes. The five-year cumulative economic impact effect of CEIS investments in New York State entities is more than $347 million.

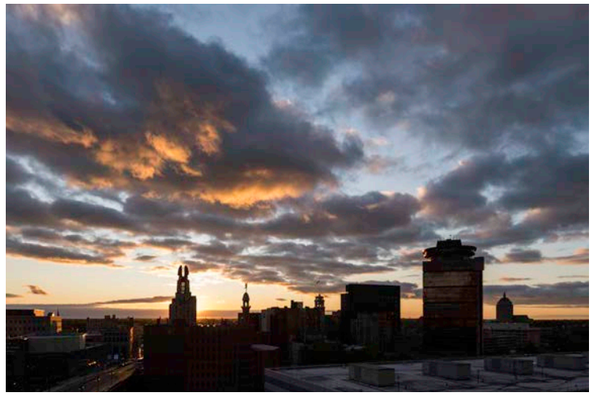
A shout-out to the AIM Photonics initiative, which led the way in non-job impacts, reporting over $19 million in monetary impacts. Clerio Vision, the local start-up company, reported 10 new jobs and eight retained jobs, along with over $13 million in non-job impacts.

FIVE-YEAR SUMMARY OF ECONOMIC IMPACT

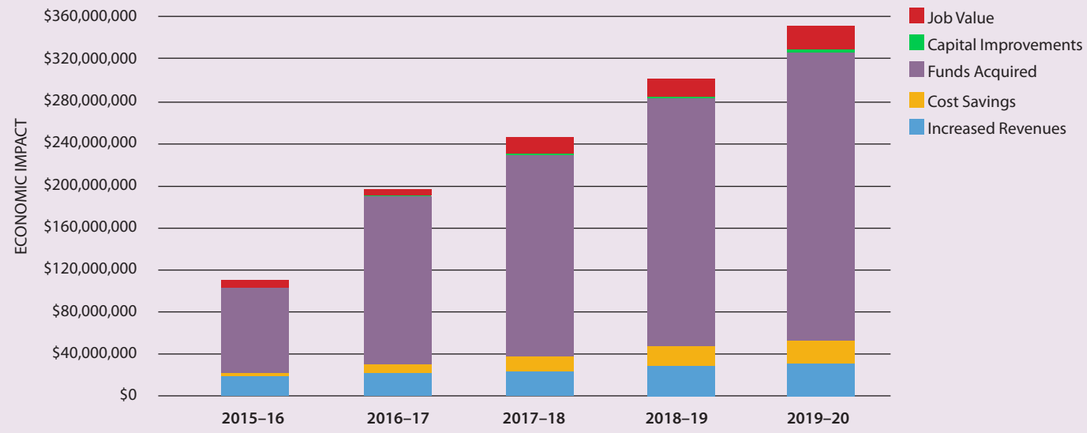
Year	2015–16	2016–17	2017–18	2018–19	2019–20	Total
Increased Revenues	$18,635,000	$1,276,127	$1,563,699	$4,620,662	$1,916,467	$28,011,955
Cost Savings	$3,927,488	$4,586,060	$6,536,372	$4,809,079	$2,807,309	$22,666,308
Funds Acquired	$81,269,321	$77,548,500	$34,250,633	$46,289,697	$37,067,808	$276,425,959
Capital Improvements	$204,549	$113,000	$263,377	$38,439	$53,000	$672,365
Job Value	$6,106,332	$4,075,292	$5,147,237	$2,361,460	$2,226,413	$19,916,734
New Jobs	61	37.75	30.25	26.5	20.25	176
Retained Jobs	28	23.5	45.25	12.5	14	123
Total Impact	$110,142,690	$87,598,979	$47,761,318	$58,119,337	$44,070,997	$347,693,321
Total Cumulative Impact	$110,142,690	$197,741,669	$245,502,987	$303,622,324	$347,693,321	$347,693,321

TOTAL CUMULATIVE ECONOMIC IMPACT





FIVE–YEAR ECONOMIC IMPACT



CAT PROGRAM FINANCIAL INFORMATION

July 1, 2019–June 30, 2020

FUNDING FROM NYSTAR

Personnel Related	
Research and Center Management	$535,655
Non-Personnel Related	
Research and Center Management	$224,301
Total NYSTAR Contribution	$759,956

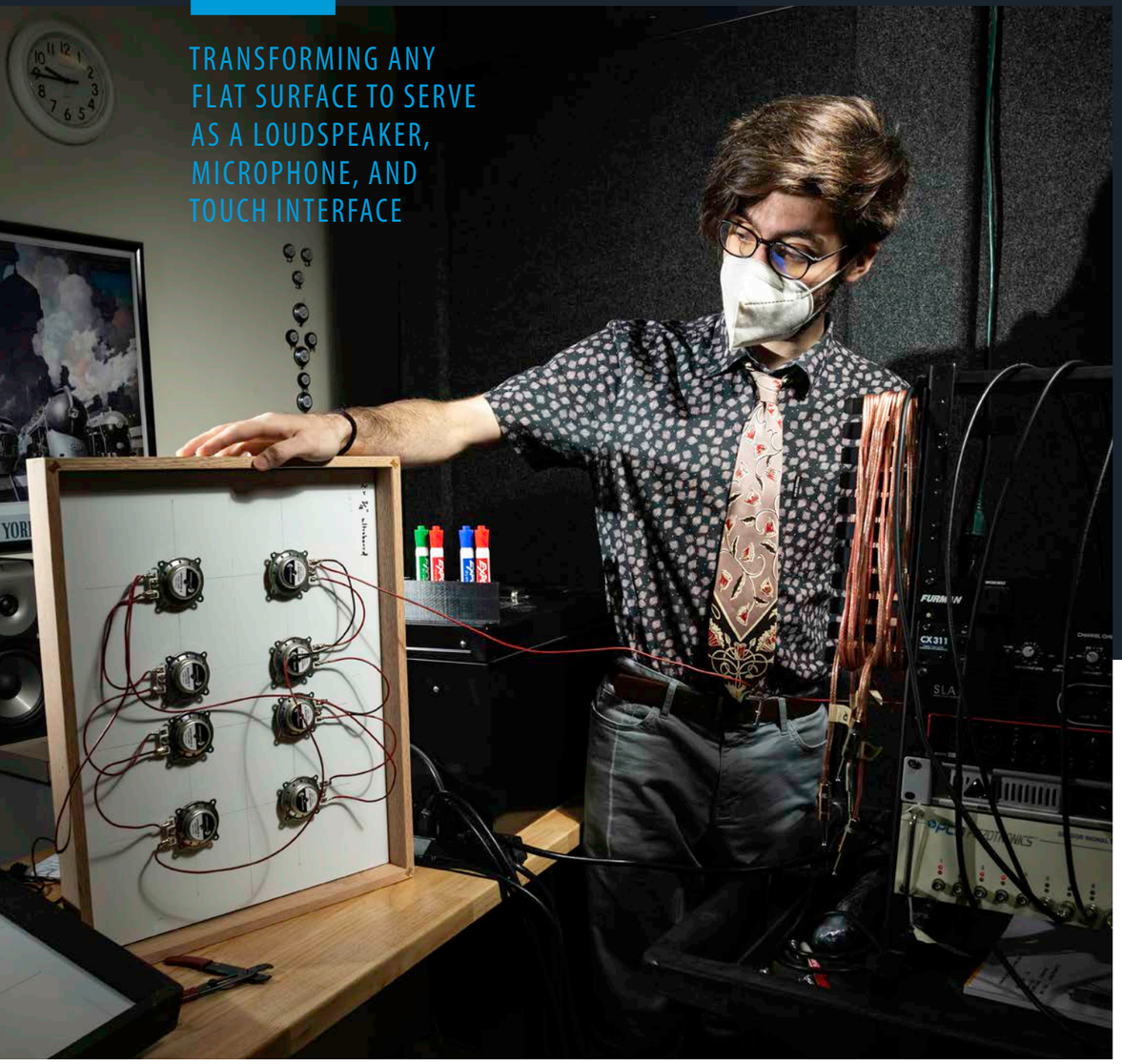
OTHER SOURCES OF FUNDS—Cash from Companies

