

Empire State Development
Division of Science, Technology & Innovation
(NYSTAR)



**2021 Program Report
Centers for Advanced Technology**

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Introduction

Empire State Development's Division of Science, Technology & Innovation (NYSTAR) manages the Centers for Advanced Technology (CAT) Program. The CAT program, created in 1983, supports applied research, development and technology transfer in multiple technological areas in collaboration with private industry. CATs play a critical role in spurring technology-based applied research and economic development in the State, promoting national and international research collaboration and innovation, and leveraging New York's research expertise and funding with investments from the federal government, foundations, businesses, venture capital firms and other entities.

Through a competitive process, NYSTAR awards 10-year designations in technology fields of strategic importance to New York's economic competitiveness. Eligible applicants are New York universities and affiliated research institutes.

Below are individual summaries for each of the 15 CATs covering the July 1, 2019 through June 30, 2020 reporting period with information as reported by the Center that includes:

- Importance to NYS
- Impacts
- Federal or Other Grants Awarded
- Education and Technology Commercialization Activities
- Commercialization
- Start-up Companies Formed
- Licensing Agreements
- Level of Matching Funds Provided

Requests for Proposals

There were no Center for Advanced Technology Requests for Proposals released during this period. The next CAT competition is expected to be held in the Summer/Fall of 2024 as 10 current CAT designations are set to expire on June 30, 2025.

Individual CAT Reports

Individual CAT reports continue for the remainder of this document.

Center for Advanced Ceramic Technology (CACT)

Alfred University

Dr. John Simmins, Director

Technology Focus:

Ceramics and Glass

Importance to NYS:

First designated in 1987, and renewed for another 10 years more recently in 2018, the Center for Advanced Ceramic Technology (CACT) at Alfred University specializes in applied and technical research that solves real-world problems to provide practicable, scalable solutions in support of commercializing cutting edge products and solutions.

At Alfred University's CACT, industrial partners gain access to the resources and expertise needed to advance research and boost their bottom line. As the only institution in the country to offer a glass science PhD program, and one of only two institutions dedicated to ceramic engineering, the CACT links firms to a unique skill set to solve challenges addressing a wide range of analytical needs and technical research areas, including:

- Materials: Bioceramics; Carbon-based composites; Electronic ceramics; Glass; Metal-Ceramic composites; Optical Materials; Polymers; Structural ceramics; Whitewares; Fuel cell materials; and Energy storage materials.
- Modeling: Microstructure; Atomistic structure of glass/ceramics; Defect behavior; Transport behavior; Multiscale modeling; and Multiphysics modeling.
- Processing: Ceramic powders; Engineered nanoparticles; Specialty glass processing; Nanoscale fabrication; Thin/Thick film coatings; Tape casting; Hot/cold isostatic pressing; Specialized sintering capabilities; Sol-gel processing (glasses, powders, films); and Traditional ceramic processing.
- Properties/Characterization: Electrical properties; Structural analysis; Mechanical behavior and fracture; Optical properties; Biocompatibility; Surface behavior and catalysis; Thermal properties; and Spectroscopy.

CACT helps support NYS-based firms by providing financial support to offset short-term analytical programs, sponsored research, internships and workforce development programs, including industry short courses. Typical cost-share support ranges from 20-30% and can help extend the amount of work firms can conduct with Alfred University. Funding is made available on a first-come, first-served basis.

Description of Achievements:

In spite of major restrictions limiting on-campus activity during the COVID-19 pandemic beginning in March 2020, the CACT continued its efforts to support New York State's ceramic and glass sectors. This included a nearly normal level of analytical services and sponsored research activities, supported student internships within industry, and continued outreach and educational programming. During this period, the CACT worked with 22 NYS-based firms, an additional 11 companies from outside NYS, and 1 federal lab (the U.S. Naval Research Laboratory) on 53 projects at the University. New York State companies included ASK Chemicals, AirFlow Catalyst Systems, Belvac, Boston Valley Terra Cotta, Corelle, Corning, Ferro, Filtros, Moog, Praxair, RCare, Refractron, Sol-Epoxy, Solar-Tectic, TGR Enterprises, SRS Holdings, Thomas Electric, Unifrax, Xerox, Xylon Technical Ceramics, and others. Student internships were supported at Belvac, Filtros, and RCare during the reporting period.

A major focus during the reporting period was on expanding the CACT and Alfred University’s support for entrepreneurship in the region. To that end, the CACT’s Executive Director and Deputy Director joined in the formation of the Startup Allegany group, whose mission is to increase interest from the student populations at the three Allegany County-based institutions of higher education: Alfred University, Alfred State College and Houghton College. Planning is underway to host a “Tri-Collegiate Think Tank” which will introduce students at the three institutions to challenges faced by economic sectors of importance to Allegany County. Discussions will focus on actions taken by these sectors to mitigate the impacts of COVID, as well as identify opportunities for the private sector to provide additional solutions. This program will then lead into a Shark Tank style business pitch competition. Winning teams will receive mentorship support from IncubatorWorks and pre-seed funding support from CACT and other private sector sponsors who have already agreed to participate. The Shark Tank style competition is anticipated to be held in early 2021, hopefully in person.

Impacts:

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
0	7	\$2,183,500	\$662,933	\$557,447	\$0	\$14,000	\$3,417,880

Designations and Recognitions:

Nothing to report this period.

Federal or Not-for-Profit Grants Awarded:

Nothing to report this period.

Education and Technology Commercialization Activities:

Industry-Oriented Education and Training

On September 9, 2019, the CACT hosted Jack McGowan from Insyte Consulting to speak to the undergraduate and graduate engineering classes on an introduction to the SBIR and STTR programs. This included the kinds of research that the SBIR/STTR programs typically fund, and how to pursue those grants. The program also included an introduction to the necessary steps needed in order to start a business if students were interested in launching a start-up company to pursue SBIR/STTR funding.

On October 11, 2019, the CACT co-sponsored the 2nd Annual AUEnergy Symposium, which focused on “Overcoming Challenges Faced by the Global Energy Ecosystem.” Topics included:

- Use of Next Generation Technologies for Energy Systems – Augmented and Virtual Reality, UABs, Block Chain;
- Innovations in Energy Storage;
- Cybersecurity for the Grid;
- Grid Resiliency;
- Industrial-Scale Energy Efficiency Programs; and
- Workforce Development Needs.

Over 200 students from area high schools were in attendance as well as another 50 representatives from industry and academia.

On October 17, 2019, the CACT hosted representatives from IncubatorWorks to present to Alfred University's undergraduate and graduate engineering class to discuss an introduction to entrepreneurship as well as to explain the resources available at the Alfred incubator facility.

On October 31, 2019, the CACT hosted Sandra Garby, co-founder of Vizinex RFID to speak to the School of Engineering on her experiences in creating multiple high-tech companies, her failures and successes, and how her Alfred education helped prepare her to pursue entrepreneurship and business development.

Commercialization:

Prior to closures due to COVID, the CACT continued its efforts to conduct industrial outreach at major international industrial glass/ceramic conferences, exhibiting at the Material Science & Technology (MS&T) show in Portland, OR in September and the International Conference and Expo on Advanced Ceramics and Composites (ICACC) show in Daytona Beach, FL. Unfortunately, Ceramics Expo in Cleveland, OH was cancelled and an in-person show is planned for 2021. CACT did participate in several local/regional programs including a regional SBIR conference hosted at SUNY Polytechnic Institute in Albany, the NYS Innovation Summit, hosted by FuzeHub in Rochester, and Solutions Forums hosted in Cortland and Ithaca. Applied research in support of industry in many cases continued in spite of restricted access to University facilities where projects were deemed essential.

Invention Disclosures /Patents:

Nothing to report this period.

Start-up Companies Formed:

Nothing to report this period.

Licensing Agreements:

Nothing to report this period.

Royalties:

Nothing to report this period.

Small Business Assistance Provided:

During this reporting period, CACT worked with the following small New York State companies: ASK Chemicals, AirFlow Catalyst Systems, Belvac, Boston Valley Terra Cotta, Filtros, RCare, Refractron, Sol-Epoxy, Solar-Tectic, TGR Enterprises, SRS Holdings, Thomas Electric, Unifrax, and Xylon Technical Ceramics. In each of these cases, analytical services were provided in support of a range of needs, including ceramic/glass materials characterization, properties testing, SEM analysis, etc. In the case of RCare, CACT supported the company by providing access to University facilities to beta test their nurse-call/monitoring system and providing cost share against one summer student hire.

**Level of Matching Funds Provided and uses:
Expenses (include Federal State, local funds & in-kind)**

Operating Expenses	NYSTAR Funding	Matching Funds		Total
		Company Cost Share	Other Sources	
Salaries & Fringe	\$433,954	\$92,421	\$83,491	\$609,866
Indirect Costs	\$65,092	\$19,260	\$20,873	\$105,225
Equipment	\$33,998	\$0	\$0	\$33,998
Materials & Supplies	\$10,917	\$8,566	\$13,680	33,163
Tuition	\$13,677	\$4,706	\$0	\$18,383
Travel	\$11,436	\$2,710	\$1,705	\$15,851
Subcontractors	\$0	\$0	\$12,000	\$12,000
Other	\$150,653	\$1,002	\$1,932	\$153,587
Total	\$719,727	\$128,665	\$133,681	\$982,073

Total Federal: \$0

Total In-kind: \$0

Center for Flexible Hybrid Medical Device Manufacturing (FlexMed)

Binghamton University

Mark Poliks, Director

Technology Focus:

Medical Manufacturing/Biomedical & Devices

Importance to NYS:

The Center for Flexible Hybrid Medical Device Manufacturing (FlexMed) at Binghamton University leverages the university's leadership of the New York Node of NextFlex, the Department of Defense Flexible-Hybrid Electronics (FHE) Manufacturing Innovation Institute, as well as the strengths of the Center for Advanced Microelectronics Manufacturing (CMM) and S3IP Center of Excellence, to develop new technologies for the production of health-related smart electronics on flexible substrates advancing medical, pharmaceutical, and industrial device manufacturing and enhancing the vibrancy of the New York State economy. The FlexMed CAT provides economic growth for New York State by serving as a "synergy center" focusing on cost-effective product development and pilot manufacturing activities. FlexMed works with industry partners of all sizes – from large integrators and manufacturers to small start-ups – across New York State to design, develop and manufacture tools, processes, materials and products in the health device space, based on flexible-hybrid electronics technologies.

