The first-ever Light and Sound Interactive (LSI) event, a three-day conference, expo, and career fair focused on light- and sound-based technologies and their applications, took place September 12 to 14, 2017, in downtown Rochester.
fastest-growing industries in the world, such as augmented and virtual reality, imaging, photonics, and emerging health care applications, to name a few. The LSI event showcases the remarkable assets that our region possesses in light- and sound-based technologies, and it attracts the best in the world of light- and sound-based technologies and their creative applications to Rochester for an exciting and inspiring multiday celebration and get-together. One primary goal of LSI is to bring the community together and build excitement in the Rochester region about the many opportunities for light- and sound-based technologies and their applications and ultimately to grow our existing companies and to inspire the creation of new ventures. The other goal of LSI is to attract the major technology companies to our region to witness the unmatched technical and creative capabilities of our regional industry-university fabric and ultimately to inspire them to bring business and expand their operations into our region. The inaugural LSI event was a huge success, with more than 1,000 attendees over the 2-1/2 day program, which encompassed more than 75 talks, panel discussions, demonstrations, a trade-show, and off-site events at our local museums and universities. We are deeply indebted and grateful for the generous donation of time and treasure by many from the Rochester community, local industry, the University of Rochester, and Rochester Institute of Technology. The great news is that we will continue to hold LSI as an annual event, with LSI 2018 scheduled for September 12–14, 2018. Hold the date!

As always, we would like to thank our dedicated and talented staff at CEIS. Everything we accomplish is because of their hard work and dedication to the CEIS mission. This includes our CEIS business manager, Cathy Adams; our CEIS administrative assistant, Margaret Urzetta; and our student program assistants: Nick Drogo, Vitumbiko Kambilonje, Anya Khalid, Jake Mitchell, Oliver Ostriker, and Andrew RypeLAJ.

Sincerely,

Mark F. Bocko, Director

Paul H. Ballentine, Executive Director

We’re pleased to present our latest CEIS annual report and to take this opportunity to bring you up to date about some of the exciting developments and new initiatives in CEIS over the past year.

There are many bright spots to highlight from the past year as we continue our central mission of encouraging economic development through university-industry research collaboration. For example, in work with Harris Corporation, a University of Rochester and IGC Consulting Group developed a portable Terahertz camera employing readily available silicon chip technology that can “see” through plastics, cardboard, and even clothing, to detect metal objects or explosive materials and make airport security screening much faster and accurate. In another project, University of Rochester researchers developing freeform optics are collaborating with Oculus on technologies that will enable the next generation of highly augmented and virtual reality, imaging, photonics, and emerging health care applications, to name a few. The LSI event showcases the remarkable assets that our region possesses in light- and sound-based technologies, and it attracts the best in the world of light- and sound-based technologies and their creative applications to Rochester for an exciting and inspiring multiday celebration and get-together. One primary goal of LSI is to bring the community together and build excitement in the Rochester region about the many opportunities for light- and sound-based technologies and their applications and ultimately to grow our existing companies and to inspire the creation of new ventures. The other goal of LSI is to attract the major technology companies to our region to witness the unmatched technical and creative capabilities of our regional industry-university fabric and ultimately to inspire them to bring business and expand their operations into our region. The inaugural LSI event was a huge success, with more than 1,000 attendees over the 2-1/2 day program, which encompassed more than 75 talks, panel discussions, demonstrations, a trade-show, and off-site events at our local museums and universities. We are deeply indebted and grateful for the generous donation of time and treasure by many from the Rochester community, local industry, the University of Rochester, and Rochester Institute of Technology. The great news is that we will continue to hold LSI as an annual event, with LSI 2018 scheduled for September 12–14, 2018. Hold the date!

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CEIS ADVISORY BOARD
CEIS leadership meets with the advisory board to develop action-oriented plans to keep innovative technologies in the pipeline, connecting academic research with corporate product development. CEIS acknowledges and applauds its advisory board members for their leadership, expertise, and forward-thinking ideas.

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

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Chair

Ian Cox
I2C Consulting Group

Bob Fiete
Harris Corporation

E llen Kousik-Williams
Carnegie, Inc.

Ryne Raffaelle
Rochester Institute of Technology

Ed White
AIM Photonics

Barry Silverstein
Oculus

Paul Ballentine

Mark F. Bocko

Oliver Ostriker

Anya Khalid

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THE OPI CLUSTER

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

OUTREACH AND FEDERAL INITIATIVES

In addition to supporting industry/university collaboration by funding their research endeavors, CEIS has continued to promote economic development through a number of outreach activities and federal grants.

Our industry outreach included sponsoring the Veterans Business Council’s annual Veterans Expo last October; hosting the University Technology Showcase in April; and having representation at the RBJ’s Power Breakfast event “Rochester’s Photonics Future” with other distinguished regional panelists.

Our American Manufacturing Jobs & Innovation Accelerator (AMJAC) grant, the Rochester Regional Optics, Photonics & Imaging Accelerator (RRPA), concluded in November 2016. Through an approved yearlong no-cost extension, CEIS was able to continue work supported through the DOL/ETA portion to aid local companies and individuals with training geared toward the OPI cluster. Although no classes at RIT or University of Rochester sites were offered, we continued to survey the participants of those classes. The responses revealed that the participants felt they received valuable information, and they were complimentary of their instructors. CEIS also partnered with FAME for a portion of the AMJAC funds, which allowed FAME to place 23 individuals in training programs at local OPI-related companies. All the candidates who completed the training program were offered a position at the company where they trained. In addition, the ETA grant supported efforts at three local small optics and imaging companies. One grateful company representative offered, “This training was geared toward our particular machines and products; however, the skills learned through this training would absolutely be applicable in other employment settings. These are skills which have enhanced the knowledge and employability of the trainees.” Our second federal grant from NIST under the AMTech (Advanced Manufacturing Technology Consortia) program—National Technology Roadmap for Photonics (NTRP) ran from June 2014 through May 2017. The NTRP activities allowed CEIS to collaborate with stakeholders to bring AIM Photonics to Rochester and in identifying collaborations in advanced optics manufacturing, lasers, and the intersection of data science and imaging.