Personnel Related	$642,160
Non-Personnel Related	$377,959
Total Other Resources	$1,020,119

COMPANIES REPORTING ECONOMIC IMPACT IN 2019–20 FROM CEIS INTERACTIONS

AIM Photonics
Aktiwave, LLC
AlchLight
AN Jordan Scientific
Arcum Therapeutics
Bausch + Lomb
Carestream Health
Clerio Vision, Inc.
Corning, Inc.
Envision Solutions LLC
Imaginant
Kitware
L3Harris Technologies
LighTopTech Corporation
Molecular Glasses, Inc.
Optimax
OptiPro Systems, LLC
O-Vitz Corporation
SeeQC, Inc. fka HYPRES, Inc.
SiMPore, Inc.
Thermo Fisher Scientific
VeRacity VRcade
VisualDx

PROJECT **ABSTRACTS**



Ben Kevelson '22, an audio and music engineering major, has been working with Michael Heilemann, a professor of electrical and computer engineering, on the technology as a cheaper alternative to smart devices such as Amazon Alexa and Google Home. The flat surface would be a speaker and a microphone all in one, both creating and receiving sound.

Femtosecond laser-based fabrication of waveguide lasers
Jie Qiao
Rochester Institute of Technology
Aktiwave LLC

The objective of this proposal is to further innovate and demonstrate a waveguide laser, enabled by femtosecond laser inscription of low-loss waveguides in laser materials such Neodymium-doped yttrium aluminum garnet crystals. Performance of waveguide lasers inscribed by both 515nm and 1030nm will be compared. Confinement of light in waveguides with small cross section can significantly lower the lasing threshold in a laser medium and enhance the effective nonlinearity of a nonlinear medium. Many commercial and defense applications require such waveguide lasers for integrated optical circuits on the micron scale, providing weight, power, and cost reductions for spacecraft microprocessors, communication buses, advanced data processing, free-space communications, and integrated optical systems.

Research in Support of High Speed LIRIC Manufacturing Processes at Clerio Vision
Wayne H. Knox
University of Rochester
Clerio Vision, Inc.

Research is proposed in several areas likely to impact the manufacturability of custom contact lenses and other ophthalmic materials of interest to Clerio Vision. First, an extensive testing plan that compares LIRIC writing in dehydrated hydrogels to our current hydrated materials program is proposed. As part of this, it is also proposed to develop new methods to provide direct measurements of thermal contributions to LIRIC writing. Furthermore, new advanced laser methods writing that could lead to very high-speed LIRIC writing of contact lenses are proposed.

Global Surveillance Augmentation for Deep Learning
Andreas Savakis
Rochester Institute of Technology
Kitware

Deep convolutional networks have become the standard in computer vision for image classification tasks. Recently, vision transformer networks, inspired by natural language processing, emerged as an alternative to convolutional networks that offer excellent performance due to their attention mechanism. In this project we propose to investigate visual transformer architectures for domain generalization and adaptation in unconstrained settings where training takes place in a labeled source domain and the model is deployed in a target domain where few or no labels are available.

Optical Phased Array for Adaptive Free-Space Optical Imaging and Communication
Hui Wu
University of Rochester
L3Harris Technologies

We propose to investigate integrated silicon photonic optical phased array (OPA) technologies and develop a new free-space optical (FSO) imaging and communication system to meet the challenges facing conventional FSO 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 energy consumption as compared to conventional solutions. We seek to leverage silicon photonic devices; 3-D integration; and supporting optics, circuits, and software to develop an OPA-based FSO system for adaptive free-space optical imaging and communication. One of the target applications is ad-hoc FSO communication links at distances up to tens of kilometers and with hundreds of nodes. We expect that the proposed research project will lead to technological breakthroughs for FSO imaging and communication and generate significant economic impacts in New York state and beyond.

Development of Multi-kW-survivable Fiber Preparation
John Marciante
University of Rochester
RAM Photonics LLC

As fiber laser systems move to increasingly higher power levels, manufacturing processes are required to keep up with multi-kW power handling capability that does not rely on subject matter experts. The goal of this project is to develop novel processes for handling, stripping, cleaning, cleaving, and splicing dual-clad optical fibers that are capable of handling multi-kW of optical power transmission. While this is done routinely by subject matter experts in laboratories around the world, the goal of this effort is to develop and define such processes that can be done by non-SMEs and can ideally be automated.

Arrayed µSiM Platforms for Advanced Cell Culture Applications
James McGrath
University of Rochester
SiMPore, Inc.

SiMPore is currently commercializing a cell culture platform developed by the McGrath lab with support from an NIH Phase II Award. The cell culture platform, the µSiM (microfluidic device featuring silicone membrane) is being used in more than a dozen laboratories for a wide range of practical applications. Last year, the McGrath lab distributed components for more than 4000 µSiMs. While SiMPore works to create a commercial solution to meet this demand for single µSiM units, there is a new demand for arrayed systems to increase experimental throughput. This proposal will develop prototype solutions for arrayed µSiM devices.

Femtosecond laser-based fabrication of waveguide lasers
Jie Qiao
Rochester Institute of Technology
Aktiwave LLC

The objective of this proposal is to innovate and demonstrate a waveguide laser, enabled by femtosecond laser inscription of low-loss waveguides in laser materials such Neodymium-doped yttrium aluminum garnet crystals. Confinement of light in waveguides with small cross section can significantly lower the lasing threshold in a laser medium and enhance the effective nonlinearity of a nonlinear medium. Many commercial and defense applications require such waveguide lasers for integrated optical circuits on the micron scale, providing weight, power and cost reductions for spacecraft microprocessors, communication buses, processor buses, advanced data processing, free-space communications and integrated optical systems, subsystems and components.