Description of Achievements:

During the first year of operation (7/1/19 – 6/30/20), the Center has made good progress toward project and contract activities. Specifically, it has:

1. Hired an Associate Director for Business Development, Dr. Mark Schadt, who brings extensive experience in corporate research, development, and manufacturing involving the fabrication of low-cost high-volume roll-to-roll production of flexible circuits for thin, flexible, and hybrid electronic devices. His role with the Center will be to oversee industry outreach and to build research collaborations with companies.
2. Began work on Center-sponsored research projects with Corning, Inc., Universal Instruments, 2M Technology, and TTM Technologies.
3. Made strides toward putting into place research projects with GE, Tapecon Inc., Innoveering LLC, Lux Semiconductors, CathBuddy, and Aquaneers.
4. Initiated efforts toward the establishment of the Industrial Advisory Board. All founding partners in the CAT proposal have been invited to join the Industrial Advisory Board. Dr. Scott Miller, Director of Strategic Programs for NextFlex Manufacturing USA, will also serve as a member of the Advisory Board.
5. Made preliminary progress toward workforce development efforts such as the development of a public version of FHE Pro, a flexible hybrid electronics workforce development course on FHE technology as applied to medical and industrial applications.
6. Established specific initiatives to support R&D programs in response to COVID-19 with GE Global Research, GE Healthcare Systems, Walter Reed National Military, MIT, and Dupont.
7. Together with GE Global Research and GE Healthcare Solutions, as well as Binghamton University's School of Nursing (Telehealth and Public Health programs), the CAT developed a proposal for a "COVID-19 Infection Indication and Monitoring System" based on technology developed under several NextFlex Manufacturing USA programs. This proposal was submitted to the NIST Manufacturing USA National Emergency Assistance Program via NextFlex.
8. Together with Binghamton researchers and collaborators from the University of Rochester School of Medicine, the CAT established a preliminary project to develop methods to test for the SARS-CoV-2 and other biological agents. This project received a SUNY Seed Grant to help initiate these efforts and was

asked to submit a whitepaper to Army Applications Laboratory. If funded, this project will result in a new rapid, highly sensitive and selective spectroscopic based diagnostic test that can be tuned for SARS-CoV-2 and other viral agents.

9. The CAT was an active participant in both MedTech and FuzeHub virtual meeting events to identify and understand the needs of and connect with NYS product developers.

Impacts:

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
0	0	\$0	\$20,000	\$1,327,000	\$0	\$0	\$1,347,000

Designations and Recognitions

Nothing to report this period.

Federal or Not-for-Profit Grants Awarded:

Project	Principle Investigator	Source	Amount	Duration (yrs)	Summary
Wearable Interstitial Fluid Biomarker Monitoring Device	Azar Alizadeh (GE), Mark Poliks (BU)	NextFlex (AFRL)	\$1,000,000	1.5	The objective of this project is to design and develop wearable disposable microneedle arrays.
Small Unmanned Aircraft Systems Using Flexible Hybrid Electronics	Steven Gonya (Lockheed Martin), Mark Poliks (BU)	NextFlex (AFRL)	\$850,000	1	Reduce weight of Small Unmanned Aircraft Systems (SUAS)
Printed Stretchable Conductors	Mark Poliks (BU)	NextFlex (AFRL)	\$250,000	1	Testing wearable devices including those embedded in articles of clothing.
Factory-to-Field Embedded Sensing for Structural Components	Nancy Stoffel (GE), Mark Poliks (BU)	NextFlex (AFRL)	\$500,000	1	Create scalable processes for sensor fabrication and integration into structural composites.
UHF-RFID Tag with Encrypted Security Features for Authentication and Tamper Resistance	Steven Gonya (Lockheed Martin), Mark Poliks (BU)	NextFlex (AFRL)	\$400,000	1	Develop security RFID tag concept that utilizes a passive (battery-less) UHF-RFID chip within FHE structure with embedded hardware security features
Additive Manufactured High Temperature Hypersonics Electronics	David Shaddock (GE), Mark Poliks (BU)	NextFlex (AFRL)	\$400,000	1	Develop additive manufactured high temperature electronics packaging for hypersonics.
Temperature and Humidity Sensing Tag	Paul Chen (GE), Mark Poliks (BU)	NextFlex (AFRL)	\$800,000	1	Develop a flexible, conformal temperature and humidity sensor tag to monitor the inside of a closed container
Wireless Vital Sign Monitoring Devices for Ambulatory Aeromedical Care	Azar Alizadeh (GE), Mark Poliks (BU)	NBMC (AFRL)	\$1,800,000	1	Multi-sensor vital sign monitoring system.

Education and Technology Commercialization Activities:

Industry-Oriented Education and Training

The CAT worked closely with NextFlex on many federally funded programs including projects that were recently funded. All projects have workforce development activities integrated within them. Graduate students who work on these projects have the opportunity to work directly with industry partners. The CAT is well established in offering professional development courses at the FlexTech Alliance Flex conferences held in California as well as the Materials Research Society Fall Meeting held in Boston, MA. Recently the CAT worked with NextFlex to develop a version of their FHE (flexible hybrid electronics) Pro course for use with government sponsors at the Air Force Research Laboratory at Wright Patterson (Dayton, OH). The CAT is currently working with NextFlex to deliver the FHE Pro course at Binghamton for NYS participants. This course offering will include laboratory demonstrations making use of the CAT facilities on campus. This will be the first time the FHE Pro course will be offered outside of the NextFlex community and a great opportunity for New York State companies to engage with the CAT, NextFlex as well as for business-to-business relationships.

Commercialization:

All of the funded projects listed above are intended to perform research and development that advances technologies toward commercialization. Ideally, all these projects will allow the corporate partners and their supplies to eventually manufacture with these technologies.

Invention Disclosures /Patents:

Nothing to report this period.

Start-up Companies Formed:

Nothing to report this period.

Licensing Agreements:

Nothing to report this period.

Royalties:

Nothing to report this period.

Small Business Assistance Provided:

The CAT worked with Infinite Corridor Technology (Brooklyn, NY) engaging them on NextFlex programs and with an emerging start-up "AFM" (Kimberly Flomerfelt-Puc, Syracuse, NY) working with the CNY Biotech Accelerator on a medical labor and delivery monitor. In addition, the CAT provided assistance to Tapecon (Buffalo, NY) to help them address recent (design review and new product introduction evaluation) demand for flexible hybrid electronics technology emerging from NextFlex programs.

Level of Matching Funds Provided and uses
Expenses (include Federal State, local funds & in-kind)

Operating Expenses	NYSTAR Funding	Matching Funds		Total
		Company Cost Share	Other Sources	
Salaries & Fringe	\$177,284	\$24,874	\$111,114	\$313,272
Indirect Costs	\$26,592	\$6,218	\$27,778	\$60,588
Equipment	\$0	\$0	\$0	\$0
Materials & Supplies	\$2,369	\$582	\$0	\$2,951
Tuition	\$0	\$0	\$0	\$0
Travel	\$839	\$440	\$0	\$1,279
Subcontractors	\$0	\$0	\$0	\$0
Other	\$2,548	\$264,724	\$43,976	\$311,248
Total	\$209,632	\$296,838	\$182,868	\$689,338

Total Federal: \$0

Total In-kind: \$0

Integrated Electronic Engineering Center

Binghamton University

S.B. Park, Director

Technology Focus:

Semiconductors and Microelectronics

Importance to NYS:

The Integrated Electronic Engineering Center's (IEEC) focus is on electronics reliability and testing. The Center performs research to better understand the materials used, components, interconnect technologies, substrates and assembly performance and reliability through the range of uses from wearable / flexible assemblies, power electronics, server platforms, consumer devices and other market sectors. The IEEC has also extended the research into smart manufacturing of these devices through the use of the Smart Electronics Manufacturing Laboratory where research is conducted to use Artificial Intelligence (AI) and machine learning to allow automatic adjustment and optimization of manufacturing parameters to produce a better end product.

The IEEC has continued its work with NYS companies, both large and small. It provided failure analysis and testing work for NYS companies to improve their understandings on how to make their products better and more reliable. By knowing what caused a fail, they can isolate where the defect came from and make corrective actions. The IEEC provides assistance to small and startup companies by offering them assembly services for their prototypes and small manufacturing runs. Most startup companies only need a handful of prototypes to get their testing done to ensure proper functionality as well as demonstrations to their prospective customers or investors. Most electronics assembly houses do not want to take on these orders due to high production costs. Startup companies have very little resources to turn to without paying large cost to an assembly house which will often charge 10x the normal cost just to recover their cost.

Description of Achievements:

An example of the IEEC assisting a NYS company is with Unison Industries in Norwich, NY. Unison Industries is a division of GE Aviation Systems. In January 2020, Unison approached the IEEC with a request to help them understand some non-characteristic electrical readouts during testing of a new electro-mechanical temperature sensor. Sensors that exhibit odd behavior will result in the signals being interpreted incorrectly by the main instruments on an aircraft. The IEEC has assisted Unison before on similar cases where their samples are sent for evaluation. We used an X-ray imaging system to fully image the part and recreate the data to provide a 3D view of the internals of the faulty assembly. The metal shell was removed to gain insight of the internals in high resolution to understand the relationship of the different components to isolate where the problem was. All this was done non-destructively and retains the original form of the assembly. This effort provided sufficient information to provide a path for Unison to make corrective action in their assembly process to better optimize how the unit is assembled.

Impacts:

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
19	16	\$15,850,500	\$1,694,500	\$1,723,000	\$99,000	\$919,900	\$20,286,900

Designations and Recognitions:

Awards / Recognition.	Date Received	Recognizing Organization	Link
Nobel Prize, Chemistry, Professor M. Stanley Whittingham	October 9, 2019	Nobel Committee	https://www.nobelprize.org/prizes/chemistry/2019/press-release/
IEEE Electronics Packaging Society Regional contributions award, Professor SB Park, Director, IEEC	Spring 2020	Institute of Electrical and Electronics Engineers (IEEE)	https://eps.ieee.org/component/content/article/10-news/99-bio-richard-c-a-pitwon.html
Outstanding Educator Award, Benson Chan, Associate Director, IEEC	Sept 30-Oct 3, 2019	International Microelectronics Assembly and Packaging Society (IMAPS)	https://www.binghamton.edu/ieec/symposium/
2020 Heat Transfer Memorial Award, Professor Bahgat Sammakia		American Society of Mechanical Engineers	https://www.asme.org/about-asme/honors-awards/achievement-awards/heat-transfer-memorial-award
Best Student Presentation, Famarz Hadian, Mohammad Genanu, Randy Owens	March 18, 2020	SMTA International, 2019	msnow.com/smta-international-technical-committee-announces-best-presentation-paper-awards-from-the-2019-conference/

Federal or Not-for-Profit Grants Awarded:

Project	Principle Investigator	Source	Amount	Duration (yrs)	Summary
MRI: Acquisition of a High-Throughput Flow Cytometry for Health Science Research and Training	Prof. Sha Jin, Biomedical Engineering	NSF	\$346,542	3	This instrument provides a previously unavailable state-of-the-art capability for flow cytometry and high throughput cell analysis. This instrument can be used by hospitals or biotech firms to analyze cells and tissues, diagnose diseases and determine treatments.

Education and Technology Commercialization Activities:

Industry-Oriented Education and Training

The IEEC has organized and hosted an annual Electronics Packaging Symposium and this year, the symposium was hosted at GE Global Research. There were 324 attendees from around the world with 194 from NYS companies and universities.

During the reporting period, the IEEC developed three educational modules, one on Smart Electronics Manufacturing Initiative/Laboratory, a second on Shock and Vibration and a third on Biofilm Fouling in Electronic Packages: Thermal Management Systems.

The Smart Electronics module was presented to both "L3Harris Communication" (Rochester, New York) and the "Indium Corporation of America" (Clinton, New York) at their facilities. Each company is heavily invested in the Printed Circuit Card Assembly and requested that the IEEC help them better understand a new manufacturing initiative in the business related to "Industry 4.0". The "Industry 4.0" movement uses Intelligent Learning Machines, Data Analytics and Integrated Control Systems to more efficiently and reliably manage assembly operations. The university team consolidated its research and findings in this area of science / technology from the last several years into a presentation / overview and covered this topic with them in an on-site meeting / review / follow-up. A team of several university researchers, scientists and staff participated in the Preparation and Presentation of this information.