To this end, CEIS, the University of Rochester, and RIT teamed up with community leaders and local industry to organize a new conference called Light and Sound Interactive (LSI). LSI is modeled after the South by Southwest Interactive Conference in Austin, Texas. The inaugural LSI occurred September 12–14, 2017. The event showcased the remarkable assets that our region possesses in light- and sound-based technologies. Its success has energized organizers to move forward in planning the 2018 LSI event.

Our other commitments to the region’s OPI cluster included Paul Ballentine co-leading the Finger Lakes Regional Economic Development Council’s OPI Work Group and identifying viable projects for funding under the Upstate Revitalization Initiative.

As federal support for CEIS programs ends, we will continue to explore synergistic opportunities to leverage state, federal, and community resources to further our economic development mission.

SUPPORTERS

The important work of CEIS is supported by a number of governmental agencies and economic development partners, listed here in alphabetical order.

AMJAC ETA PROGRAM RESULTS

FAME/5% Pledge
23 trainees: 34% women, 30% minority, 13% veterans; if completed, 100% offered a position

Company Workforce Training
27 trainees. Advanced Imaging: 50% minority; JML Optical: 28% minority; Optima: no detail on 16 trainees

Institute of Optics Summer School
53 trainees: 17% women, 17% minority, 7% veterans; 34% found employment or advanced career

RIT Continuing Education Courses
69 trainees: 22% women, 17% minority, 10 veterans; 20% found employment or advanced career

AMTECH NTRP DATA GATHERING

70% of New York State’s 245 OPI companies have <100 employees

Since 2010, the 6 largest companies shed 35% of their employees; 123 of the smaller companies increased their workforce by 45%

OPI-related Companies
245 statewide, including 130 in Finger Lakes region; 53 of 130 are optics related, while 35 of 130 are imaging companies
For the fiscal year July 1, 2016, to June 30, 2017, the total documented dollar value of the economic impact of CEIS–supported research and outreach was more than $87 million. This self-reported data (new and retained jobs, increased sales, cost savings, capital investments, and additional funds acquired) from 18 of our partners provides a snapshot of the region’s economic successes.

A shout out to Clerio Vision; the local start-up company reported 7 new jobs and 6 retained jobs, along with over $3 million in non-job impacts. Special recognition to OptiPro Systems as well, who reported 9 new jobs and 11 retained jobs, along with $2.7 million in non-job impact. Last, but not least, the AIM Photonics initiative led the way in non-job impacts, reporting a whopping $72 million in monetary impacts.

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FIVE-YEAR SUMMARY OF ECONOMIC IMPACT

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<tbody>
<tr>
<td>Increased Revenues</td>
<td>$22,058,613</td>
<td>$20,816,657</td>
<td>$22,584,794</td>
<td>$18,635,000</td>
<td>$1,276,127</td>
<td>$85,335,191</td>
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<td>Cost Savings</td>
<td>$3,146,200</td>
<td>$6,276,553</td>
<td>$1,999,100</td>
<td>$9,327,488</td>
<td>$4,586,060</td>
<td>$19,925,401</td>
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<td>Funds Acquired</td>
<td>$7,380,774</td>
<td>$5,103,808</td>
<td>$6,050,728</td>
<td>$581,269,321</td>
<td>$77,548,500</td>
<td>$177,333,123</td>
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<td>Capital Improvements</td>
<td>$679,000</td>
<td>$792,806</td>
<td>$263,421</td>
<td>$204,549</td>
<td>$133,000</td>
<td>$2,052,776</td>
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<td>Job Value</td>
<td>$4,921,362</td>
<td>$4,245,605</td>
<td>$2,944,601</td>
<td>$6,106,332</td>
<td>$4,075,292</td>
<td>$22,293,192</td>
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<tr>
<td>New Jobs</td>
<td>28.35</td>
<td>21</td>
<td>20</td>
<td>61</td>
<td>37.75</td>
<td>168</td>
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<tr>
<td>Retained Jobs</td>
<td>43</td>
<td>46</td>
<td>26</td>
<td>24</td>
<td>21.5</td>
<td>161</td>
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<tr>
<td>Total Impact</td>
<td>$38,185,949</td>
<td>$35,235,429</td>
<td>$35,796,636</td>
<td>$110,142,690</td>
<td>$87,598,979</td>
<td>$306,959,683</td>
</tr>
<tr>
<td>Total Cumulative Impact</td>
<td>$38,185,949</td>
<td>$73,421,378</td>
<td>$109,218,014</td>
<td>$219,360,704</td>
<td>$306,959,683</td>
<td>$306,959,683</td>
</tr>
</tbody>
</table>

**ECONOMIC IMPACT**

**TOTAL CUMULATIVE ECONOMIC IMPACT**

**FIVE-YEAR ECONOMIC IMPACT**

**CAT PROGRAM FINANCIAL INFORMATION**

**COMPANIES REPORTING ECONOMIC IMPACT IN 2016–17 FROM CEIS INTERACTIONS**

**FUNDING FROM NYSTAR**

- Research Expenditures
  - Personnel Related: $279,617
  - Non-Personnel Related: $192,504
- Operational Expenditures
  - Personnel Related: $297,775
  - Non-Personnel Related: $157,389
- Total NYSTAR Contribution: $927,285

**OTHER SOURCES OF FUNDS**

- Cash from Companies
  - Personnel Related: $1,233,854
  - Non-Personnel Related: $579,062
- Other Contributions
  - Personnel Related: $0
  - Non-Personnel Related: $0
- Total Other Sources: $1,811,916

**Companies Reporting Economic Impact in 2016–17 From CEIS Interactions**

- AIM Photonics
- AlchLight
- Bausch + Lomb
- Carestream
- Clerio Vision, Inc.
- Corning, Incorporated
- Harris Space & Intelligence Systems
- Harris RF Communications
- HYPRES
- Kitware
- Kodak Alaris
- LightTopTech Corporation
- OptiPro Systems, LLC
- Ovitz Corporation
- SIMPore, Inc.
- Thermo Fisher Scientific
- UR Ventures Technology Development Fund
- visualDx
A YEAR IN REVIEW

AUGUST 2016

FuzeHub announces the Jeff Lawrence Manufacturing Innovation Fund. This program will stimulate growth in the manufacturing sector within New York State. The fund plans to award successful applicants with grants ranging from $25,000 to $75,000 every quarter.