Chipscale photonic gyroscope based on weak value amplification
Jaime Cardenas
University of Rochester
AN Jordan Scientific, LLC

Professor Cardenas and Professor Jordan will collaborate to design, fabricate, and test an optical gyroscope integrated on a photonic chip with weak value amplification. The chip will measure angular velocity using a microring resonator with weak value-based phase readout. The key technology for on-chip weak value phase readout was developed during the 2019–2020 CEIS CIR period. Funds provided by CEIS and Professor Jordan's LLC will support a graduate student in Professor Cardenas' group. This effort is part of a larger effort in collaboration with Leonardo DRS, a defense-related company with a national scope.

Adaptive Optics Simulations of LIRIC-processed Multifocal Contact Lenses for Myopia Correction
Susana Marcos
University of Rochester
Clerio Vision Inc.

LIRIC (Laser-Induced Refractive Index Change), developed as a non-subtractive corneal refractive surgery has been proved to write corrections in soft contact lenses (CLs) and is well suited for diffractive multifocal corrections customized to the patient's needs. Spatial Light Modulators (SLM) in Adaptive Optics Visual Simulators can represent multifocal lenses and allow subjects to perform visual testing through programmed corrections. We will test the accuracy of SLMs to map LIRIC-multifocal CLs, vision through SLM-simulated lenses in emetropic/myopic young subjects, and the effect of pupil and accommodation. We will investigate the optimal CL design parameters (near-add, far/near energy split, apodization) to preserve visual quality at all distances while providing a signal for myopia control.

Biological Impact of LIRIC in the Cornea
Krystel R. Huxlin
University of Rochester
Clerio Vision Inc.

LIRIC (Laser-Induced Refractive Index Change) is being developed as a non-ablative form of corneal refractive correction. Preclinical work to date has used 80MHz 405nm light. Yet for eye safety reasons, ophthalmic practice uses only ultraviolet, 1035nm or 810nm light for ocular imaging and procedures. In the last two years, Clerio modified their laser systems to perform LIRIC at 1035nm in ex vivo eyes. Now, in this proposal, we will carry out the next phase of technology development by testing the safety and efficacy of 1035nm LIRIC in vivo, in a pre-clinical rabbit model, over a period of six months post procedure.

Ultrashort pulse light sources and new in-vivo diagnostics for LIRIC optimization
Wayne H. Knox
University of Rochester
Clerio Vision, Inc.

My photochemical scaling model has successfully predicted much better LIRIC writing using lower repetition rates and shorter pulses. Yet, commercial ultrafast lasers do not provide short enough pulses to reach the true material limits. Pulse compression techniques will be expanded to a new generation of damage-free hollow core gas-filled compressor fibers and tested. Secondly, a new NIR fiber optical probing technique will be built into an existing LIRIC writing system and tested as a new in-situ probe of the localized temperature during LIRIC writing. The temperature rise during LIRIC will be studied in relation to material damage and LIRIC parameters.

Infrared Detector Array Evaluation for Space
Judith Pipher
University of Rochester
Cornell University (New York Space Grant)

The University of Rochester is characterizing 3–5 m and 6–11 m HgCdTe 2k x 2k infrared detector arrays for the NEO Surveyor Mission (NEOS), a directed NASA mission, formerly the proposed PI mission NEOCam. Currently, NEOS is in Phase B, under a grant from the University of Arizona. The former NEOCam PI, Dr. Mainzer, is the NEOS mission director, and she moved to the University of Arizona from JPL in 2020. Our mandate is to find not only the top-level characteristics such as noise, dark current, and quantum efficiency as a function of wavelength for these arrays but also to identify and characterize unusual effects which will affect calibration in space. To date, we have identified two brighter fatter effects, a scale factor characterization method, and have measured the MTF of the longer wave HgCdTe array. Flight is planned for early 2026.

MicroLED Display Technology Development
Karl Hirschman
Rochester Institute of Technology
Corning Incorporated

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.

Global Surveillance Augmentation for Deep Learning
Andreas Savakis
Rochester Institute of Technology
Kitware

Deep learning techniques have demonstrated excellent performance on image classification tasks; however, their training requires large labeled datasets that are expensive and time consuming to generate. Synthetic datasets offer an attractive alternative for training deep networks but cannot match the performance obtained when training on measured (real) data. We propose to investigate the performance of domain adaptation methods on satellite data, where training takes place in the synthetic source domain and the system adapts to the measured data in the target domain where few or no labels are available.

Flat-Panel Loudspeakers/Microphones for First Responder Handheld Devices
Michael Heilemann
University of Rochester
L3Harris Technologies, Communication Systems

We are exploring the potential for flat-panel loudspeaker/microphone technology to improve performance and durability of radios manufactured by L3Harris. Our recent advances in flat panel loudspeaker design make it possible to create visual displays that also serve as a loudspeaker and microphone. This technology could be implemented in the display of handheld devices. Employing microphone array signal processing and methods for spatial control of panel vibrations, it is possible to make both the reception and radiation of sound directional. This capability will enable background noise cancellation and enhance the privacy of communications for users.

Optical Phased Array for Adaptive Free-Space Optical Imaging and Communication
Hui Wu
University of Rochester
L3Harris Technologies

We propose to investigate integrated silicon photonic optical phased array (OPA) technologies and develop a new free-space optical (FSO) imaging and communication system to meet the challenges in conventional FSO 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 energy 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 and communication. The target application is free-space 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 communication and generate significant economic impacts.

Adaptive Nulling for Steep Aspheres Using a Holographic Reference Surface
Thomas 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 continue the work from 2019–2021, employing a real-time photopolymer exposure as an adaptive nulling reference and use a Fizeau geometry to measure steep aspheres.

Laser surface processing for pharmaceutical applications
Chunlei Guo
University of Rochester
Pfizer Inc.

Pharmaceutical equipment and devices require sanitation and antifouling. Recently, the Guo lab at the University of Rochester has demonstrated a technique that allows them to create sanitation and antifouling surfaces on a range of materials. This project will explore the suitability of this technology on pharmaceutical devices and its applications.

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 high-powered lasers. Robust welds that withstand vibrational forces are required for some environments. We will research and develop imaging-processing techniques to identify fiber-weld features and fiber-weld-grid features that predict weld failure due to vibration. Such techniques will help screen products before testing, saving resources and aiding in the development of the manufacturing process.

Image analysis to determine the sensitivity and accuracy of a rapid sensor for SARS-CoV-2
James McGrath
University of Rochester
SiMPore, Inc.

The global COVID-19 pandemic caused by the SARS-CoV-2 virus demands fast, reliable, and inexpensive point-of-care detection of active infection for global population screening. We have discovered that SiMPore's precision microslit membrane technology can be implemented to develop a novel sensor based on the fact that the membrane rapidly fouls with virus-like particles. While we are rapidly developing prototypes under active NSF funding, we are not yet focused on the tools needed to quantify the amount of captured virus to determine the sensitivity and accuracy of our device. This request for funds will develop those tools which in combination with high-speed imaging will allow for accurate validation and risk assessment of these diagnostic devices. The project is addressing a global demand and has tremendous economic potential.