The Shock and Vibration module was presented for the Raymond Corporation (Greene, NY). Raymond had been working to evaluate a Mechanical Assembly and needed help in understanding their product design, materials and assembly process, to evaluate the long-term performance and reliability of the assembly. Because of the usage of the device, their primary concern focused on Shock and Vibration testing. An education module highlighting the test methods required to support this inquiry was presented to the lead project engineer as requested.

The Biofilm module was presented to D.E. Shaw Research (New York City). D.E. Shaw noted a concern related to the thermal management systems they are using on their Supercomputer and approached the IEEC for help understanding the root cause of the problem. The IEEC, working with the BioFilm Research Center (BFRC) at Binghamton University, provided an assessment of their current technology, what the current state-of-the-art is for similar systems, and how to evaluate their concerns. The education module was a collection of the IEEC and BFRC capabilities and understanding relative to D.E. Shaw's requirements.

Commercialization:

The pooled research being conducted by IEEC funded principal investigators (PIs) are being well received by our member company IBM and GE. The research into electro-migration of low temperature solder systems are key to these companies adopting these solder systems into their products. The advantage of low temperature systems are lower residual stresses in their assemblies and lower warpage of components after solder assembly. Having lower warpage and stress results in less failures after assembly. These are all good, but these low temperature solder systems exhibit different electro-migration behavior which prevents widespread adoption in the industry. IEEC research into how much current a solder joint can take provides these companies with limits that they now understand and can use in their system designs, this allows them to get the mechanical advantages of lower stresses and warpage into their assemblies while staying out of any potential areas of having an electrical fail due to overstressing a solder joint with high current. Design tradeoffs such as knowing how many solder joints to spread the incoming current to stay safe is key to a good and reliable design. This research is being accepted widely in the electronics industry.

Invention Disclosures /Patents

Disclosure /Patent Name	Inventor	Co-inventor	Description
Disclosure: Electronic-ECM: A Permeable Microporous Elastomer for an Advanced Bio-	Prof Ahyeon Koh	Matthew Brown	Developed a bio-integrated platform, based on an ultrathin, elastic fibrous mesh that allows the skin to breathe, passively permit sweat, and small molecule diffusion. The elastic mesh presents a minimal mechanical footprint with comparable elasticity and durability to skin tissue, resulting in a comfortable and lightweight device.

integrated Continuous Sensing Platform			
Disclosure: Improved Capacitive Sensing for Arrays of Narrow, Wide-Gap Micro-beams for Acoustic MEMS Sensors	Prof. Ron Miles	Mahdi Farahikia	RB-627. The invention increases the sensitivity of an array of micro-beams that are used as acoustic sensors for miniature devices by eliminating the adverse effects of wide gaps in between the sensing elements due to design requirements.
Disclosure: Battery Management System for a Flow Battery	Prof. Pritam Das		RB-624. Battery Management System for Flow Battery

Start-up Companies Formed

Nothing to report this period.

Licensing Agreements

Nothing to report this period.

Royalties

Nothing to report this period.

Small Business Assistance Provided

The IEEC provides help to small and startups with their needs in electronics and electronics packaging. IEEC's Smart Electronics Manufacturing Lab provides electronic prototyping assembly services to small and startups. This type of service is unique to industry. The service provided is part of the research the IEEC is doing related to Industry 4.0. The IEEC also provides packaging review of designs and helps make design changes to allow for design for manufacturing and design for test. In 2020, the IEEC provided assistance to Vita-Innovations, a small spinoff from Cornell University working on a smart face mask to be used in a hospital environment. The design includes health monitors for pulse rate, Pulse Oximetry, body temperature and some other functions. This effort started with COVID as a driver but is still viable as a way to monitor patients in the hospital waiting room/emergency room. The electronics had to fit into two small boxes on a facemask and all functions are monitored and transmitted via Bluetooth. The IEEC provided assistance with 3D modeling of the facemask along with 3D printing service to print the prototypes as well as packaging changes to fit the electronics into the mask. This effort is continuing in 2021 as they extend their development. IEEC will be providing testing to provide some reliability assessment of their package.

Level of Matching Funds Provided and uses
Expenses (include Federal State, local funds & in-kind)

Operating Expenses	NYSTAR Funding	Matching Funds		Total
		Company Cost Share	Other Sources	
Salaries & Fringe	\$648,007	\$495,258	\$744,673	\$1,887,938
Indirect Costs	\$97,201	\$120,057	\$181,925	\$399,183
Equipment	\$0	\$0	\$13,571	\$13,571
Materials & Supplies	\$28,973	\$22,630	\$48,700	\$100,303
Tuition	\$5,778	\$129,450	\$126,095	\$261,323
Travel	\$2,442	\$35,762	\$55,816	\$94,020
Subcontractors	\$0	\$0	\$0	\$0
Other	\$81,242	\$53,112	\$63,028	\$197,382
Total	\$863,643	\$856,269	\$1,233,808	\$2,953,720

Total Federal: \$235,156

Total In-kind: \$0

Center for Advanced Materials Processing

Clarkson University

Devon Shipp, Director

Technology Focus:

Advanced Materials & Materials Processing

Importance to NYS:

The mission of the Center for Advanced Materials Processing (CAMP) at Clarkson University is to achieve excellence in applied research and technology development in advanced materials through collaborations with companies, industries, and entrepreneurs. Such alliances will advance innovation, assist in developing new products, and solve manufacturing challenges, and thus promote economic development in New York State and promote the growth of North Country and New York State industries.

Description of Achievements:

CAMP provides its business partners with technical support and expertise in advanced materials development, characterization and processing, fulfilling its goal to advance economic development and promote the growth of North Country and New York State industries. Partners include large and small companies, as well as local, state and federal government entities. During this reporting period, CAMP continued to identify partnerships and institute new initiatives to enhance collaborations with industry and incentivize faculty to engage in industry-relevant research.

Under the continuing leadership of interim co-Directors Silvana Andreescu and Devon Shipp, engagements between NY State companies and Clarkson University faculty continue to grow and mature. NY State companies such as Corning, Global Foundries, L3Harris, Xerox, and Estee Lauder have all continued their CAMP-based projects, and a number of these companies have strengthened their engagement by committing to multi-year and multi-project contracts, often with multiple Clarkson faculty. CAMP is also supportive of small companies and faculty start-ups, encouraging and assisting them in their efforts to seek SBIR/STTR funding.

CAMP and Clarkson University have made significant investments in facilities that will provide access to state-of-the-art microscopy for faculty and New York companies. Recent purchases of an atomic force microscope (AFM) and scanning electron microscope (SEM) will provide high-resolution nanometer-scale imaging and measurement capabilities. These instruments will leverage research expertise in colloids, surface science, and nanomaterials that are Clarkson's traditional strengths, offering advanced capabilities for industry projects. To promote innovation and faculty engagement in industry-relevant projects, CAMP has instituted several new initiatives specifically designed to encourage faculty-company engagements. These include an open competition for "CAMP Graduate Research Fellowships" and the "CAMP Instrumental Use Seed Program", both of which provide the means for companies and faculty to obtain preliminary data with the expectation of following up with a major grant and/or grant proposal with industry involvement.

Much of CAMP's reputation is built on faculty expertise and with the hiring of new faculty it sees significant opportunity to engage with new industries across the state. These new faculty, along with more experienced CAMP faculty, maintain a strong presence across the nation in terms of federal funding and reputation. CAMP and Clarkson University are also committed to invest in continuing CAMP's reputation in colloids and surfaces, including the Chemical Mechanical Planarization (CMP) area, a traditional strength of CAMP that generated

significant economic impact for the semiconducting industry over the past 25 years. Through joint strategic planning and administrative support, a faculty cluster hiring in CMP is underway to maintain and grow expertise in this area.

As the pandemic unfolded, CAMP faculty and staff worked hard to help alleviate problems caused by the virus and the resulting lockdown. CAMP reached out to companies to see if help could be procured to supply PPE or other medical needs. CAMP professor Suresh Dhaniyala worked to understand and track airborne particles, specifically his team developed a low-cost bio-aerosol sensor and collector for wide-scale sampling. It uses a micro-sized high-voltage source to ionize airborne viruses, bacteria and fungi and collect them on a surface. Samples from the collector can be analyzed with portable DNA/RNA sequencers, which allows for real-time bio-aerosol detection. Profs. Bryon Erath, Doug Bohl, Abul Baki and Ian Knack acquired a tomographic particle image velocimetry system to advance laser measurement techniques for complex three-dimensional fluid flows in both air and water. Profs. Erath and Andrea Ferro received further funding from National Science Foundation (NSF) to examine how air expelled from the mouth during speech contributes to the spread of the virus, which further supports a project with a regional manufacturer of facial coverings and changes needed for air handling systems in indoor air environments.

Impacts

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
57	43	\$1,333,790	\$854,221	\$672,139	\$309,000	\$986,281	\$4,155,431

Designations and Recognitions

Awards / Recognition	Date Received	Recognizing Organization	Link
Clarkson University Secures Nearly \$100,000 in STEM Grant Funding from National Science Foundation	July 2019	National Science Foundation	Clarkson University Secures Nearly \$1,000,000 in STEM Grant Funding from National Science Foundation Clarkson University
Ross Taylor/Clarkson Professor Named American Institute of Chemical Engineers Fellow	May 2020	AIChE	Clarkson Professor Named American Institute of Chemical Engineers Fellow Clarkson University
Clarkson Professor Andrea Ferro Receives Mentoring for Research and Scholarship Award	May 2020	Clarkson University	Clarkson Professor Andrea Ferro Receives Mentoring for Research and Scholarship Award Clarkson University
Clarkson University Professor Sitaraman Krishnan Receives Tau Beta Pi Faculty Award	May 2020	Tau Beta Pi	Clarkson University Professor Sitaraman Krishnan Receives Tau Beta Pi Faculty Award Clarkson University
Robert Thomas/Clarkson Professor Recognized as ASTM Emerging Professional	June 2020	American Society of Testing and Materials (ASTM International)	Clarkson Professor Recognized as ASTM Emerging Professional Clarkson University

Federal or Not-for-Profit Grants Awarded

Principle Investigator	Co-Investigator	Source	Amount (to Clarkson only)	Duration (yrs)	Summary
Andreescu, Emanuela Silvana		NSF	\$0 (no cost extension)		Single Particle Investigation of Environmental Chemical Processes using Nano Impact Collision Techniques
Gracheva, Maria E.		NSF	\$0 (no cost extension)		CAREER Coupling nanoscale device modeling with coarse-grained biomolecular simulations
Gracheva, Maria E.		NSF	\$25,245 (supplement)	1	CAREER Coupling nanoscale device modeling with coarse-grained biomolecular simulations
Erath, Byron D.	Ian Michael Knack, Douglas Gordon Bohl and Abul Basar Moammad Baki	NSF	\$288,441 (new)	4	MRI: Acquisition of a Tomographic Particle Image Velocimetry System
Melman, Artem		NIH – Prime RFSUNY – Contractor	\$63,085 (new)	3	Effect of Ferritin Subunit Composition on Iron Core Formation, Morphology and Iron Mobilization: Physical Characterization and Physiological Relevance
Peethamparan, Sulapha		Dept of Transportation – prime	\$250,000 (new)	3	Non-traditional and natural pozzolan based SCMs or inorganic polymers for transportation infrastructure
Gracheva, Maria E.		NSF	\$0 (no cost extension)		CAREER Coupling nanoscale device modeling with coarse-grained biomolecular simulations
Wriedt, Mario		NSF	\$122,921 (supplement)		CAREER Zwitterionic Metal Organic Frameworks with Multi Stimulus Responsive Properties
Martinez, Marcias J.		Dept of Defense - prime	\$20,000 (new)	0.3	ASA 20-07 Finite Element Model for Non-Destructive Inspection (NDI)
Partch, Richard E.		Dept of Defense- prime	\$48,041 (new)	0.5	Physical Vapor Deposition (PVD) as a Method to Produce High Aspect Ratio Conductive Flakes for Advanced Bi-Spectral or Infrared (IR)

Education and Technology Commercialization Activities

Industry-Oriented Education and Training

CAMP “Brown Bag Luncheons”

CAMP holds a Brown Bag Lunch series to discuss research and funding opportunities on selected focus areas. These informal Friday lunches serve as an opportunity to learn about research on campus, build collaborations, discuss the current status of technology development in that field, share experiences pertaining to industry connections and funding, and identify opportunities for collaborative research and industry engagement. Teams of Clarkson faculty facilitate the sessions, and some include short presentations and/or external speakers, in the industry. All Clarkson faculty and industrial representatives are welcome to attend. Between 10 to 18 people participated in each of the five lunches.