SEPTEMBER 2016

Carestream Health, Inc. wins a $150 million federal contract to provide a digital imaging system for the U.S. armed services. Awarded by the Defense Logistics Agency, the contract calls for Carestream to supply, service, and maintain digital imaging equipment, a picture archiving system, and a communication system for the Army, Navy, Air Force, Marine Corps, and some service-related civilian agencies.

Carestream Health, Inc., a leader in medical and dental imaging, and an interdisciplinary team of University researchers (Departments of Surgery, Biomedical Engineering, Electrical and Computer Engineering) begin collaborating on developing new technologies to expand the use of ultrasound imaging for medical diagnosis. Projects jointly supported by the technologies to expand the use of ultrasound imaging for medical diagnosis. Projects jointly supported by the Biomedical Engineering, Electrical and Computer Engineering) begin collaborating on developing new manufacturing facility. The TAP facility is located near 50 acres of developable industrial land.

FEBRUARY 2017

Eastman Business Park selected as the home of the new AIM Photonics Test, Assembly and Packaging (TAP) manufacturing facility. The TAP facility is located near 50 acres of developable industrial land.

FEBRUARY 2017

CEIS director and executive director begin planning for inaugural Light & Sound Interactive conference to be held in downtown Rochester in September 2017.

FEBRUARY 2017

Cardiac Technologies Inc. launched QHire, a platform that supports the growing need for electronic clinical outcome assessment services, known as eCOA, in drug development. The platform delivers the shortest and most streamlined study configuration and start-up in the industry.

OCTOBER 2016

RIT hosts NYSTAR’s Annual Partners Meeting. Panel discussions over the two-day event included public-private partnerships that are investing in manufacturing innovation and barriers/opportunities to boost commercialization. Lightning Rounds featured an asset from each NYSTAR program. CEIS Director Mark Bocko’s presentation of the flat-panel speaker he has been working on was a big hit.

JANUARY 2017

OptiPro Systems LLC received the 2016 Tibbetts Award for its achievements in innovation and job creation as a participant in the federal Small Business Innovation Research program. The Ontario, Wayne County–based company was among 37 U.S. businesses to receive the award, presented during a White House ceremony.

JANUARY 2017

QPoint, a platform that supports the growing need for electronic clinical outcome assessment services, known as eCOA, in drug development. The platform delivers the shortest and most streamlined study configuration and start-up in the industry.

JANUARY 2017

CEIS director and executive director begin planning for inaugural Light & Sound Interactive conference to be held in downtown Rochester in September 2017.

FEBRUARY 2017

CEIS hosted a joint meeting with ESVD’s Strategic Business and NYSTAR divisions to identify synergies/assets among the state’s CATs and CoEs that would be leveraged when courting companies to locate in New York State.

APRIL 2017


APRIL 2017

Bob Fiete, chief technologist of Harris Corporation Space and Intelligence Systems, and Paul Travens, president and CEO of Vuzix, were the featured speakers at the CEIS Annual University Technology Showcase. The Partner Appreciation Award was presented to Dan Newman of Harris Corporation to recognize him for his role in the continued collaboration with Harris, the University of Rochester, and RIT. Strong Zhou of RIT won the poster contest for her entry “Erythrocytes Are Oxygen-Sensing Regulators of the Cerebral Microcirculation.”

MAY 2017

SiMPore successfully applied for a Phase II STTR from the NSF. They will be pursuing further development of membrane technology for blood dialysis. SiMPore is attempting to develop a miniaturized, continuously operating hemodialysis system incorporating SiMPore’s membranes.

JUNE 2017

CEIS awarded more than $525,000 in 2017–18 CAT projects with 29 faculty researchers and 14 New York State companies, including 6 new faculty researchers and 4 new company partners.
2017–2018 PROJECT ABSTRACTS

Development of Novel Topical Antimicrobial Therapeutics
Paul Dunman
University of Rochester Arcum Therapeutics, Inc.

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

Understanding On Eye Performance of Presbyopia Correcting Contact Lens
Geunyoung Yoon
University of Rochester Bausch and Lomb

Presbyopia is a visual condition faced by all adults over the age of approximately 40. Individuals with presbyopia lose the ability to focus on nearby objects, which significantly impacts quality of life. Although extending depth of focus via a multifocal contact lens to overcome presbyopia is increasingly popular, clinical outcomes with these lenses are variable and often unpredictable. A better understanding of the role of practical factors when a multifocal lens is worn by patients improves our ability to predict its performance and moreover to develop advanced designs.

The project is aimed toward the evaluation of through-focus performance of multifocal contact lenses designs in which these realistic factors such as decentration and conformation of presbyopia-correcting contact lenses imaged by a real-time pupil camera and high-resolution optical coherence tomography.

Mathematical Model and Computer Simulation of the Motion of a Toroidal Contact Lens
Kara L. Maki, David Ross
Rochester Institute of Technology Bausch and Lomb

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

Compressive Beamforming for Portable Ultrasound
Zeljko Ignjatovic
University of Rochester Carestream Health, Inc.

We propose a compressive parallel-beamforming ultrasound imaging method that is a dramatic departure from conventional approaches and has the potential to disrupt the state of the art in ultrasound imaging. Rather than using an expensive linear array with hundreds of transducer elements and associated electronics, the new method eliminates the expensive electronic components (amplifiers, A/D and D/A converters) connected to each element of the array and replaces them with a single channel that is shared by the entire array, to significantly reduce array complexity and allow genuinely portable implementations. The proposed system uses unfocused imaging of the target medium via a binary-coded aperture, which gives much improved spatial resolution and reduces the sidelobe artifacts commonly seen in traditional ultrasound systems, and allows a significant 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.