Development of High Dynamic Range (HDR) Capabilities of CID Sensors
Zoran Ninkov
Rochester Institute of Technology
Thermo Fisher Scientific

Charge Injection Device (CID) detector arrays are designed and fabricated with two capabilities not found in most competing technologies, namely random addressability and non-destructive readout (NDRO). This permits many novel readout modalities to be implemented that have not been explored. For example, the ability to segment an image after a rapid initial "guide" exposure into brightness level that then permits bright regions to be exposed, readout, reset and continue to be exposed multiple times while fainter regions are integrated for longer. This and other readout approaches depend on the stability of the addressing, reset and readout, which will be studied.

Preclinical Prototype Development of Transcranial Ultrasound Imaging Probe
Zeljko Ignjatovic
University of Rochester
Carestream Health

The goal of this research project is to establish and demonstrate a new ultrasound imaging paradigm involving ultrasound excitation frequencies well below those commonly used in standard clinical practice (e.g., ten times lower frequency) and excitation pulse shaping for the purpose of minimizing losses of ultrasound waves in adult human skull to allow brain tissue imaging at resolution and contrast ratios comparable to those of standard clinical ultrasound in soft tissue imaging (e.g., kidneys, liver, heart, …). In addition to tailoring the ultrasound array and excitation wave characteristics to maximize power transfer through skull bone, reduce heating effects, and maximize signal-to-noise ratio, the project will revolve around development and use of super-resolution algorithms based on regularized least-square estimation algorithms and machine learning approaches for the purpose of achieving resolution and contrast limits in TCUS that are comparable to those of standard clinical ultrasound systems operated at much higher frequencies for soft tissue imaging.

Artificial Intelligence RF Photonic Signal Classifier
Dr. Stefan Preble
Rochester Institute of Technology
L3Harris Technologies

The objective of this project will be to prove the feasibility of an RF signal classifier implemented using a photonic neural network. In this project, a photonic neural network (PNN) would be developed to classify RF signals at 3–30GHz. The goal would be to demonstrate that the PNN can correctly classify signals.

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.

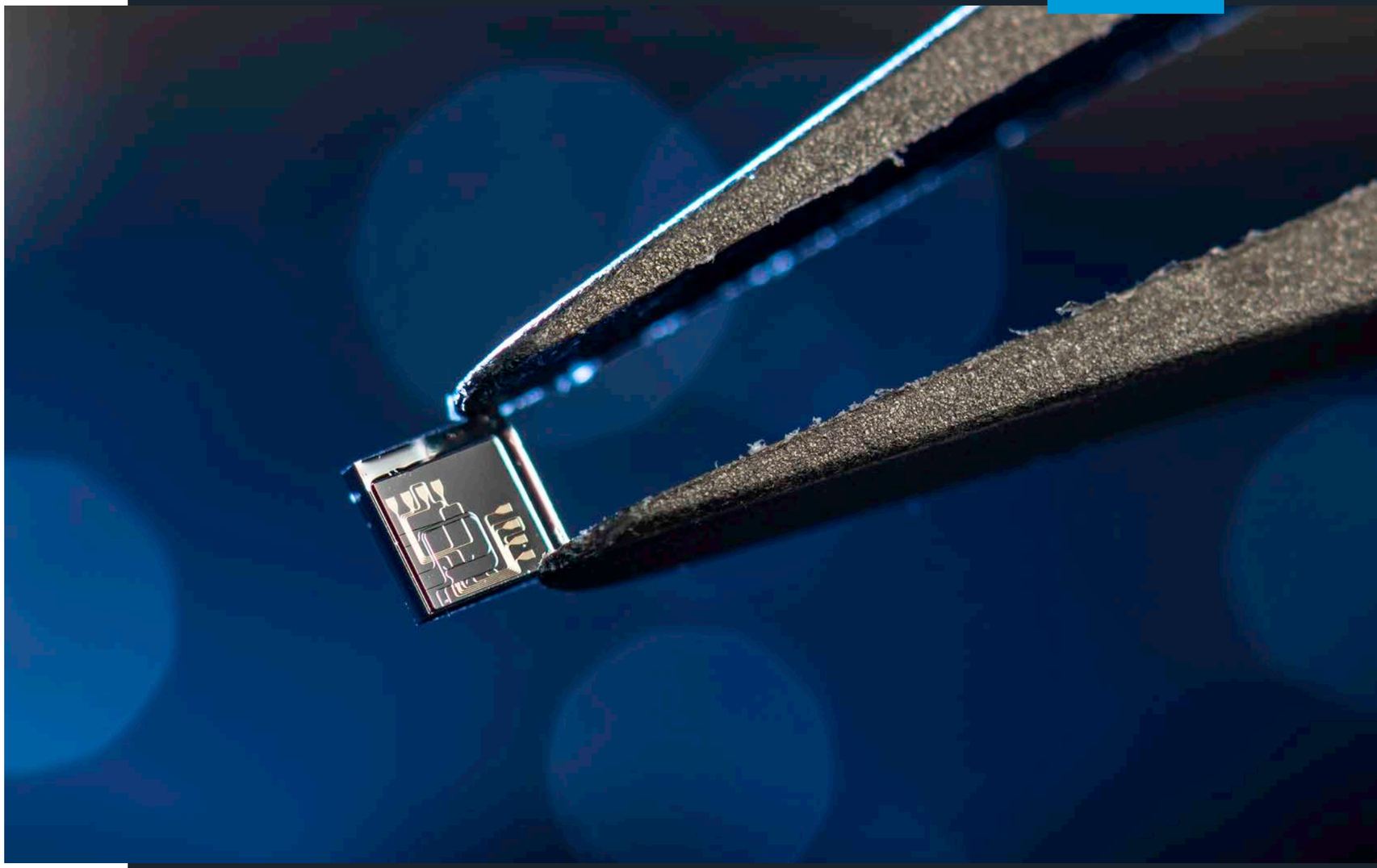
Techniques and methods for Gabor-domain optical coherence elastography
Jannick Rolland and Kevin Parker
University of Rochester
LighTopTech Corp.

A multi-modal instrument for simultaneous, noninvasive structural and functional assessment of biological environments will be developed. Coupling the high-definition imaging capability in 3-D of Gabor-domain optical coherence microscopy (GDOCM) with the capability of measuring elastic properties with elastography will yield unprecedented high-resolution functional imaging capability.

Advanced Manufacturing of Photonic Smart Coatings for Utility-Scale PV Applications
P. Scott Carney
University of Rochester
SunDensity Inc.

SunDensity Inc. offers a novel approach to improving the efficiency of any solar module with innovative additive manufacturing process thus accelerating the cost reduction of solar energy and making it universally affordable. The company has developed patent-pending photonic technology for maximizing the conversion of solar radiation into electric power with an innovative additive manufacturing process for large-scale deployment of photonic coating for PV applications.

PIONEERING A NEW WAY OF USING LIGHT IN AN INTERFEROMETER FOR EXTREMELY PRECISE MEASUREMENTS AND SENSING, PACKAGED ON A 1 MM BY 1 MM PHOTONIC CHIP



Future applications of integrated photonic chip research in the lab of Jaime Cardenas, an assistant professor of optics at the University of Rochester, could include more sensitive devices for measuring tiny flaws on mirrors, dispersion of pollutants in the atmosphere, and eventually quantum applications.