STEM Outreach and Industry Support:

CAMP Professor Richard Partch continued to reach out to area high school science teachers who invite him to return to present in their classes on advances in materials that improve and/or save peoples' lives. A STEM presentation was conducted at Massena, NY High School to biology as well as chemistry classes. Professor Partch has shared expertise on chemistry for remediation of Opioid overdose for Canton, NY High School teacher J. Burdick to use in NY State Teacher Conferences and classroom presentations. Professors Partch and Andreescu have co-presented a talk to a member-directed community event, SOAR, in the North Country on printing technology and the use of printing to create portable health monitoring devices.

CAMP is building collaborative efforts with the Brookhaven National Laboratory (BNL) in Long Island, NY to increase capabilities of CAMP's faculty by providing access to world-class state-of-the-art material characterization equipment in support of their industry projects. This year, CAMP entered in a collaborative agreement to offer an advanced materials characterization class taught by BNL experts. Nine (9) Clarkson graduate students mentored by CAMP faculty participated and visited the BNL labs. Professor Andreescu received a material characterization grant from the center for functional nanomaterials (CNF) that allows her group to perform advanced materials characterization work at BNL. A leading BNL scientist, Dr. Mircea Cotlet, presented his research and discussed opportunities for collaboration with BNL. His presentation at Clarkson highlighted the research and capabilities offered by BNL and informed CAMP faculty on how to reach out and access these facilities. These interactions continued with a presentation by Professor Andreescu at BNL on September 23, 2019.

CAMP Instrumentation Training:

CAMP offers user training for all shared user instrumentation. The breadth of training depends on the level of involvement operating a certain instrument requires. The most requested training program is for Scanning Electron Microcopy (SEM), which consists of 120 minutes of lecture on fundamentals followed by eight (8) hours of one-to-one hands on training after which students are evaluated and given a pass/fail depending on their performance. This training program covers topics such as theory, practical aspects of imaging, sample prep, and general best practices.

Commercialization:

CAMP, in collaboration with Clarkson University's Sponsored Research Services and Shipley Center for Innovation, actively seeks opportunities to bring technologies developed in our laboratories to the commercial market for the benefit of our State and country at large. During this period, we saw royalty income from our long-standing relationships with industry, in this case Ferro Corporation. We find it advantageous to support

both licensing of technologies to established companies as well as start-ups to give our technologies the best chance of success. In additions to our royalty activity, we received a number of invention disclosures from our faculty during this period, many from industry-sponsored projects, which indicate an enthusiastic research enterprise that creates a pipeline for commercialization in the future.

Invention Disclosures /Patents

Disclosure /Patent Name	Inventor	Co-inventor	Licensing Partner	Research Sponsor	Description
Method and System for Controlled Nanostructuring of Nanomagnets Patent Number: 10,340,066	Mario Wriedt	Darpandeeep Aulakh, Joshua Pyser, Kim R. Dunbar, Xian Zhang	N/A	N/A	A composite magnetic matrix comprising a porous metal-organic framework (MOF) and a plurality of molecular magnets, where a plurality of pores of the MOF each comprise one of the plurality of molecular magnets, and where the each of the plurality of molecular magnets retains its magnetic properties in the matrix.
Enhanced Contact Electrical Discharge Plasma Reactor for Liquid and Gas Patent Number: 10,357,753	Selma Mededovic	Gunnar Stratton, Thomas Holsen, Christopher Bellona	N/A	N/A	An electrical discharge plasma reactor system for treating a liquid, a gas, and/or a suspension.
Aft Rotor Ducted Wind Turbine Patent Number: 10,563,635	Kenneth D. Visser	N/A	N/A	N/A	A wind energy extraction apparatus utilizing a separate surface enclosing the turbine rotor is disclosed.
Methods and apparatus for a mechanical testing system to characterize the heterogeneous deformation at microscale	Ajit Achuthan	Natasha K Banerjee, Sean Banerjee, Janith Wanniarachchi, Peter-John Z King	N/A	Naval Research Laboratory	Experimental characterization of the mechanical behavior of materials at various length scales is a critical need in various engineering applications.
3D Atmospheric Pressure Plasma Jet Array For Large Uneven Surface Treatment	Selma Mededovic	Shane Rogers, Thomas Holsen, Xudong Su	DMAX Plasma LLC	N/A	The invention is a cost effective and efficient tool for uneven surface treatment and can be used in areas of food decontamination, surgical tools sterilization, biomedical applications, and surface processing.
Mechanism of Bacteria Inactivation on Surface by Atmospheric Pressure Plasma Jet and Uneven Surface Sterilization	Selma Mededovic	Shane Rogers, Thomas Holsen, Xudong Su	DMAX Plasma LLC	N/A	This study proposed a novel design of a 3D atmospheric pressure plasma jet (APPJ) 3x3 matrix array driven by argon gas for large scale uneven surface sterilization.

Start-up Companies Formed:

Nothing to report this period.

Licensing Agreements

Inventor	Licensing Partner
SV Babu	Ferro Corporation
Selma Mededovic	DMAX Plasma LLC
Sitaraman Krishnan	New World Consumer Products LLC

Royalties

Principle Investigator	Co-Investigator	Company Partner	Royalty Income
SV Babu	William G. America & Ramanathan Srinivasan	Ferro Corporation	\$22,964
Selma Mededovic	Thomas Holsen	DMAX Plasma LLC	\$7,500
Sitaraman Krishnan		New World Consumer Products LLC	\$16.28

Small Business Assistance Provided

CAMP Business Development Manager Elisabeth Cain and CAMP Professor Richard Partch continue to engage small businesses and assist them in finding the technical expertise and advice in the area of advanced materials that they require. For example, Professor Cain worked closely with the Adirondack Park Agency (APA), faculty and students to establish collaborations in nanocellulose research and pursue joint applications for state and regional funding in woody/forestry products (Regional Forest Economy Partnerships/State Economics & Infrastructure Development Program). Professor Partch continues to serve as technical advisor to the Northern NY region CITEC to connect area industry with faculty technology experts in CAMP. He has travelled with CITEC personnel, K. Chepeleff and Steve Lockwood, to improve product manufacture at Schluter Co. in Plattsburg to follow up on analyses carried out in 2018; and to Dunn Paper Co. in Gouverneur to improve river water filtration. In spring-summer 2019, Professor Partch arranged for CAMP to do analyses on OX Paper Co. paperboard. He also interacts regularly with the Northern NY region Industrial Development Agency when questions arise about what technical expertise is available in CAMP for advancing their NY State business.

Level of Matching Funds Provided and uses

Expenses (include Federal State, local funds & in-kind)

Operating Expenses	Matching Funds			Total
	NYSTAR Funding	Company Cost Share	Other Sources	
Salaries & Fringe	\$288,186	\$539,215	\$200,407	\$1,027,808
Indirect Costs	\$42,082	\$80,882	\$22,834	\$145,798
Equipment	\$110,178	\$26,485	\$11,430	\$148,093
Materials & Supplies	\$90,160	\$78,450	\$68,323	\$236,933
Tuition	\$8,328	\$74,952	\$16,933	\$100,213
Travel	\$18,883	\$31,831	\$20,405	\$71,119
Subcontractors	\$0	\$0	\$0	\$0
Other	\$10,135	\$25,924	\$181,725	\$217,784
Total	\$567,952	\$857,739	\$522,057	\$1,947,748

Total Federal: \$0

Total In-kind: \$0

Center for Advanced Technology Center for Life Science Enterprise Cornell University

Matt DeLisa, Director

Technology Focus:

Life Sciences

Importance to NYS:

The Center for Life Sciences Enterprise at Cornell University facilitates economic activity and impact in the Southern Tier region of New York State and beyond. The Center has services for business development at all stages of the company start up life cycle, from business idea development to securing multi-million-dollar venture capital funding. The Center contributes to job retention and growth in the state across many industry sectors, including medicine, pharmaceuticals, agriculture, materials science, and engineering. The Center for Life Science Enterprise supports Cornell University’s land grant mission, providing transformative opportunities in the agricultural, veterinary, medical and engineering sectors in New York.

Description of Achievements:

- Fueled the development of promising biotechnologies through matching grants to five Cornell researchers who partnered with life sciences companies in human medicine and agriculture, in the areas of medicine, human nutrition, assisted reproduction, biosecurity, agriculture, and the dairy industry.
- Provided industry education and support through the Entrepreneurship@Cornell summer internship program, which connects Cornell students with NYS life sciences companies for hands-on internships in all areas of product and business development. Eight interns worked with five biotechnology companies and received matching funds from the CAT program and the companies for their internship support.
- Supported 13 high-tech startup companies through the Kevin M. McGovern Family Center for Venture Development in the Life Sciences through intensive business incubation.

Impacts:

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
3	2	\$345,000	\$12,400	\$825,000	\$830,000	\$170,000	\$2,182,400

Designations and Recognitions:

Nothing to report this period.

Federal or Not-for-Profit Grants Awarded:

Project	Principle Investigator	Source	Amount	Duration (yrs)	Summary
Breeding Insight 2: Expansion to Support More Diverse Plant and Animal Use Cases	Moira Sheehan	USDA-ARS	\$4,229,114	1	High-tech plant and animal breeding technology

Improving Maize and Sorghum Efficiency Using Grass Diversity and Computational Modeling	Ed Buckler	USDA-ARS	\$1,206,418	1	Improving food crop efficiency
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Education and Technology Commercialization Activities:

Industry-Oriented Education and Training

In partnership with the Entrepreneurship@Cornell program, conducted a summer internship program with NYS startup companies in the life sciences fields, including agriculture and biofuels, industrial safety, and laboratory product and service technology development. The interns gain invaluable industry experience and training, while the small company gains Cornell students’ expertise and staffing support they could not otherwise receive. The following companies participated this reporting period:

- Capro-X
- Iterate Labs, Inc
- MiTeGen
- Harrick Plasma
- Nova Sterilis

In addition, five graduate research assistants and three scientific staff worked on projects supported by the CAT and received project-specific training and education.