Deep Learning for High-Resolution 3D Cone Beam CT Medical Image Analyses
Jiebo Luo
University of Rochester Carestream Health, Inc.

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

Towards Automated Clinical Evaluation of Tendon Through Shear Wave Elastography
Stephen McAlavey, Mark Buckley
University of Rochester Carestream Health, Inc.

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

ABSTRACTS

Graduate student Sarah Wayson works in the lab of Diane Dailey to develop and implement high-frequency quantitative ultrasound imaging of a collagen gel.
Plane Wave and Elastographic Imaging of AAA and Carotid Arteries
Michael S. Richards
University of Rochester
Carestream Health, Inc.

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

Assessing the Link Between Refractive Change and Mechanical Properties in ICRS Contact Lenses
Paul Funkenbusch
University of Rochester
Clio Vision Inc.

Our long-term goal is to use femtosecond micromachining to customize refractive corrections in human eyes, be it in the cornea and intra-ocular lenses (IOLs). The proposed experiments will investigate new regimes of low repetition rate (10-40 MHz), wavelengths of 1064 nm and 532 nm, and high-power scaling (<10W) to achieve ultrafast writing speeds in epithelial materials such as hydrogels and cornea.

Biological Impact of LIBIC in the Cornea
Krystl R. Hudkin
University of Rochester
Clerio Vision Inc.

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

Computer Modeling of Telecom Signals in Multimode Optical Fibers
Giovanni Pradella
University of Rochester
Corning Incorporated

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

Efficacy of Visual Training for Recovering Sight in Stroke Patients
Steven Feldon
University of Rochester
Envision Solutions LLC

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

Light-Diffusing Fiber as a Disinfectant and/or Antimicrobial Agent
Paul Dunman
University of Rochester
Harris Corporation

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

High Power Femtosecond Ytterbium-Doped Fiber Laser-based System for Optimization of Femtosecond Micromachining Ophthalmic Devices
Wayne H. Knox
University of Rochester
Clerio Vision Inc.

Our ultimate goal is to use femtosecond micromachining as a non-damaging method of custom-correcting refractive error in human cornea and intra-ocular lenses (IOLs). The proposed experiments will investigate new regimes of low repetition rate (10-40 MHz), wavelengths of 1064 nm and 532 nm, and high-power scaling (<10W) to achieve ultrafast writing speeds in epithelial materials such as hydrogels and cornea.

Support for Distributed Computing and Network Management in Mobile A
Wendi Heinzelman
University of Rochester
Harris Corporation

Performing communication and computation in an ad hoc network of mobile devices is challenging yet critical for next-generation military networks. Not only must we ensure that data can be securely communicated where it is needed, when it is needed, even in the face of network dynamics, but we must also ensure that computation can be accomplished quickly using available resources within the network. The goal of this research is to develop technologies and approaches for achieving robust data connections in heterogeneous network platforms using a mixture of ad hoc and hierarchal networks. Techniques that will be investigated include combining the advantages of both ad hoc and hierarchical approaches, and on conducting the necessary experiments.

Further Development of THz Imager Array in Support of Harris’ Commercial THz Imaging Development
Zafar Iqbal
University of Rochester
Envision Solutions LLC

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

Developing THz Detector Technology for Inspection Applications
Zoran Ninkov
University of Rochester
Harris Space and Intelligence Systems

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

Further Development of THz Detector Arrays and Extension to the IR
Judith L. Pipher
University of Rochester
Harris Space and Intelligence Systems

In collaboration with RTI Pirkov, ECE PI Iqtagovic, and Harris Space and Intelligence Systems, our group has in past years been developing THz and long-wave IR arrays exploiting thermal emission in CMOS 0.15µm. Currenty, generation 6 designs have been submitted to MOSIS foundation by the ECE group, the first of “smart” chips with memory, an A/D converter and S/H circuitry on-chip. We will concentrating on noise reduction of the more recent generation chip deliverables, IR characterization of the ~10 micron devices, and on continuing the necessary experiments on the new Gen 6 arrays. Our group specializes in array technology and measurement. We will obtain array data after finding the optimal values of Vgs for each of the 90 pixels in the THz 6 array, saving them to memory, and operating the array with optimum Vgs for the purposes of imaging. We have already developed routines to determine noise characteristics, dark current and quantum efficiency as well as other salient parameters.

Smart Sensors for Classical and Quantum Data Links
Roman Dalmazio
University of Rochester
HYPER Inc.

The project is devoted to development of novel optical smart sensors, based on superconducting single photon detectors (SSPDs) integrated with the Josephson junction-based mixed signal circuits to provide readout, tuning, and control of the detector. These digitally assisted detectors will have performance characteristics far surpassing those of the traditional, analogue-type SSPDs and will exceed their scalability to larger SSPD arrays. We will target high-value applications in quantum networks for quantum information applications, including high data rate quantum key distribution. We will also pursue SSPD applications in interface optics with digital superconductor-electronic and studies of novel SSPDs based on superconductors/forniometric nanobolier strips.
**2017–2018 Project Abstracts**

**High-Frequency Quantitative Ultrasound Systems for Tissue Engineering**

Diane Dalecki, Denise Hocking
University of Rochester
Inimagin

Technologies for monitoring engineered tissues quantitatively are critically needed to advance the field of tissue engineering. The overall goal of this project is to develop and implement high-frequency quantitative ultrasound systems for nondestructive characterization of engineered tissue constructs.

These ultrasound technologies will (i) provide important quantitative tools for monitoring the functionality of tissue engineered products, (ii) offer rapid feedback for optimizing construct design and fabrication parameters, and importantly (iii) circumvent destructive testing. Inimagin is a world leader in high-frequency, nondestructive ultrasound instrumentation. This project will unite experts in biomedical ultrasound and tissue engineering (Dalecki and Hocking) with Inimagin’s technical expertise.