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.

Integrated optical frequency detection and weak value amplification
Jaime Cardenas
University of Rochester
AN Jordan Scientific, LLC

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's 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.

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

Developing a Brillouin Scattering Microscope to Quantify Mechanical Properties
Geunyoung Yoon
University of Rochester
Clerio Vision, Inc.

The 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.

Assessing the Ergonomic Design Aspects of DinamicOR Rack
Ehsan Rashedi
Rochester Institute of Technology
DinamicOR

Dinamic rack is designed to organize the operating room equipment to be accessed quickly and easily. The organizing task involves the physical demands majorly on the upper extremity and lower back of the body. Rochester Institute of Technology (RIT) will carry out an experimental study to assess the ergonomics aspects of the Dinamic rack vs. the current back table design, specifically by evaluating the postures of and loads on the upper body and lower back while the organizing/setup task is being performed. Further, RIT will quantify the performance of participants performing tasks between the two systems and also will gather participants' feedback/suggestions on design changes to facilitate the improvement of the product.

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.

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.

Physio-algorithms for LCOI's Physio science products
Raymond Ptucha
Rochester Institute of Technology
L&C Orthopedic & Innovation (LCOI)

The goal of the research is to provide portable, low-cost, accurate biomechanical analysis systems for individuals in the orthopedics, neurological, and sports performance area. The goal is to improve how individuals function, using automated software to guide rehabilitation, injury prevention, and improve sports performance. The first version of this system is presently available (http://lcorthopedicsinnovation.com/physioscience/) but lacks the desired accuracy for critical measures of the cervical spine (head and neck), foot, and ankle. By applying the latest in 2-D imaging and depth imaging from the Azure Kinect DK system combined with the latest advancements in machine learning and deep learning algorithms, the goals of this work will be achieved.

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, 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.

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Hui Wu
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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.

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Jannick Rolland and Kevin Parker
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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.

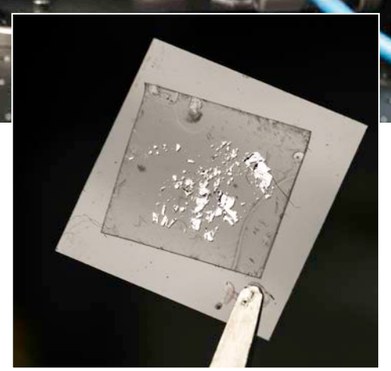
Image Processing for Optical Weld-Joint Failure Prediction
Drew Maywar
Rochester Institute of Technology
RAM Photonics

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

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. Inkjet 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.

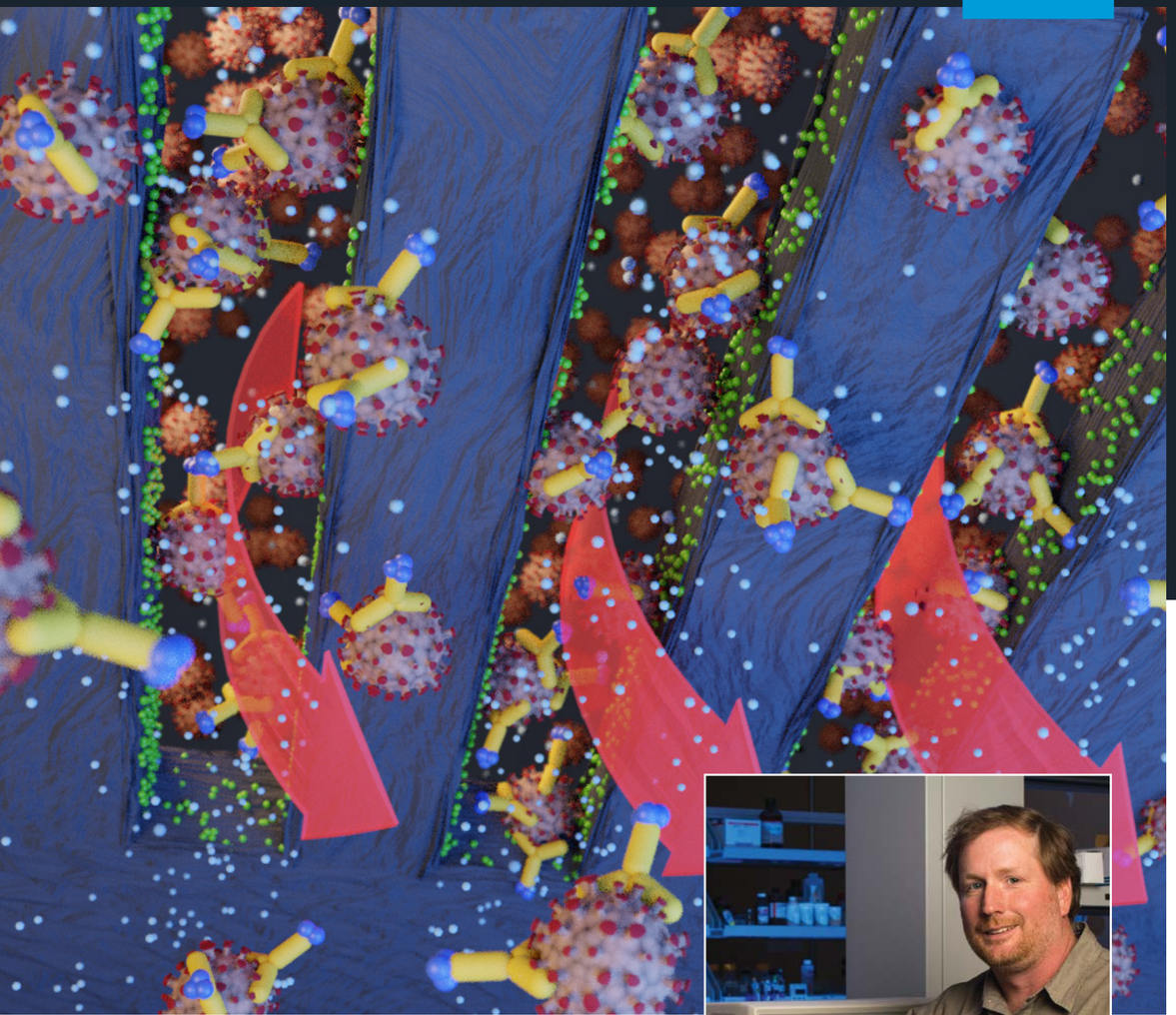
EXPLORING WAYS TO INTEGRATE NOVEL 2-D MATERIALS WITH TRADITIONAL SEMICONDUCTOR MATERIALS



Jesus Sanchez-Juarez, a PhD student in the lab of assistant professor of optics Jaime Cardenas, uses this approximately 1 cm x 1 cm sample of polydimethylsiloxane (PDMS) polymer film to perform a 2-D material exfoliation process.