Commercialization:

The Center for Life Science Enterprise awarded matching grants to Cornell researchers, who partnered with NYS companies in medicine and agriculture to develop novel diagnostics and treatment as follows:

- Larry Bonassar, PI, partnered with 3DBio Therapeutics to develop injectable collagen-based materials for the repair of herniated discs.
- Marie Caudill, PI, partnered with Balchem Corporation to determine the impact of the nutrient choline on absorption of docosahexaenoic acid to support optimal fetal brain development and neurological health.
- Cheong, Soon Hon, PI, partnered with MiTiGen to evaluate the impact of automated ultra-fast cooling and warming used in the cryopreservation process for oocytes and embryos for assisted reproduction.
- Laura Goodman, PI, partnered with Sabre Companies, LLC, to improve biosecurity against high-impact animal diseases in the veterinary environment.
- Frank Schroeder PI, partnered with Ascribe Bioscience, Inc., to develop new agricultural products to improve crop yields via microbiome engineering.

Invention Disclosures /Patents:

Nothing to report this period.

Start-up Companies Formed:

Nothing to report this period.

Licensing Agreements:

Nothing to report this period.

Royalties:

Nothing to report this period.

Small Business Assistance Provided:

The Kevin M. McGovern Family Center for Venture Development in the Life Sciences, Cornell's business incubator for life sciences companies, focuses on accelerating research and development of client companies' technology and products, by assisting companies with validation of business plans, securing outside investment, and strengthening management teams. The following small NYS based businesses were in residence at the McGovern Center during the reporting period:

- Ascribe Biosciences - <https://ascribepbioscience.wordpress.com> - Develops agribiotech products to combat major crop pathogens without negative impacts on human health and the environment.
- Dimensional Energy - <https://www.dimensionalenergy.net> - Converting waste carbon dioxide from industrial emissions into solar fuels and feedstocks.
- Dynamic Boundaries - Developing biomimetic materials as injectable treatments for osteoarthritis.
- Ecoelectro - <http://www.ecoelectro.com/> - Improving fuel cell performance, at lower cost thresholds.
- Esper BioSciences, Inc. - <http://www.smallbizdev.cornell.edu/companies/esper-biosciences-inc> - Enabling improved, faster, and more portable DNA sequencing technologies.
- Ionica Sciences - <http://www.ionicasci.com> - Rapid use diagnostic testing platform to detect Lyme disease, mosquito-borne diseases, and STIs.
- MPOd - <https://www.mpod.io/> - Provides diagnostic tools for infectious diseases, including COVID19.
- ORLink - <https://myorlink.com> - Cloud-based software that reduces surgical supply waste, makes operating rooms more efficient, and improves patient safety.
- Renerva - <https://www.renerva.com> - Developing implantable technologies to improve nerve repair procedures.
- Repairogen - <http://www.repairogen.com/> - Enhancing efficiency of skin's natural DNA repair process through protein inhibition technology.
- Sonder Research X - <https://www.aufbauholdings.com/portfolio/sonder-research-x> - Developing diagnostics and therapeutics in ophthalmology and oncology.
- VitaScan Technologies - <http://vitascan.me> - Smartphone enabled point-of-use diagnostic platform for micronutrients.
- ZYMtronix - <http://www.zymtronix.com> - Nanoparticle delivery system for enzymes, with multiple commercial applications

The Biotechnology Resource Center provided scientific core facility services in genomics, proteomics, metabolomics, imaging, bioinformatics, and flow cytometry to the following NYS small business:

- 3DBio
- Applied DNA Sciences
- Cotyra
- Embark Veterinary
- Ichor Therapeutics
- MicroBios

- National Food Lab Inc./Eurofins US
- Nature’s Bounty
- Rheonix
- SeeQC

Also refer to above section Industry Oriented Education and Training for description of internship program collaboration that provides small business assistance in addition to industry-oriented education.

Level of Matching Funds Provided and uses
Expenses (include Federal State, local funds & in-kind)*

Operating Expenses	NYSTAR Funding	Matching Funds		Total
		Company Cost Share	Other Sources	
Salaries & Fringe	\$210,378	\$40,806	\$100,925	\$352,109
Indirect Costs	\$31,557	\$9,767	\$15,139	\$56,463
Equipment	\$0	\$0	\$0	\$0
Materials & Supplies	\$83,400	\$11,052	\$0	\$94,452
Tuition	\$0	\$25,233	\$0	\$25,233
Travel	\$1,270	\$2,387	\$0	\$3,657
Subcontractors	\$0	\$92,692	\$0	\$92,692
Other	\$22,782	\$24,861	\$3,490	\$51,133
Total	\$349,387	\$206,798	\$119,554	\$675,739

* Figures are for period 7/1/19 – 12/31/19. Cornell did not report for period ending 6/30/20 because of COVID closures but rather did a report for period 1/1/20 – 12/30/20.

Total Federal: \$0

Total In-kind: \$0

Advanced Science Research Center Sensor CAT

City University of New York

Dr. Rein Ulijn, Director

Technology Focus:

Sensor Technology

Importance to NYS:

The new Advanced Science Research Center (ASRC) Sensor CAT program (<https://www.asrcsensorcat.com/>) leverages the high-tech instrumentation and scientific research expertise which compose CUNY's ASRC in NYC, a state-funded facility that recently reached its fifth year of operation and has now fully-developed its five interdisciplinary scientific initiatives: Nanoscience, Structural Biology, Neuroscience, Photonics, and Environmental Science. In addition to these initiatives and their staff expertise, ASRC supports the CAT's long-term goals of NYS Industry support with access to its core high tech instrumentation facilities. Specifically, the ASRC has already invested in creating a Next Generation Environmental Sensors Lab (NGENS: <https://asrc.gc.cuny.edu/environment/facilities/ngens/>) designed to support CAT Industry Partnerships with sensor-specific applications and product development.

The ASRC Sensor CAT is already playing a pivotal role in partnering with NYS industry allowing access and utilization of the ASRC's high tech instrumentation facilities for crucial research and innovation during the COVID-19 crisis. It is also uniquely positioned together with CUNY to diversify the STEM-workforce, providing opportunities for internships and workforce training together with its growing community of CAT companies. The program has unique potential to increase awareness, specifically in NYC region, to the diverse resources, both people and instrumentation, that exist within CUNY.

Description of Achievements

Beyond contracting its first CAT projects amidst the pandemic and center shutdown, the ASRC Sensor CAT's achievements can be found in the outreach and establishment of relationships across the wide, diverse CUNY-NYC landscape. On April 7, 2020 the new ASRC Sensor CAT successfully pivoted from original plans for an in-person program opening planned for May to creating in two weeks a webinar designed to bring together scientists, researchers, and industry to discuss innovative solutions for controlling the spread and fighting the COVID-19 crisis (webinar link: [ASRC Sensor CAT: Call to Action Webinar](#)). More than 100 scientists from 22 research institutions and 15 companies joined in this event, which generated wide-ranging interest in the new program and helped to further identify and promote four of these projects for fast-tracking industry partnerships through the CAT.

Additional partnerships of note have been built during this period with CUNY's Baruch College where the Zicklin School of Business together with Field Center for Entrepreneurship, Small Business Development Center (SBDC), and CUNY Startup organizations reside. Together with the CAT, leaders from these entities will co-teach a first of its kind course in the Fall '21 focused on STEM Entrepreneurship – providing CUNY STEM graduate students a focused course where they can learn and explore taking Intellectual Property from the Lab to the Marketplace (creating a pipeline synergistic to CUNY iCorp program).

Opening the door to NYC's growing focus on life sciences industry, ASRC Sensor CAT developed a partnership with the city's LifeSciNYC program where the CAT will pilot cost-share of summer '21 internships for CUNY students, providing those students opportunities with life science start-up companies. This partnership has the

long-term goals of using the CAT as a vehicle to increase opportunities for CUNY students chosen for internships through the LifeSciNYC program. The goal is also to build relationships between those companies and the CAT where it can support further development of their new technology.

Additional achievements are found with establishing structure and organization of the new program, building a strong foundation for its long-term success. That work involved introduction and education of CUNY stakeholders, such as the Technology Commercialization Office (TCO), to the utility of the CAT and its potential to positively impact CUNY and its research efforts across campuses.

Impacts

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
1	0	\$10,000	\$0	\$224,700	\$0	\$0	\$234,700

Designations and Recognitions:

Nothing to report this period.

Federal or Not-for-Profit Grants Awarded:

Nothing to report this period.

Education and Technology Commercialization Activities:

The ASRC Sensor CAT working together with the CUNY TCO and CUNY iCorps participated in the beginning of a workshop series that took place at CUNY’s College of Staten Island on February 27, 2020.

In addition, the CAT’s new business development director participated in the CUNY iCorp Winter bootcamp finale at Queen’s College on January 17, 2020, as a judge. Plans to be a mentor at the NYCRRIN Spring Albany Short Course in March were delayed due to the COVID crisis, but he successfully participated in the virtual CUNY iCorp Lean Start-Up Summer Bootcamp on June 17th-26th. The CUNY iCorp programs relationship with the new ASRC Sensor CAT will help develop a pipeline of new startup companies successfully going on to gain funding and eventually become partners with the CAT.

The CAT, together with the Zicklin School of Business, is developing a first-of-its-kind graduate level course for CUNY STEM students focused on entrepreneurship. The course will be piloted in the Fall of ’21. Students attending the course will bring with them Intellectual Property (IP) developed within the lab or directly from CUNY TCO office to use as a model for product and business development throughout the course. The course will also involve guest speakers and lectures, from NYC Venture Capitalists to CUNY graduate start-up founders, using valuable real-world experiences as teaching tools. Students in the course will also have the opportunity to take this knowledge into potential roles on current CAT industry projects, or further test their startup ideas enrolling in a CUNY iCorp course (a pathway to eventual new company founding and NSF SBIR/STTR funding).

Industry-Oriented Education and Training:

The ASRC Sensor CAT is working to develop relationships with industry partners in NYC and is analyzing use of the Center’s core facilities such that an understanding of key instrumentation and skills of interest can be built into a future industry-oriented training program. Discussions of co-sponsored research began with a major NYS employer based on their current use of the Center. These discussions included internships where set skills training programs can be integrated, and potential industry-sponsored fellowship promoted.

In addition, the ASRC Sensor CAT together with the ASRC Illumination Space (<https://asrc.gc.cuny.edu/illumination-space/>) have begun piloting a Community Sensor Program which began in the Spring of 2020 with its first cohort of NYC area high school students. The program curriculum is now being further developed for the Fall Semester 2020 to include virtual open-source training courses to be utilized by both area schools and community groups. The overall goal is not only of creating a sensor training program across educational ranges from elementary to college, but also providing future CAT Industry partners additional value both in tech development and community and CUNY outreach.

Commercialization:

The new ASRC Sensor CAT is working together with the CUNY TCO to facilitate learning and education related to commercialization of CUNY faculty technology. The ASRC Sensor CAT is in the beginning stages of its new Industry Partnerships and current CAT contracts and plans to support education and development of commercialization strategies together with these stakeholders’ input.

Invention Disclosures /Patents:

Nothing to report this period.

Start-up Companies Formed

Company Name	City	Product/Service	Sector
Dultech	NYC	Sensing platform to detect viruses	

Licensing Agreements:

Nothing to report this period.

Royalties:

Nothing to report this period.