**Nondestructive/Noninvasive Three-Dimensional Imaging with Gabor-domain Jannick Rolland**

University of Rochester
LightSight Corporation

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

**Global Surveillance Augmentation for Deep Learning**

Andreas Savakis, John Kerekes
Rochester Institute of Technology
Kidware Inc.

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

**Electrical Monitoring of Exosome Capture on Nanomembranes**

James McGrath
University of Rochester
Swire Inc.

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

**Development of Quantum Dot Coated Detector Arrays**

Zoran Mrkwić
Rochester Institute of Technology
Thermo Fisher Scientific

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

**In Vivo Photoacoustic and Ultrasound Imaging Probe for Human Thyroid Cancer Detection**

Jonathan D. Ellis, Vikram Dogra
University of Rochester
Navalguard Rao
Rochester Institute of Technology
LIF Ventures

The scientific hypothesis is photoacoustic imaging can classify thyroid cancer from non-cancer. We are developing an innovative acousto-lens based photoacoustic imaging (PAI) system combined with ultrasound (US), to yield real-time co-registered photoacoustic (PA) and US frontal plane images. Data was collected on in-vivo, ex-vivo phantoms and human ex-vivo tissues (prostate, thyroid, kidney, and fibroid) using PAI. Collected data helps to build a causal relationship and identify the important features for classification and check the validity of the hypothesis.
Adaptive optics bench testing for presbyopia-correcting contact lenses
Geunyoung Yoon
University of Rochester
Clerio Vision, Inc.
Presbyopia is a visual condition that all adults over the age of approximately 40 years face. Individuals with presbyopia lose the ability to focus on nearby objects, which significantly impacts quality of life. Although extending depth of focus via a multifocal contact lens to overcome presbyopia is increasingly popular, clinical outcomes with these lenses are variable and often unpredictable. A better understanding of the role of practical factors when a multifocal lens is on the corneal surface improves our ability to predict its performance. The project is aimed towards the evaluation of through-focus performance of multifocal contact lens designs in which these realistic factors are simulated by using an adaptive optics bench testing system.

Mathematical Model and Computer Simulation of the Motion of a Contact Lens During and After a Blink
David Ross and Kara Maki
Rochester Institute of Technology
Bausch & Lomb
In recent work supported by Bausch & Lomb, we developed a model of the suction pressure induced in the tear film by a symmetric contact lens conformed to a rigid, symmetric eye. Here we will extend that work and model the motion of an asymmetric lens that is displaced by a blink and which ressetles under the influence of shear stresses produced by gradients in the suction pressure. We will produce a code in collaboration with Bausch & Lomb engineers that can be used in development and design work.

Towards Automated Clinical Evaluation of Tendon through Shear Wave Elastography
Michael Richards
University of Rochester
Clerio Vision, Inc.
The overall goal of the proposed research is to improve the patient-specific assessment of the pathological severity associated with the onset of cardiovascular disease such as aneurysm and atherosclerosis. The recent development of clinical ultrasound (US) based tissue mechanical property measurements (e.g., elastography) has motivated the use of these technologies to measure the spatial variations in in-vivo vascular mechanical properties in real time or pseudo real time. The patient-specific information gathered in a diagnostic or screening mode can be then used to improve treatment recommendations for a variety of life-threatening vascular diseases.

Visual Acuity of Clinically Relevant Refractive Correctors Using LIRIC
Jonathan Ellis
University of Rochester
Clerio Vision, Inc.
Our long-term goal is to use femtosecond micromachining to customize refractive corrections in human eyes, be it in the cornea, contact lenses, or implanted IOLs. This requires high-numerical aperture (NA) lenses, >1.6, placing severe limits on optical scanning. We have used previous CESS support to develop a scalable manufacturing platform for manufacturing clinically relevant refractive devices. Our goal now is to use this platform to build arbitrary refractive corrections in contact lenses and assess the visual acuity of the refractive correction.

Modeling and Optimizing the LIRIC Writing Process
Paul D. Funkenbusch
University of Rochester
Clerio Vision, Inc.
LIRIC is a multiphoton absorption process that is used to locally change the refractive index of cornea tissue and hydrogels. The LIRIC process requires a high-numerical aperture beam with a known optical quality that is scanned rapidly through the material. This process depends on numerous parameters, including NA, beam-quality, pulse width, laser repetition rate, focal spot velocity, and material properties. This project will establish a framework model of the LIRIC writing process and design experiments to determine the coupling between parameters. The overall objective is to optimize the LIRIC process for both hydrogel and cornea tissue applications.

Plane Wave and Elastographic Imaging of AAX and Cardioid Arteries
Govind P. Agrawal
University of Rochester
Clerio Vision, Inc.
LIRIC is a multiphoton absorption process that is used to locally change the refractive index of cornea tissue and hydrogels. The LIRIC process requires a high-numerical aperture beam with a known optical quality that is scanned rapidly through the material. This process depends on numerous parameters, including NA, beam-quality, pulse width, laser repetition rate, focal spot velocity, and material properties. This project will establish a framework model of the LIRIC writing process and design experiments to determine the coupling between parameters. The overall objective is to optimize the LIRIC process for both hydrogel and cornea tissue applications.

Computer Modeling of Telecom Signals in Multimode Optical Fibers
Wayne Knox
University of Rochester
Clerio Vision, Inc.
In this project, my research group will work with Dr. William Wood of Corning, Inc. to develop a comprehensive computer model for studying transmission of optical pulses through multimode and/or multimode fibers capable of supporting several optical modes. A computer model will be developed in stages and tested through experimental verification whenever possible. This work is important to Corning because multimode and multimode fibers are likely to be used in the near future for implementing the technique of space-division multiplexing.
Support for Distributed Computing and Network Management in Mobile Ad Hoc Networks

Wendi Heinzelman
University of Rochester
Harris Corporation

Performing communication and computation in an ad hoc network of mobile devices is challenging yet critical for next-generation military networks. Not only must we ensure that data can be securely communicated wherever it is needed, when it is needed, even in the face of network dynamics, but we must also ensure that computation can be accomplished quickly using available resources within the network. The goal of this research is to optimize and secure the formation and evolution of a robust network to support communication and computation within a mobile ad hoc network environment.