CORPORATE PARTNERS

DEVELOPING A BIOMARKER DETECTOR SO THIN IT WOULD TAKE MORE THAN 1,000 STACKED ON TOP OF EACH OTHER TO EQUAL THE WIDTH OF A HUMAN HAIR



James McGrath, a professor of biomedical engineering at the University of Rochester and a cofounder of Rochester-based SiMPore Inc., in collaboration with SiMPore and the University of Ottawa, leads a team that is developing an inexpensive system using highly sensitive solid state nanopores to detect biomarkers of acute disorders.

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, and 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," they use femtosecond laser processing to etch proprietary nanostructures on materials. Their procedure doesn't coat the materials; instead it changes the intrinsic properties of the materials. Their topographies can change the color of titanium to blue, make silicon attract water, or even make water bounce off brass.

AN JORDAN SCIENTIFIC, LLC

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

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 our 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.

DINAMICOR
www.dinamicor.com

DinamicOR is a medical equipment manufacturer whose mission is to standardize operating room organization with an ergonomic and intuitive Workflow Management System—improving the efficiency and reproducibility of surgical processes, which will enable perioperative staff to focus on providing thoughtful patient care.

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.

IMAGINANT
www.imaginant.com

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

KITWARE
www.kitware.com

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

KODAK ALARIS
www.kodakalaris.com/en-us

We're a company born from one of the world's most iconic brands. A company that is passionate about using technology to transform organizations and improve people's lives across the planet. From our digital scanners and intelligent state-of-the-art software services that power some of the world's largest companies to our photographic paper production, printing kiosks, and suite of consumer apps that help people capture and connect with the emotional moments that define all our lives. We work behind the scenes, making the connections, pushing the boundaries of technology, and helping you to 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.

L&C ORTHOPEDIC & INNOVATION (LCOI)
www.lcorthopedicsinnovation.com

L&C Orthopedics & Innovation was founded in 2016 with a focus in bio-mechanical analysis of individuals in the orthopedics and sports performance world. Our goal is to use automated software to guide rehabilitation, prevent injuries, and improve sports performance to benefit individuals and clinics.

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.

NEW YORK SPACE GRANT/NASA/CORNELL UNIVERSITY
www.nyspacegrant.org

The NASA/New York Space Grant Consortium is a network of colleges, universities, and industry partners that work together to create a variety of opportunities and exposure for individuals in science, technology, engineering, and math (STEM) disciplines and NASA-specific initiatives. The National Space Grant College and Fellowship Program aims to support education and outreach of space-related research and events. The consortium aims to inspire, engage, and educate students in science, technology, engineering, and math (STEM) disciplines and to prepare the future STEM workforce for high-technology industries, particularly those located in the state of New York.

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.

PARVERIO
www.parverio.com/

Parverio was founded to address the rising containment known as microplastics. With our revolutionary technology, we aim to bring microplastic testing and awareness to concerned individuals everywhere.

PFIZER
www.pfizer.com

Pfizer Inc. is an American multinational pharmaceutical and biotechnology corporation in relentless pursuit of breakthroughs that change patients' lives. We innovate every day to make the world a healthier place. It was Charles Pfizer's vision at the beginning, and it holds true today.

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.

SEEQC, INC.
www.seeqc.com

SeeQC is developing the first digital quantum computing platform for global businesses. The company applies classical and quantum technology through digital readout and control technology and through a unique chip-scale architecture. SeeQC's quantum system provides the energy and cost efficiency, speed, and digital control required to make quantum computing useful and bring the first commercially scalable, problem-specific quantum computing applications to market. The company is one of the first companies to have built a superconductor multilayer commercial chip foundry and through this experience has the infrastructure in place for design, testing, and manufacturing of quantum-ready superconductors. SeeQC is a spin-out of **Hypres, Inc.,** the world's leading developer of superconductor electronics.

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.

SUNDENSITY INC.
www.sundensity.net

SunDensity Inc. produces photonic smart coatings (PSC) for utility solar power producers who need to reduce the cost of energy. Their nano-optical coating improves PV efficiency by downshifting UV rays for greater power output from solar modules, thus lowering overall power costs and accelerating solar energy adoption into the next generation of clean power.

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. We offer an unmatched combination of innovative technologies, purchasing convenience, and comprehensive support.