Small Business Assistance Provided

The new ASRC Sensor CAT is working together with the SBDC located at Baruch College to provide new small business creation support. Furthermore, the CAT is leveraging existing resources within other NYSTAR programs and Federal Small Business support programs to guide CAT companies towards support in the areas of legal resources, grant writing, and new business founding.

The CAT itself is also developing a NYS resource guide and connect companies to further support for development of their small businesses. The resources will include information on the vast CUNY support network, similar state-funded programs like the CATs/COEs, local accelerators/incubators, and variety of funding sources existing within NSF and Department of Defense (DoD) programs.

Level of Matching Funds Provided and uses
Expenses (include Federal State, local funds & in-kind)

Operating Expenses	NYSTAR Funding	Matching Funds		Total
		Company Cost Share	Other Sources	
Salaries & Fringe	\$127,041	\$0	\$158,256	\$285,297
Indirect Costs	\$19,056	\$0	\$21,767	\$40,823
Equipment	\$1,448	\$0	\$0	\$1,448
Materials & Supplies	\$0	\$8,964	\$0	\$8,964
Tuition	\$0	\$0	\$0	\$0
Travel	\$1,888	0	\$0	\$1,888
Subcontractors	\$0	\$0	\$0	\$0
Other	\$0	\$0	\$0	\$0
Total	\$149,433	\$8,964	\$180,023	\$338,420

Total Federal: \$0

Total In-kind: \$0

Center for Advanced Technology in Telecommunications

New York University, Polytechnic University

Shivendra Panwar, Director

Technology Focus:

Information Technology & Telecommunications

- **Wireless networks:** The Center for Advanced Technology in Telecommunications (CATT) focuses on radio frequency identification (RFID) and wireless device location technologies.
- **Network Security:** The CATT is a designated National Security Agency Center for Academic Excellence in Information Assurance Education.
- **Network Applications:** The emerging interest in peer-to-peer (P2P) content distribution and decreasing storage network prices will present new opportunities and business models.

Importance to NYS:

The CATT at New York University (NYU), with research support from Columbia University, is designated in the information technology and telecommunications technology focus and operates as a collaborative research center consisting of researchers from the electrical engineering and computer science departments. The CATT conducts collaborative applied research with industry leading to technology transfer and economic impact. Additionally, the CATT conducts industry-oriented education and training, and facilitates outreach and networking on three main areas: Wireless networks, Network Security and Network Applications.

Description of Achievements:

The COVID pandemic has severely impacted the Center. Most PI's, staff and students were involved in continuing in their the educational and research efforts under these very adverse circumstances. This crisis also re-emphasized the role of telecommunications in helping at least part of the economy running in the middle of a pandemic. The use of remote servers, internet service providers and teleconferencing applications has allowed a large fraction of workers to continue working remotely. It has also drawn attention to some of the limitations of technology: Zoom fatigue and the societal divide between those who have good internet access and devices and those who do not are two examples.

The Center has risen to the challenge by continuing to work with client companies, many of whom have gone online. As this report will show, CATT continues attracting new clients and projects, while satisfying existing clients. The overall level of economic impact, match funding and number of projects is stable.

The New York Tech economy continues to grow with Google, Facebook, Apple and Amazon continuing to expand their footprint in New York City, even in the middle of the pandemic, as noted in a recent NY Times article. The availability of deep pools of potential employees, convenient public transport and last, but not the least, the research and training available at area universities like NYU and Columbia University, have facilitated this trend.

NYU continues to do well as a research university and is now ranked 24th nationally in terms of research funding, up from 55th in 2008. NYU ranks first in the nation for licensing income over the last ten years. Eighteen startups were spun off last year. Indeed, NYU spins off 50% more startups per research dollar than the national average. NYU Tandon and CATT have increasingly worked to leverage the resources of the university to achieving greater success in research and entrepreneurship.

NYU Wireless has established itself as the leading center for fifth generation (5G) cellular wireless research in

the US. With the help of NYU Tandon, CATT is getting involved in the ongoing discussion of the perceived weakness of the US industry in the 5G infrastructure sector. There is no US company in this area: Nokia and Ericsson, the two major players in the US, are headquartered in Finland and Sweden, respectively. CATT is in communication with the FCC, DoD and members of Congress on how to address this strategic weakness through enhanced R&D in future 6G cellular systems. The Center believes that it is well placed to lead this effort when funding is in place for this national effort. As a first step, CATT has submitted a pre-proposal to the NSF for a \$25 million Engineering Research Center. Engineering Research Centers are the apex of NSF investments in engineering research, and it will be a big win for NY State if we win this extremely competitive funding.

CATT’s cybersecurity faculty have pioneered a graduate-level online cybersecurity program. The NYU Cyber Fellows program – designed by NYU Tandon in partnership with companies and the New York City Cyber Command (NYC3) – offers scholarships that result in one of the lowest-cost online master’s degrees in the country and develops highly skilled technical graduates ready to step into the growing cybersecurity gap. Over 200 students are expected to join this program this Fall.

Impacts

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
49	319	\$7,687,762	\$605,000	\$3,040,512	\$19,637,082	\$0	\$30,970,356

Designations and Recognitions

Nothing to report this period.

Federal or Not-for-Profit Grants Awarded

Project	Principle Investigator	Source	Amount	Duration (yrs)	Summary
RAPID: Effective Resource Planning and Disbursement during the COVID-19 Pandemic	Quanyan Zhu	NSF	\$150,000	1	The main focus of this RAPID project is to develop a multi-network framework that captures the linkages and inter-dependencies between networks that govern information spreading, panic spreading, and disease spreading in urban populations.
Smart Wearable COVID19 BioTracker Necklace: Remote Assessment and Monitoring of Symptoms	Farokh Atashzar	NSF	\$125,000	1	The project will develop a wireless smart Internet of Things (IoT) necklace, containing multimodality sensors that can accurately and objectively track multiple vital symptoms of respiratory malfunction and infection, covering a large spectrum of COVID19 symptoms.
Agent-based Modeling Toward Effective Testing and Contact-tracing During the	Porfiri	NSF	\$161,124	1	The research will respond to COVID-19 outbreak in real time through a fine-resolution agent-based and data-driven model that aims at providing unprecedented insight in the spread

COVID-19 Pandemic					and potential mitigation strategies of this virus at the city level.
DARPA AISS	Ozgur Sinanoglu	Texas AM	\$270,000	3	Target design flow will provide a means of rapidly evaluating architectural alternatives that address required design and security metrics.
Verizon 5G EdTech Challenge	Thanasis Korakis	VERIZON LLC.	\$310,000	1	The project reflect how transformative 5G technologies will provide extraordinary opportunities in education.
A Fully Digital Transceiver Design for mmWave Communications	Shivendra Panwar	PI RADIO	\$99,807	.5	The proposed technology forms the key technological bridge between the theoretical promise of mmWave and actually achieving it in the real world.
Physics-Aware Learning Framework for Microstructure Design	Chinmay Hegde	Iowa State University	\$150,000	.5	In the project, the team will develop a new machine learning framework called Physics-Aware Learning for Microstructure Design (PALM).
For the Privacy Enhancing Technologies Symposium (PETS)	Damon McCoy	Ford Foundation	\$50,000	1	The annual Privacy Enhancing Technologies Symposium (PETS) brings together privacy experts from around the world to present and discuss recent advances and new perspectives on research in privacy technologies.
Context-Aware Learning for Inverse Design in Photovoltaics	Chinmay Hegde	Iowa State University	\$100,000	2	The DIFFERENTIATE program seeks to leverage the emerging artificial intelligence (AI) revolution to help resolve the energy and environmental challenges of our time.
TYPE A: NSF Student Travel Grant for 2020 Privacy Enhancing Technologies Symposium (PETS)	Damon McCoy	NSF	\$18,000	1	Proposal supports student travel for 18 students to attend 2020 Privacy Enhancing Technology Symposium (PETS), to be held in Montreal, Canada from July 14-18, 2020. This travel grant will enable career development and learning opportunities US-based graduate students.
RAPID: Understanding Entanglement between Panic Spreading and COVID-19 Pandemic in NYC Urban Centers	Quanyan Zhu	NSF	\$150,000	1	"This project will help us better understand the transmission of viruses based on the movement and interactions of people in their environment," says Scott Freundschuh, a program director in NSF's Division of Behavioral and Cognitive Sciences. This type of documentation and modeling could be applied to airports, grocery stores, and playgrounds -- anywhere large groups of people touch things then leave.
Embedded security challenge: An education initiative focusing on cybersecurity	Michail Maniatakos	Army Research Office (ARO)	\$17,666	1	In this project, a red-team/blue-team cybersecurity competition, named Embedded Security Challenge (ESC), is proposed, as part of the NYU annual Cyber Security Awareness Week (CSAW).

Fuzzing/Controlled Excitation and Multi-Modal Sensor Monitoring/Fusion for Hardware, Firmware, Software Integrity	Ramesh Karri	Air Force Research Laboratory	\$250,685	.5	This project will develop techniques to detect anomalies in hardware/firmware/software using robust multi-modal monitoring of processor operation of multiple on-processor, off-processor, and inter-processor digital and analog side channels.
Predicting Visual Symptoms in Patients with Mild Traumatic Brain Injury		New York University School of Medicine (NYU SOM)	\$75,253	1	Using machine learning, including novel feature selection approaches, propose to identify biophysically meaningful diffusion MRI markers relevant to and predictive of visual eye-tracking deficits in patients with MTBI.
Cooperative Secure Learning	Farshad Khorram	BAE SYSTEMS	\$24,788	.5	Formulate the structure and encodings of salient features for cooperative learning over private data sets.
STTR Phase I: Fully-Digital mmWave Lens-Antenna System for Resilient Tactical Communications	Ramesh Karri	Pi Radio	\$49,950	.5	NYU will create a 5G security protocol from an algorithmic viewpoint.
RTL Obfuscation Deployment and Evaluation	Siddharth Garg	The Boeing Company	\$150,000	.5	Cloud Deployment of RTL to GDSII- Deploy ASSURE on Nimbus cloud, verify the locking flow within the cloud environment and make any adjustments, changes needed to deliver a complete working prototype.
STTR Phase I: Establishing a Crowdsourcing Platform for First-Hand Data Collection and Sharing of Critical Resources in COVID-19 Affected Areas	Quanyan Zhu	COVID-19 Research Catalyst Grants	\$7,000	1	This project aims to establish a digital platform of collecting multi-source supply data using crowdsourcing and sharing information with the public.
Examining Prenatal Inflammation and Neurodevelopment in a Longitudinal fetal to Age 9 Imaging Study	Guido Gerig	New York University School of Medicine (NYU SOM)	\$31,373	5	The group will oversee calibration of images across scan time points or scanners including image harmonization, segmentation of brain tissue and subcortical structures, longitudinal modeling of image-derived features including shapes from structural and diffusion imaging, and integration of multimodal images.
Social Feature Engineering and	Rumi Chunara	Blue Cross and Blue	\$240,892	2	The main efforts will concern social feature engineering (social determinants are likely a key