Further Development of THz Imagery Array in Support of Harris’s Commercial THz Imaging Development

Zeljko Ignjatovic
University of Rochester
Harris Space and Intelligence Systems

Our group at the University of Rochester proposes to conduct a variety of THz measurements and parameter characterization and develop design methodologies for THz focal plane arrays in standard CMOS technologies. We propose to use an FET-based THz imaging array design to move forward. A custom low-noise electronics and a spherical incidence setup along with a low-noise preamplifier, perform LIV, voltage current and a current sweeps for transconductance, channel conductance and resistance measurements, and terahertz radiation reusability.

Further Studies and Development of THz Detector Arrays

Judith Pipher
University of Rochester
Harris Space and Intelligence Systems

This project aims to continue development of THz detector arrays to be used in cameras for security and surveillance applications for standoff detection threat detection, package inspection, medical imaging applications, and material testing, and to extend performance to the infrared (~10–15 μm). Our lab has designed the enclosures (vacuum-tight, cold) and has constructed and operated an array controller that can be programmed for each generation of arrays. Each generation has exhibited improvements derived from experimental results from the prior generation. Each generation focal plane (for past and future arrays which are not all digital) requires changes to clocking and biasing. And our lab executes those programs; we can also address single pixels with our array controller design. We continue to support RTO colleagues with their needs—e.g., designing and constructing fanout boards, helping with thermoelectric coolers, consulting on radiometry. This year we will concentrate on completing the generation 3 testing and will work in tandem with the RTO group on testing of the various THz test structures, as well as verifying performance of the IR test structures. Once an IR focal plane is produced, we will work on that.

Smart Sensor for Classical and Quantum Data Links

Roman Sobolewski
University of Rochester
HYPRES, Inc.

The objective of the project is to explore the possibilities to develop the "smart sensor"—the superconducting nanowire single photon detector (SNSPD) integrated with Josephson junction based mixed-signal circuits to provide readout, tuning, and control of the detector. This digitally assisted sensor will have performance characteristics far surpassing those of the traditional analog SNSPDs and will unlock straightforward scalability to larger SNSPD arrays. We will target high-value applications in quantum networks for quantum information applications, including high-data-rate quantum key distribution. Our smart sensor will also find many applications in classical data channels for energy-efficient computing, Lidar, and laser communications.

Global Surveillance Augmentation for Deep Learning

Andreas Savakis
Rochester Institute of Technology
Xnovo, Inc.

In this project we plan to explore deep learning in algorithms for global surveillance applications, including object detection and change detection in satellite images. Our first goal is to train deep convolutional neural networks (DCNNs) for the detection of important object classes in panchromatic and color satellite imagery. To accomplish this goal, we will generate a dataset of augmented data that is sufficiently large and diverse for training DCNNs. Another goal is to develop change detection algorithms that identify important changes in satellite imagery taken at different times.

Nondestructive/noninvasive three-dimensional imaging with Gabor-domain optical coherence microscopy

Jannick Rolland
University of Rochester
LightTapTech Corporation

Real time, high-resolution nondestructive inspection methods are needed to characterize materials, including plastics, glass and human tissue, through their depth. Fast, accurate metrology brings value to the manufacturing industry by improving quality, increasing productivity, and reducing costs. This project will advance the development of a Gabor domain optical coherence microscopy (GD-OCM) instrument, the Explorer4D™, to qualify materials in the manufacturing process. Hardware and software tools will be developed for fast, nondestructive microscopy of contact lenses in manufacturing. GD-OCM will be applied to on-line, automated characterization of contact lenses.

Detection of the Attributes of Artificial and Natural Photonic Images and Methods to Improve Consumer Images to Make Them More Aesthetically Pleasing

David Messinger
Rochester Institute of Technology
Kodak Alaris

Kodak Alaris has selected RIT to conduct research to develop image-processing algorithms for a high-end global consumer image scanner. This will unlock straightforward scalability to larger SNSPD arrays. We will target high-value applications in quantum networks for key distribution, including high-data-rate quantum key distribution. Our smart sensor will also find many applications in classical data channels for energy-efficient computing, Lidar, and laser communications.

Ultrafast Lasers for Advanced Optic/Photonics Fabrication

Jie Qiao
Rochester Institute of Technology
Optro Systems

This project develops an ultrafast laser-based polishing technology to enable the fabrication of freeform and integrated optics for sensing and imaging. This project will integrate a femtosecond laser-based beam-scanning system and investigate the optimum laser-processing parameters via numerical modeling and experimental verifications.

High-Power, Low-Cost CO2, Laser for Laser-Enhanced Pyrolysis

John Marzianti
University of Rochester
Solid Cell

Laser-enhanced pyrolysis has recently been demonstrated to provide a substantial energy and cost savings over the conventional heat-only production method for generating syngas from shale gas (specifically, converting ethane into ethylene). To reap this cost benefit and enable a new market for otherwise wasted burned ethane in refineries, high-power lasers must be realized at low cost, in direct opposition to the current trend. The goal of this program is to (a) develop a prototype laser system assembled from low cost components, and (b) apply the laser system to Solid Cell's pyrolysis reactor to demonstrate the scalability of the low-cost approach.

Multimodal Displays: Sight, Sound, and Touch for Personal Computing Devices

Mark Bocko
University of Rochester
Synaptic, Inc.