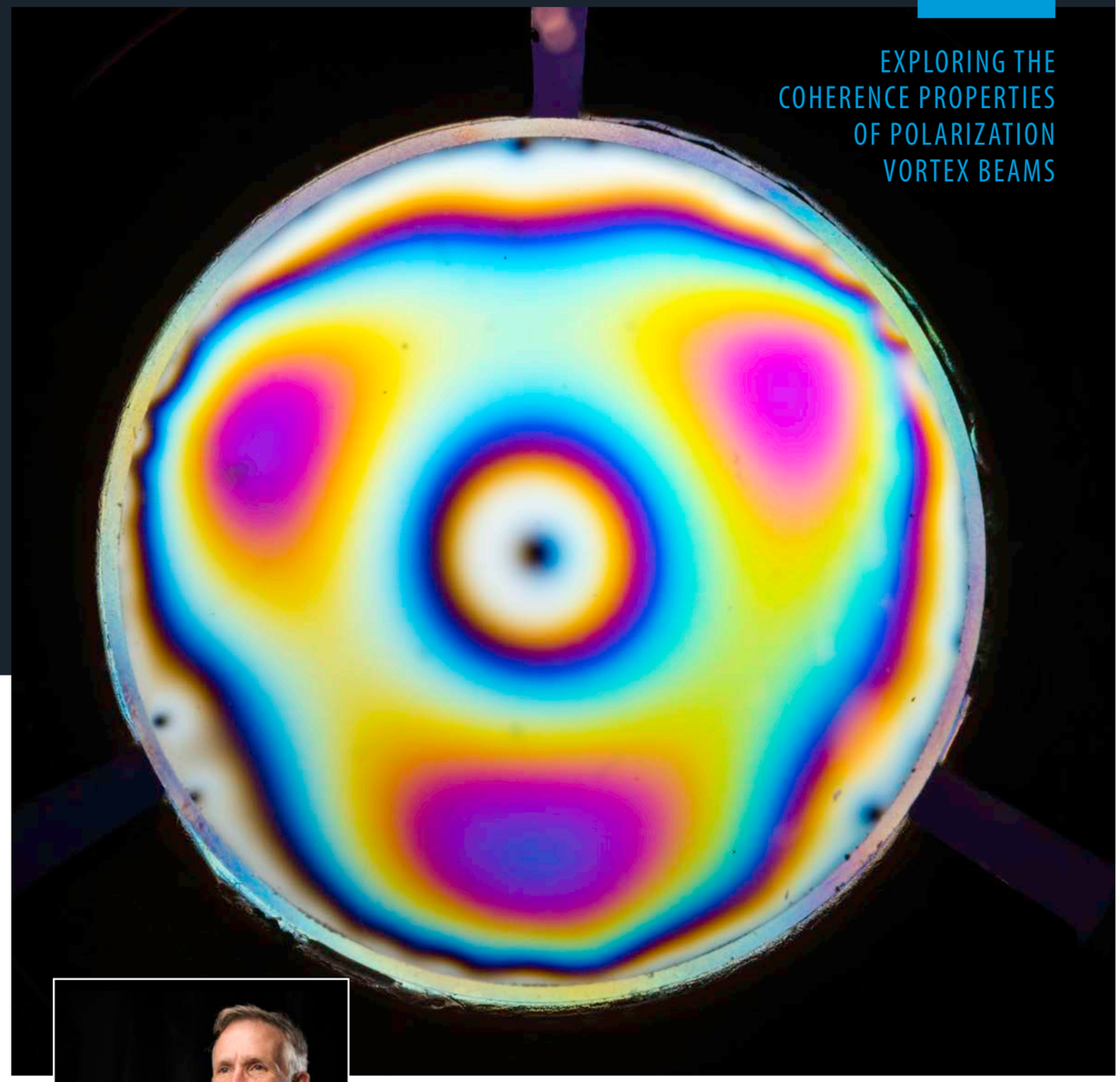
VISUALDX
www.visualdx.com

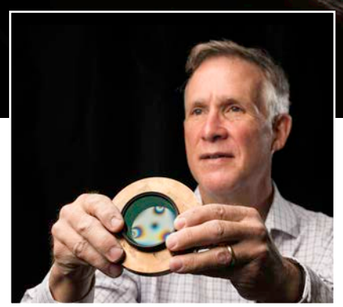
When unsure of a diagnosis, VisualDx is the go-to tool for fast, accurate decision making. Quickly build a differential to evaluate the possibilities, compare variations, and improve diagnostic accuracy at the point of care. VisualDx is the leader in clinical decision support, used in more than 1,500 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 sector. 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 for soldiers.

EXPLORING THE COHERENCE PROPERTIES OF POLARIZATION VORTEX BEAMS





The Institute of Optics director, Tom Brown, leads a group of researchers that explores the use of a real-time photopolymer exposure as an adaptive nulling reference to measure steep aspheres.

GOVIND AGRAWAL

James C. Wyant Professor of Optics, Professor of Physics, and Distinguished Scientist at the Laboratory for Laser Energetics, University of Rochester

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

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

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

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MARK BOCKO

Distinguished Professor of Electrical and Computer Engineering, Professor of Physics and 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

Mercer Brugler Distinguished Teaching Professor, Professor of Optics, and Director of the Institute 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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JAIME CARDENAS

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

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Education PhD, University of Rochester, Physics, 1999; BS, University of Illinois Urbana-Champaign, Engineering Physics, 1994

Research Interests Computed imaging, Spectroscopy, Coherence theory

Recent Research Projects Light scattering by plasmonic disks and holes arrays: different or the same?, Metal-Dielectric-Enhanced Upconversion: Going "Meso," clustering diffused-particle method for simulating electromagnetic fields among large ensembles of electromagnetically polarizable particles

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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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Professor of Ophthalmology and of Visual Sciences and Director of the Flaum Eye Institute, Associate Vice President for Health Sciences, 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

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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

Associate Dean for Education and New Initiatives, 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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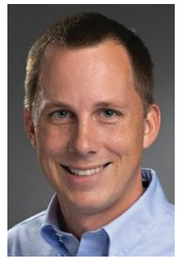
THOMAS GABORSKI



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 and Senior Scientist in the Laboratory for Laser Energetics, 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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MICHAEL HEILEMANN

Assistant Professor of Electrical and Computer Engineering, University of Rochester

Education PhD, University of Rochester, Electrical Engineering, 2018; MS, University of Rochester, Electrical Engineering, 2015; BS, Canisius College, Physics, 2013

Research Interests Structural acoustics and vibration, Loudspeaker design, Audio signal processing perception, Spatial audio

Recent Research Projects Measures of vibrational localization on point-driven flat-panel loudspeakers, The evolution and design of flat-panel loudspeakers for audio reproduction, Near-field object-based audio rendering on flat-panel displays

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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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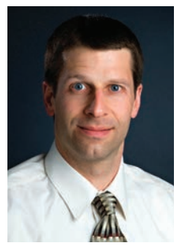
KARL HIRSCHMAN



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

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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

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Education PhD, Imaging Science, Rochester Institute of Technology, 2005; MS, Imaging Science, Rochester Institute of Technology, 1999; BS, Imaging Science, Rochester Institute of Technology, 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

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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 and of Physics and in the Center for Visual Science, Professor of Materials Science, Distinguished Scientist in the Laboratory for Laser Energetics, 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 and Mechanical Engineering, Academic Director of the Center for Medical Technology and Innovation, Center for Musculoskeletal Research, University of Rochester

Education PhD, Mechanical Engineering, University of Michigan, 1996; BS, Mechanical Engineering, University of Delaware, 1990; BS, Textile Science, 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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Albert Arendt Hopeman Professor of Engineering, 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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JOHN MARCIANTE

Associate Professor of Optics, Laser and Photonic Systems Group, University of Rochester

Education PhD, University of Rochester, Optics, 1997; MS, University of Rochester, Optics 1992; BS, University of Illinois at Urbana–Champaign, Engineering Physics, 1991

Research Interests Large-mode area fibers, High-efficiency high-power fiber lasers and amplifiers, High-power ultrafast fiber lasers, Fiber lasers at exotics wavelengths, Brightness improvement of high-power semiconductor lasers, Power scaling/beam combining of fiber and semiconductor lasers

Recent Research Projects Review of ultrafast fiber oscillators based on Mamyshev and dissipative soliton resonance mechanisms, Observations of spatial coherence collapse in high-power, broad-area lasers using fiber-assisted self-heterodyning

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SUSANA MARCOS

Nicholas George Professor of Optics and the David R. Williams Director of the Center for Visual Science

Education PhD, University of Salamanca, Physics, 1996; MS, University of Salamanca, Physics, 1992; BS, University of Salamanca

Research Interests Visual optics, Ocular imaging

Recent Research Projects Functional integration of eye tissues and refractive eye development mechanisms and pathways, Vision with spatial light modulator simulating multifocal contact lenses in an adaptive optics system, Simulating outcomes of cataract surgery: important advances in ophthalmology

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DREW MAYWAR

Professor of Electrical, Computer, and Telecommunications Engineering Technology, Rochester Institute of Technology

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

Research Interests Fiber-optic communication 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 induces vibration of brachytherapy seeds

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

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JAMES MCGRATH

Professor of Biomedical Engineering, University of Rochester

Education PhD, Division of Health Sciences and Technology, Harvard/MIT, 1998; MS, Massachusetts Institute of Technology, Mechanical Engineering, 1994; BS, Arizona State University, Mechanical Engineering, 1991

Research Interests Nanoparticle and molecular separations, Nanotechnology, MEMS and micro fabrication, Cell culture technologies, Biological tissue models, Small format hemodialysis, Biosensors, Electrokinectic devices