Predictive Health Outcomes		Shield of Louisiana			factor toward predicting engagement and mortality.
Experimental studies of electrical double-layer capacitance	Davood Shahrjerdi	NSF	\$119,960	3	The proposed research explores a new paradigm for precise engineering of the electrical double-layer capacitance of miniaturized graphene electrochemical devices.
Action-perception loops over 5G millimeter wave wireless for cooperative manipulation	Ludovic Righetti	NSF	\$749,999	3	The project takes a holistic approach to control, perception and communication to establish the foundations of edge-based wireless real-time action-perception loops for autonomous robots.
Naming, Twinning and Observing - Towards Scalable, Reliable and Resilient CPS	Henning Schulzrinne	NSF	\$500,000	3	The project aims to improve dependability of Internet of Things (IoT) and cyberphysical systems.
Minimum-Cost Strategies for Sequential Search and Evaluation	Lisa Hellerstein	NSF	\$ 357,511	3	The project research will focus on fundamental sequential ordering problems for search and evaluation.
ASPIRE: Interdisciplinary Research and Education (Renewal)	Nasir Memon	NSF	\$ 2,026,410	5	This renewal project will leverage and improve the resources and infrastructure generated by the current SFS program. The project will support an educational program that relies on a number of high-quality courses in cybersecurity.
End to End Security-Oriented Optimization of Image Acquisition Pipelines	Nasir Memon	NSF	\$497,800	3	This project seeks to tackle: 1) optimization of the imaging pipeline to facilitate reliable forensic analysis in the most challenging conditions; 2) design of training protocols that generalize to various authentication problems; 3) optimization of the entire acquisition and distribution workflow.
Collaborative Research: Frequency Domain Conversion of Computer Aided Design Files to Enable Encryption, Authentication and Feature Search Function	Nikhil Gupta	NSF	\$ 242,697	1	This study will research a novel method of imparting new functionalities in CAD models by converting them to the frequency domain using lossless algorithms. The frequency domain representation allows searching the files for specific design features of interest, which is not feasible in the current CAD file formats. Transformation to the frequency domain opens up possibilities for developing new compression and encryption methods.
Educational Initiative on Cybersecurity in	Nikhil Gupta	NSF	\$ 464,034	3	The project will first develop an introductory graduate level course on Additive Manufacturing (AM) security to be taught at both schools. This

Additive Manufacturing					course will be part of a new Master of Science program and a new certificate program, both in AM.
Toward Energy-Efficient Heterogeneous Computing Integrating Polymorphic Magnetic and CMOS Devices	Shaloo Rakheja	NSF	\$ 299,420	2	This research will connect the physics of such magnetic devices with their use in circuits in which magnetic devices co-exist with and complement silicon devices for enhanced functionality and user experience. Results from this research will be incorporated into a hands-on circuit design workshop organized annually at NYU.
Learning-based Adaptive Optimal Control Principles for Human Movements	Zhong-Ping Jiang	NSF	\$ 293,606	3	This proposal aims to deepen preliminary research in learning-based control theory as a new computational principle of sensorimotor control.
Understanding Information Asymmetry in Smart Grids	Yury Dvorkin	Alfred P. Sloan Foundation	\$249,905	2	To study the role of information asymmetry among stakeholders in distribution system planning and the implementation of distributed energy resources
Understanding Cortical Networks Related to Speech Using Deep Learning	Yao Wang	NSF	\$832,574	3	Developing neural decoders for language processing, developing directed connectivity models, and experimental validation.
Transient characteristics and interference modeling for millimeter-wave communications	Theodore Rappaport	NSF	\$249,688	3	The proposed research integrates measurement, modeling, theory, and analysis to advance fundamental understanding of mmWave communications, providing a means towards designing and evaluating mmWave communication systems.
Online Political Transparency Project	Damon McCoy	Wellspring Philanthropic Fund, Luminate, Democracy Fund	\$875,000	1	This project is focused on improving the transparency of online political advertising.
NYU Cyber Scholarship Program (CySP)	Nasir Memon	National Security Agency	\$170,508	1	CySP is designed to encourage the recruitment of the nation's top cyber talent and the retention of DoD personnel who have skills necessary to meet DoD's cyber requirements and help secure our nation against network threats.
Applied Learning Initiative - Stackable Credentials	Nasir Memon	NYC Economic Development Corp.	\$2,900,000	4	Stackable Credentials Program will provide life-long learning and stackable credentialing through one-month, self-paced modules focused on Cybersecurity and created by industry.

Novel Glaucoma Diagnostics for Structure and Function	Guido Gerig	NYU School of Medicine (From NIH)	\$19,992	1	To investigate the clinical problems associated with the detection and monitoring of glaucomatous changes in retinal structure and function, and investigate new diagnostics for glaucoma.
Development and evaluation of patient-reported outcome score visualization to improve their utilization	Enrico Bertini	New York University School of Medicine (From AHRQ)	\$82,675	1	The specific aims of this research are as follows: <ul style="list-style-type: none"> • Evaluate patient preferences, understanding, usability, and acceptability of modes of PRO score presentation in the patient portal. • Evaluate clinician preferences, understanding, usability, and acceptability of modes of PRO score presentation in the EHR.
CAREER: Advances in Graph Learning and Inference (Transfer from Iowa State University)	Chinmay Hegde	NSF	\$105,091	4	Specific applications studied in this project include, better approaches for monitoring roadway congestion and identify traffic incidents in a timely manner; root-cause analysis of complex events in social networks; and design of better personalized learning systems, lowering educational costs and increasing quality nationwide.
Collaborative: Digital Safety and Security for Victims of Intimate Partner Violence	Damon McCoy	NSF	\$349,970	4	Examines the role of technology in intimate partner violence and investigates the development of new tools, techniques, and theories to combat technology-enabled abuse.
Empirically Validated Perceptual Tasks for Data Visualization	Enrico Bertini	NSF	\$402,405	4	Project will combine past research in the study of human vision, research in data visualization, and new research at the intersection of those two fields to create a model of how the visual system pulls patterns and statistics from visualized data.
An Educational Initiative on Cybersecurity in Additive Manufacturing	Nikhil Gupta	NSF	\$464,034	3	NYU is partnering with New York City College of Technology (City Tech) to educate students and stakeholders in project builds capacity in the emerging field of additive manufacturing security.

Education and Technology Commercialization Activities:

Industry-Oriented Education and Training

CATT’s cybersecurity faculty have pioneered online certificate and graduate-level cybersecurity programs designed by NYU Tandon in collaboration with industry partners and the New York City Cyber Command (NYC3). These programs offer certificate and master’s degree scholarship resulting in the lowest-cost programs from a private, elite university in the country. This workforce development initiative with CATT develops highly skilled technical graduates to fill the growing cybersecurity gap.

CATT continues to work with NYU Tandon’s enterprise learning team to develop tailored programs and course offerings to 10 top, industry partners, most notably JP Morgan Chase, Goldman Sachs, Bank of America, TIAA, ConEdison, and AIG with more than 12,000 eligible employees for economic development for New York State. NYU Tandon has developed these offerings for the ongoing education and training, of the local, domestic workforce. Certificates and Master level programs in mobility, network security, offensive security, and power engineering, have been developed for working professionals.

In addition to the commitment to corporate education and training, industry partners work closely with NYU Tandon Center for Cyber Security through annual Advisory Council meetings, lectures, and research programs as well as the Cyber Security Awareness Week (CSAW) <https://www.csaw.io>. The CSAW competition is hosted virtually from our Brooklyn campus, with over 10,000 participants from the US, Europe, Israel, India, Abu Dhabi, and Mexico. The competition was started by CATT PI Prof. Nasir Memon and Ramesh Karri and is now in its seventeenth year and growing. The collaboration between CATT’s faculty, and industry stakeholders has attracted corporate interest as the venue provides interaction with academics in this critical area and recruiting qualified cybersecurity talent.

CATT is instrumental in raising awareness of the NYU Tandon programs among partners, employees, and the cyber community in general. Enrollment has grown nearly double the size from last year with more than 400 employees from industry partners participating in our cybersecurity workforce development education programs.

Invention Disclosures /Patents:

Disclosure /Patent Name	Inventor	Description
Method and Apparatus for Efficient Reporting of Information in a Wireless Communication System	Arnab Das,	The present invention relates to wireless communications methods and apparatus and, more particularly, to methods and apparatus for reporting and interpreting communicated control information.
System, Method and Computer-Accessible Medium for Predicting Wireless Signal Degradation	Dennis Shasha, Aditya Dhananjay, Marco Mezzavilla, Sundeep Rangan	An exemplary system, method and computer-accessible medium for determining a degradation(s) of a wireless link(s).
System, Method, and Computer-Accessible Medium for Power Measurement for MMWAVE Cellular System	Marco Mezzavilla, Aditya Dhananjay, Dennis Shasha, Sundeep Rangan	An exemplary system, method and computer-accessible medium for determining a particular base station to connect to by a mobile phone.
Aircraft Universal Power Converter	Karimi Kamiar, De Leon Francisco, Wang Duanyang, Liu Shengyi, Tang Qingquan, Gu Dazhong, Colak Kerim, Bojarski Mariusz	The invention discloses an aircraft universal power converter and a power supply system suitable for use by an aircraft. The power system converts power from an unregulated DC power source to multiple AC and DC voltage outputs.
Nanofluid Sensor with Real-Time Spatial Sensing	Kanguo Cheng, Ali Khakifirooz, Ghavam G. Shahidi, Davood Shahrjerdi	A semiconductor structure capable of real-time spatial sensing of nanoparticles within a nanofluid is provided. The structure includes an array of gate structures.

Engineering Energy Storage Devices by Controlling Defects in Carbon-Based Electrodes	Ting Wu, Abdullah Alharbi, Roozbeh Kiani, Davood Shahrjerdi	The carbon-based electrode may be used as an electrode in a supercapacitor or as an anode layer of a rechargeable battery.
Unified Networking System and Device for Heterogenous Mobile Environments	Amandeep Singh, Gaston Ormazabal, Henning G. Schulzrinne.	Method for unified networking for a device in heterogeneous mobile environments includes maintaining and monitoring active network interfaces, managing the location of the device, managing network access security, and many other benefits.
Method and Apparatus for Implementing Space Time Processing with Unequal Modulation and Coding Schemes	Robert Lind Olesen, Eldad M. Zeira, Peter J. Voltz, Yongwen E. Yang, Qingyuan Dai, Chang-Soo Koo, I-Tai Lu, KunJu Tsai	A method and apparatus for implementing spatial processing with unequal modulation and coding schemes (MCSs) or stream-dependent MCSs are disclosed. Input data may be parsed into a plurality of data streams, and spatial processing is performed on the data streams to generate a plurality of spatial streams. An MCS for each data stream is selected independently.

Start-up Companies Formed:

Nothing to report this period.

Licensing Agreements:

Nothing to report this period.

Royalties:

Nothing to report this period.

Small Business Assistance Provided:

Nothing to report this period.