In this collaborative project with Synaptic Incorporated, we will employ flat panel audio and haptic (touch feedback) technology developed at the University of Rochester to create integrated multimodal displays that provide users with visual, sound, and touch interfaces in handheld devices. The research plan is focused on developing low-cost piezoelectric force exciter arrays and the necessary custom electronics for integration with ultra-thin OLED displays in smartphones and other handheld intelligent devices.
Enhancing the UV/VUV sensitivity of CMOS Image Sensors
Zoran Ninkov
Rochester Institute of Technology
Thermo Fisher Scientific
This project continues our effort to improve the UV/VUV/X-ray sensitivity of CMOS image sensors by coating the arrays with quantum dots (QD) that fluoresce at visible wavelengths. This year’s work will proceed with developing the techniques to utilize aerosol jet deposition of commercially produced quantum dots onto CMOS detector arrays supplied by Thermo Fisher Scientific. In order for Thermo Fisher to proceed with the plans for commercialization, two key measurements are required. These tests are (a) radiation testing of the CMOS and (b) deep UV/VUV/X-ray absolute sensitivity measurements of the QD-coated devices. If these two tests are positive, these devices would see widespread application in the markets served by Thermo Fisher Scientific, namely UV/VUV/X-ray spectroscopy and radiation hard applications. We will be conducting the two tests at (a) the NIST SURF III Cyclotron Facility in Gaithersburg, Maryland, and (b) the Texas A&M Cyclotron. One exciting commercial application for these devices is to build an X-ray spectrometer on a CMOS chip where discrete areas of the chip are coated with different-sized quantum dots that have a cross-section for fluorescence tuned to specific X-ray wavelengths. NASA has already expressed interest in such devices to enable the use of miniaturized X-ray detecting spacecraft.

Skin Lesion Morphology Characterization and Disease Classification
Jiebo Luo
University of Rochester
VisualDx
In this study, we investigate a novel approach to greatly improve skin disease diagnosis. A direct approach is to target the ground truth disease labels, while an alternative approach instead focuses on determining skin lesion characteristics that are more visually consistent and discernible. We hypothesize that, for computer-aided skin disease diagnosis, it is both more realistic and more useful that lesion morphology tags should be considered as the target of an automated diagnosis system such that the system can first achieve a high accuracy in describing skin lesions and in turn facilitate disease diagnosis using lesion characteristics in conjunction with other evidences. To further meet such an objective, we propose to employ the state-of-the-art multilabel convolutional neural networks (ML-CNN) for machine learning. To ensure that the system will be robust for data from diverse clinical sources, we propose to build a large-scale and diverse dataset with detailed annotations at both image and lesion levels in collaboration with VisualDx. The developed algorithms will be integrated with the existing VisualDx system to validate the benefit of automatic skin image analysis.

2016–2017 PROJECT ABSTRACTS

Kodak officials lit up a new marquee and digital sign in September 2017 at Kodak Center Theater on West Ridge Road in Rochester. The new sign will promote events to the estimated 40,000 vehicles that pass by the theater every day.
CORPORATE PARTNERS

ALCHLIGHT
www.alchlight.com

Alchlight, based in Rochester New York, is the leading developer and distributor of advanced and proprietary laser fabricated materials. Acclaimed by the New York Times as “optical alchemy,” they use femtosecond laser processing to etch proprietary nanostructures on materials. Their procedure doesn’t coat the material; 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 of brass.

ARCUM THERAPEUTICS
www.arcumtherapeutics.com

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

BAUSCH AND LOMB
www.bausch.com

Bausch and Lomb offers one of the world's most comprehensive portfolios of eye health products. B+L markets five broad categories of products: contact lenses, lens care, pharmaceuticals, cataract and vitreoretinal surgery, and refractive surgery.

CARESTREAM
www.carestream.com

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

CLEERIO VISION
www.cleeriovision.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 non-invasively. 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 LERIC, 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 Incorporated is a diversified technology company that develops breakthrough technologies that significantly improve people’s lives. Corning pursues innovation and focuses on high-impact growth opportunities in the telecommunications, flat panel display, environmental, life sciences, and semiconductor industries.

ENVISION SOLUTIONS LLC

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

FLINT CREEK RESOURCES
www.flintcreek.com

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

FLUXDATA, INC.
www.fluxdata.com

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

HARRIS CORPORATION
www.harris.com

Harris provides advanced, technology-based solutions that solve government and commercial customers’ mission-critical challenges. The company has approximately $5 billion in annual revenue and about 23,000 employees—including 9,000 engineers and scientists—supporting customers in more than 125 countries. Harris Corporation is a top 10 defense contractor providing mission-critical solutions through its Communication Systems, Critical Networks, Electronic Systems, and Space and Intelligence Systems segments.

HYPRES, INC.
www.hypres.com

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

IMAGINANT
www.imaginant.com

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

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 new 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’re on a mission to unlock the power of images and information for the world. We work behind the scenes, making the connections, pushing the boundaries of technology, and helping you to make sense of and exploit the ever-expanding volume of data that is the hallmark of the 21st century.

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

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

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

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

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

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

SYNAPTIcs INC.
www.synaptics.com
We are the pioneers and leaders of the human interface revolution, bringing innovative and intuitive user experiences to intelligent devices. From usability and R&D to supply chain and support, we collaborate with our partners to invent, build, and deliver human interface solutions that integrate seamlessly and optimize system value. The improved ease of use, functionality, and aesthetics of Synaptics-enabled products help make the digital lives of people more productive, secure, and enjoyable.
Thermo Fisher Scientific Inc. (NYSE: TMO) is the world leader in serving science, with revenues of $17 billion and 50,000 employees in 50 countries. Our mission is to enable our customers to make the world healthier, cleaner, and safer. We help our customers accelerate life sciences research, solve complex analytical challenges, improve patient diagnostics, and increase laboratory productivity. Through our four premier brands—Thermo Scientific, Life Technologies, Fisher Scientific, and Unity Lab Services—we offer an unmatched combination of innovative technologies, purchasing convenience, and comprehensive support.

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

VISUALDX

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 over 50 percent of U.S. medical schools. Trusted by physicians and nurses all over the world, VisualDX is utilized across several professional specialties.