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

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Dean's Professor of Dermatology, Professor of Optics, 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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Education PhD, Electrical Engineering, Biomedical Concentration, Massachusetts Institute of Technology, 1981;MS, Electrical Engineering, Massachusetts Institute of Technology, 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, The blue noise mask, The development of sonoelastography, The development of crawling waves, Tissue biomechanics and the microchannel flow model, The H-scan for identification of scatterers, The reverberant shear wave fields, The needle pulse, OCT elastography, Enhanced resolution, Advanced 3D-4D analytics, The new view of tissue scattering

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JUDITH PIPHER

Professor Emeritus of Physics and Astronomy, University of Rochester

Education PhD, Astronomy, Cornell University, 1971; MS, Astronomy, Cornell University, 1970; BS, Physics and Astronomy, University of Toronto, 1962

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

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

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Professor in the Kate Gleason College of Engineering, Rochester Institute of Technology

Education PhD, Cornell University, Electrical and Computer Engineering, 2007; BS, Rochester Institute of Technology, Electrical Engineering, 2002

Research Interests Silicon photonics, Quantum optics

Recent Research Projects Integrated quantum photonics for photon-ion entanglement, System, device and method for aligning and attaching optical fibers, High extinction ratio microring modulator, Highly-confined, low-loss visible photonics using foundry-fabricated silicon nitride circuits

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RAYMOND PTUCHA

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

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

Recent Research Projects Computer vision algorithms for portable vision diagnostic device

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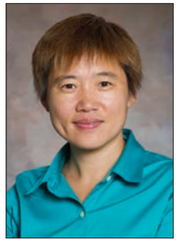

Associate Professor of Imaging Science, Rochester Institute of Technology

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

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

Recent Research Projects 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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Research Interests Theoretical and application-oriented research topics covering several aspects within the fields of ergonomics, biomechanics, work physiology, safety, and rehabilitation

Recent Research Projects Lumbar time-varying muscle synergies in trunk flexion and bending movements at different velocities, A systematic review of fall risk factors in stroke survivors toward improved assessment platforms and protocols, Abstract TP61: Can a single motion sensor identify lower limb movement alterations among stroke survivors?

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

Research Interests Optical system design for imaging and non-imaging 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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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, Digital image processing and computer vision

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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 health care solutions, Stochastic modeling and optimization, Design of novel techniques to facilitate the development and diffusion of smart and connected health care solutions

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

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NICK VAMIVAKAS

Professor of Quantum Optics and Quantum Physics, University of Rochester

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

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

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

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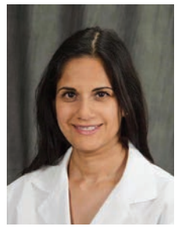

Clinical Assistant Professor of Ophthalmology, University of Rochester

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

Research Interests Contact lenses, Lens solution, Ophthalmic drops

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

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Education PhD, Electrical Engineering, California Institute of Technology, 2003; MS, Microelectronics, Tsinghua University, Beijing, 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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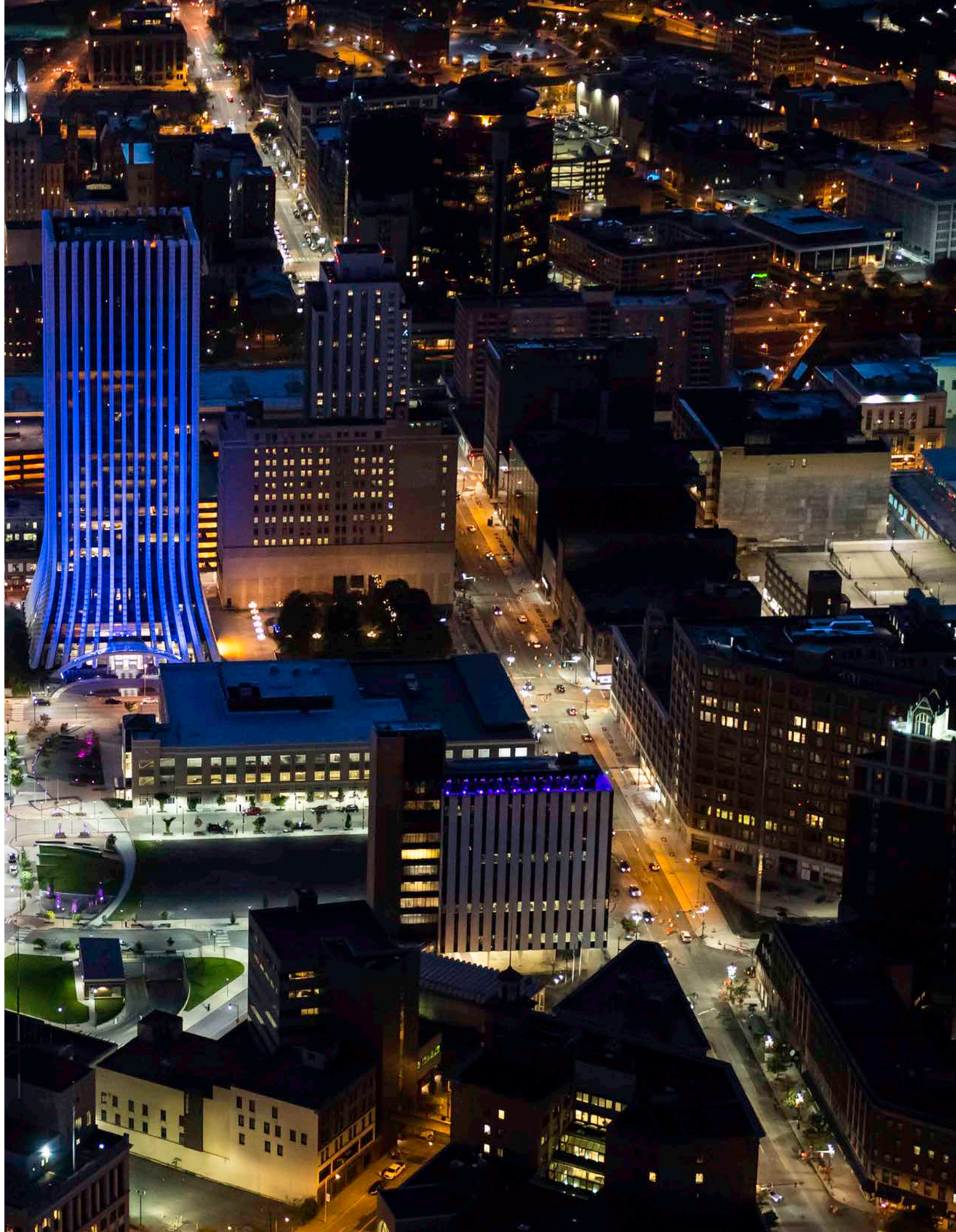
New York has hundreds of optics, photonics, and imaging companies clustered into active regional collaborations. These regions are home to abundant organizations and companies that can deliver complete R&D, engineering, and manufacturing capabilities, providing entrepreneurial vision combined with next-edge research. This map shows the entities—from public and private universities to corporations and governmental agencies—involved in the New York Photonics initiative.



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