This portable device was designed by University spin-off LighTopTech, cofounded by company president Cristina Canavesi and her PhD advisor, Jannick Rolland, the Brian J. Thompson Professor of Optical Engineering at the University of Rochester. LighTopTech is one of 10 start-ups to advance in a competition sponsored by a New York accelerator focused on optical technologies.
GOVIND AGRAWAL
James C. Wyant Professor of Optics, Professor of Physics, and Senior 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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MIGUEL ALONSO
Associate Professor of Optics in The Institute of Optics, University of Rochester
Education PhD, The Institute of Optics, University of Rochester, Optics, 1996; MS, Universidad Autonoma Metropolitana, Physics, 1990
Research Interests Propagation of waves, Connection between rays and waves, Integral transforms, Phase space representations, Uncertainty relations
Recent Research Projects Building accurate estimates of wave fields propagating based on ray information alone
(585) 275-7227 www.optics.rochester.edu/people/faculty/alonso_miguel/index.html alonso@optics.rochester.edu

JAMES AQUAVELLA
Professor, Department of Ophthalmology, University of Rochester
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Recent Research Projects Ocular metrology and inflammatory mediator response to topical administration of anti-inflammatory drugs
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Research Interests Imaging microelectronics, Wireless sensors, Multimedia signal processing
Recent Research Projects Digital audio watermarking and steganography, Image sensors with built-in image compression, Digital CMOS image sensor read-out circuits
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Research Interests Optical polarization and metrology, Opthothetical modeling, Integrated optoelectronics
Recent Research Projects Enhancing image contrast using polarization correlations, Stress engineering for polarimetry and imaging, Polarization control of optical nanostructures, Nonlinear properties of microstructured optical fibers
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Recent Research Projects Diseases of the musculoskeletal system
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Recent Research Projects Cu Ink Adhesion Solutions
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Research Interests Computational science and engineering, Numerical analysis, Applications of computer science in electrophysiological signaling stabilization, Refractometry, Flexure systems, Stage metrology
Recent Research Projects Noncontact video-based detector of cardiac arrhythmias
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Research Interests Linear displacement interferometry, High-power gas laser frequency stabilization, Refractometry, Resonance systems, Stage metrology
Recent Research Projects Designing and developing smart optical sensors for compact, remote displacement sensing and for multi-DOF interferometry
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Research Interests: MR, CT, and GU radiology, Ultrasound
Recent Research Projects: In vivo photoacoustic and ultrasound imaging probe for human thyroid cancer detection
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Recent Research Projects: Light Diffusing Fiber as a Disinfectant or Antimicrobial Agent, Efflux pumps and inhibitors of serum-grown Acinetobacter baumannii, Identifying new antimicrobial agents against Mycobacterium tuberculosis, Tertifendine as a new S. aureus antibiotic
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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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Recent Research Projects: Thyroid-associated eye disease
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Recent Research Projects: Cellular co-culture screening assays
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Recent Research Projects: Optical Probing for Freeform Optics Metrology
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Research Interests: Femtosecond laser-matter interactions at high intensities.

Recent Research Projects: Superwicking cooling devices for computer CPU and microelectronics.

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

Recent Research Projects: Infections in the immunocompromised host; Treatment of infections through photodynamic therapy.

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Research Interests: Multimedia communication, Wireless sensor networks, RFID systems, Cloud computing, Heterogeneous networking.

Recent Research Projects: Developing RFID systems for inventory management, Designing a QoS-aware protocol architecture to support real-time multimedia data transmission, Optimizing video-based sensor networks.

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Research Interests: Silicon device integration on nontraditional substrates, Metal-oxide-semiconductor for thin-film electronics, Silicon-based optoelectronics.

Recent Research Projects: Development and characterization of high-performance transistors on glass, Development of bipolar and MOS high-power microwave transistors.

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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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Research Interests: Optics of the eye, Femtosecond laser micro-machining in cornea and lens, Visual perception and psychophysics, Biomedical imaging.

Recent Research Projects: Femtosecond laser micromachining, Effect of corneal wound healing on physiological optics of the eye, Perceptual learning with a damaged visual system.

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Research Interests: A/D conversion, CMOS analog circuits, Low power circuit architectures, Image sensors.

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

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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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Research Interests Development, evaluation and preclinical integration of image guidance environments for surgical navigation of minimally invasive cardiac interventions
Recent Research Projects Predicting target vessel location in robot-assisted CABD interventions using feature-based CT to US registration
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Recent Research Projects Fine-grained user profiling from multiple social multimedia platforms, Wine recommendation for grocery shoppers
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Recent Research Projects Affect of contact lens distortion on exchange of tear, Model for suction pressure under a contact lens
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Recent Research Projects Acoustic radiation force imaging techniques, Spatially Modulated Ultrasound Radiation (SMURF) imaging, Single tracking location (STL), Shear wave elastography imaging (SWEI)
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Recent Research Projects The interaction of nanoparticles with cells and protein mixtures, Ultrasitn silicon-based nanomembranes for filtration of molecules and nanoparticles, Ultrasitn silicon-based nanomembranes for biological co-cultures
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Recent Research Projects: Spatial segmentation of multi/hyperspectral imagery by fusion of spectral-gradient textural attributes, Knowledge-Based Automated Road Network Extraction System Using Multispectral Images  
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Recent Research Projects: Ocular surface metabolism and inflammatory mediator response to topical administration of anti-inflammatory drugs  
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Recent Research Projects: The AIR Flu Chip: A Multiplex Optical Biosensor of Influenza Serology  
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Recent Research Projects: Teledyne HgCdTe 10 micron cutoff detector arrays for use in future space experiments with particular emphasis on NEDCam (Near Earth Object Camera), Characterization of Raytheon long-wavelength HgCdTe detector arrays, FIRE spectrometer development, Persistent surveillance-driven projects  
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Recent Research Projects
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Recent Research Projects
Optical coherence tomography for quantification of contact lens properties

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