Level of Matching Funds Provided and uses:

Expenses (include Federal State, local funds & in-kind)

Operating Expenses	NYSTAR Funding	Matching Funds		Total
		Company Cost Share	Other Sources	
Salaries & Fringe	\$674,401	\$1,466,208	\$1,759,662	\$3,900,271
Indirect Costs	\$101,160	\$197,491	\$401,711	\$700,362
Equipment	\$34,149	\$26,005	\$55,936	\$116,090
Materials & Supplies	\$14,136	\$848,771	\$459,408	\$1,322,315
Tuition	\$93,700	\$41,282	\$95,351	\$230,333
Travel	\$3,104	\$177,850	\$62,065	\$243,019
Subcontractors	\$0	\$0	\$0	\$0
Other	\$41,710	\$32,468	\$136,159	\$210,337
Total	\$962,360	\$2,790,075	\$2,970,292	\$6,722,727

Total Federal: \$631,093.00

Total In-kind: \$0

Center for Advanced Technology Future Energy Systems (CFES)

Rensselaer Polytechnic Institute

Dr. Jian Sun, Director

Technology Focus:

Energy

Importance to NYS:

The Center for Future Energy Systems (CFES) is a Center for Advanced Technology (CAT) funded by Empire State Development. First designated in 2004 as a CAT, CFES supports New York State energy initiatives and the energy industry through applied research, technology transfer, education, and outreach. CFES research focuses on renewable energy, energy storage, energy efficiency, and smart grid technologies to enable a future energy system that is sustainable, resilient, and economical. CFES also provides the focus of energy research at Rensselaer to connect world-leading expertise of faculty and staff with the needs of the energy industry to spur economic development in New York.

Description of Achievements:

CFES had a strong, successful fiscal 2020 and, since March 2020, demonstrated the commitment and resiliency of our faculty, staff and industry partners as we as overcoming the challenges of the COVID pandemic. Though projects were delayed, and industry match was affected by the shutdown, the year overall was a success from both a research and financial perspective. The Center began 11 new research projects with NY companies resulting in \$2,017,000 of research funding. These 11 new projects involve leadership from 10 of our faculty members. The Center was also awarded \$1,956,000 new research funding from non-NY sources. Together, these awards added \$3,973,000 of new research funds to the CFES research portfolio. Of the 11 NYS companies, five are start-up/small businesses including JEM Engineering, Pterra Consulting, MIMiC Systems, SelfArray, and Orion Polymer. The Center contributed \$463,000 in cost share to New York companies. Overall, 16 collaborative research projects with NYS companies were conducted this reporting period.

NYSERDA and Department of Energy (DOE) are important sources of funding for CFES collaboration with NY industry. New NYSERDA grants awarded to CFES for collaborative research with NYS companies include Orion Polymer (two awards in energy storage) and JEM Engineering (Distributed Energy Resources). The Center was also awarded a DOE grant for research with GE (Advanced Clean Energy project).

Center industry partners reported nearly \$3.9 million in economic impact for fiscal 2020 and over \$32 million over the past five years resulting from their research collaboration with CFES. This year, significant impacts were reported by small and startup companies, including:

- ActaSys Inc.: An RPI start-up that recently re-located to Brooklyn, NY. They develop synthetic jets for EV sensors. The company now has 13 employees and its success is the result of research initiated in 2013 and with continued use of our Wind Tunnel Research facility.
- MICROrganic Technologies: This Castleton-on-Hudson based company has developed a Microbial Fuel Cell platform that eliminates the need for aeration in wastewater treatment, reducing energy usage in wastewater treatment plants by 50-80%.
- MIMiC: A company that makes modular indoor solid-state HVAC systems.
- ORION Polymer: Another RPI start-up that develops ionic polymers for energy storage application.

Impacts

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
12	7	\$468,958	\$311,000	\$486,751	\$2,390,945	\$177,847	\$3,835,501

Designations and Recognitions

Nothing to report this period.

Federal or Not-for-Profit Grants Awarded

Project	Principle Investigator	Co-Investigator	Source	Amount	Duration (yrs)	Summary
20260009 High Fidelity, High Resolution and Secure Monitoring and Control of Future Grids.	Meng Wang		NSF	\$450,000	3	Utilize machine learning and AI techniques to achieve state estimation for a power grid.
20260010 Development of Cryogenic Hydrogen-Energy Electric Transport Aircraft.	Luigi Vanfretti		NASA	\$420,600	3	Design Concept.
20260011 Stable Diacid Coordinated Quaternary Ammonium Polymers for 80-150 C Fuel Cells	Chulsung Bae		DOE ARPA-E	\$600,000	3	Synthesis, characterization and conversion of highly ion conductive and chemically stable, mechanically robust hydrocarbon-based quaternary ammonium functionalized membranes.
20260013 Cyclic Olefin Copolymer-based Alkaline Exchange Polymers and Reinforced Membranes.	Chulsung Bae	Yu Seung Kim from Los Alamos National Lab	DOE EERE	\$400,000	2	Develop a novel class of hydrocarbon-based reinforced composite alkaline exchange membranes
20260021 Model Validation Workflows for Dominion Energy Power Plants	Luigi Vanfretti		Dominion Energy	\$222,000	1	Modeling, validation and calibration of power network generation units.
20260026 Grid X - The Autonomous Digital Grid	Luigi Vanfretti		King Abdullah University of Science and Technology	\$240,000	3	Develop the knowledge needed to design a scalable, reconfigurable, self-optimizing, self-organizing electrical power network.
20260024	Chulsung Bae		Hanwha Chemical	\$300,000	3	Development of specific grafted alkaline polymers that meet

Anion Exchange Membrane Materials Development for Water Electrolysis						specific development targets and evaluation methods for AEM applications.
20260023 Rational Development of Novel Metal Organic Polyhedra-based Membranes for CO2 Capture	Chulsung Bae	University of Buffalo	DOE	\$128,317	1	Optimization of polymer structures to enhance performance of polymer membranes in CO2 separation process.

Education and Technology Commercialization Activities

Industry-Oriented Education and Training

In the fall semester, CFES research supported 10 postdocs, 25 graduate students, and nine undergrads. CFES also enabled the learning experience of 14 undergraduate students in capstone projects with the RPI Multidisciplinary Lab. The first project was an extension of the Wood Chip Drying NYSEDA grant (2014, 2019) with Troy Boiler Works (TBW) to spec a 25 ton/day continuous woodchip drying system. The second was a development of a prototype luminescent solar concentrator for a building facade.

In the spring semester, CFES research supported nine postdocs, 24 graduate students, and 14 undergrads.

Commercialization:

Of the 11 new projects involving NYS companies this year, five were with start-ups and small companies. Partnership with CFES was an integral part of their technology development and commercialization strategy. Three CFES partners participated in the NYSTAR Innovation Summit in Rochester (October) and the Fuzehub Commercialization Awards (November). Combined Energies won a \$50K grant and CFES explored testing protocols to accelerate their universal power converter product development efforts. CFES was also an Exhibitor supporting NY BEST (October) and Industry Day (November) on the RPI campus to introduce faculty and industry clients for potential collaborations.

Invention Disclosures /Patents:

Disclosure /Patent Name	Inventor	Co-inventor	Research Sponsor	Description
Modeling of High Voltage SiC Power Devices	Paul Chow	Collin Hitchcock	NASA	Improvement of SiC power MOSFET devices via field reduction architectures.
Stable Diacid Coordinated Quaternary Ammonium Polymers for 80-150 C Fuel Cells	Chulsung Bae	Ding Tian	DOE ARPA-E	Undertake the synthesis, characterization and conversion of highly ion conductive and chemically stable, mechanically robust hydrocarbon-based quaternary ammonium functionalized membranes.
#10,525,457 Anion Exchange Membranes and Polymers for Use in Same	Chulsung Bae	Angela Mohanty		The market for novel class of anion exchange membranes, made from ionomer resins produced in this program will have an impact on electrochemical devices including fuel cells, electrolyzers, redox flow batteries, and bio-electrochemical systems.

Hydroxide Ion-solvating Polymer Membranes for Alkaline Electrolysis	Chulsung Bae	Gregory Kline	DOE ARPA-E	Novel ionic membrane with advanced stability for alkaline electrolysis systems.
Thermally Stable Hydrocarbon-based Anion Exchange Membrane and Ionomers	Chulsung Bae	Carrie Lynn Trant	DOE ARPA-E	Improvement of highly ion conductive and chemically stable, mechanically robust hydrocarbon-based quaternary ammonium functionalized membranes.
Methods to Detect and Damp Power System Resonance	Jian Sun	Christoph Buchhagen	TenneT	Methods to detect and damp harmonic amplification in power systems, especially in offshore wind power plants and other systems.

Start-up Companies Formed:

Nothing to report this period.

Licensing Agreements:

Nothing to report this period.

Royalties:

Nothing to report this period.

Small Business Assistance Provided:

CFES supported five new small business partnerships this reporting period and that includes grant awards to Orion Polymer (two new NYSERDA awards totaling \$90,000) and JEM Engineering Services (NYSERDA award of \$225,000). Additionally, during this reporting period, we continued progress on collaborative research projects for other startups and small companies including Actasys, Enermat, JEM Engineering, Storen Technologies, Pterra Consulting, and MIMiC Systems. CFES maintained contact with previous small business partners to follow progress and offer assistance including Blasch Precision Ceramics, BioChemInsights, Advanced Polymer Sales, MicroOrganic Technologies, Vyv (formerly Vital Vio) and Self Array.

Level of Matching Funds Provided and uses

Expenses (include Federal State, local funds & in-kind)

Operating Expenses	NYSTAR Funding	Matching Funds		Total
		Company Cost Share	Other Sources	
Salaries & Fringe	\$629,582	\$826,210	\$1,039,058	\$2,494,850
Indirect Costs	\$94,437	\$136,079	\$200,972	\$431,488
Equipment	\$73,334	\$76,132	\$154,525	\$303,991
Materials & Supplies	\$13,308	\$33,698	\$169,023	\$216,029
Tuition	\$115,830	\$0	\$0	\$115,830
Travel	\$7,843	\$5,607	\$52,066	\$65,516
Subcontractors	\$0	\$0	\$340,137	\$340,137
Other	\$2,768	\$2,380	\$0	\$5,148
Total	\$937,102	\$1,080,106	\$1,955,781	\$3,972,989

Federal Match: \$745,911

In-kind: \$0

Additive Manufacturing and Multifunctional Printing (AMPrint) Center for Advanced Technology Rochester Institute of Technology

Denis Cormier, Director

Technology Focus:

3D Printing and Additive Manufacturing

Importance to NYS:

New York State, particularly in the Finger Lakes region, is widely considered to have among the strongest concentrations of printing industry expertise anywhere in the world. Society has largely gone digital though, and document printing companies such as Xerox and Kodak have shed tens of thousands of jobs over the past two decades. Many 3D printing (3DP) and additive manufacturing (AM) technologies are closely related to document printing though, and this represents a unique opportunity for New York State. The 3DP/AM industry has experienced approximately 25% compound annual growth over the past decade. This makes it among the fastest growing manufacturing sectors in the country. These technologies are increasingly becoming critical in the aerospace and defense industries, the medical device industry, and in printed electronics. The AMPrint Center seeks to help New York State equipment manufacturers, material providers, and end users tap into the rapidly growing market for 3DP and AM technologies.

Description of Achievements:

As was the case for everyone, the start of the COVID crisis in Spring 2020 affected the AMPrint Center's priorities. The AMPrint Center was heavily engaged in helping New York State with its COVID response. Several hundred face shields were 3D printed, laser cut, assembled, and distributed. One recipient was Acute Kids Pediatric Urgent Care, which said that it would have had to stop treating patients without the shields. The acute shortage of face masks meant that employees at Rochester Regional Hospital (RRH) had to wear emergency masks at times. RRH was unable to purchase nebulizers needed to test how well the emergency masks were sealing with faces of the wearers. The AMPrint Center staff therefore designed, tested, and 3D printed 80 mask-fit-test nebulizers that were distributed for use in the RRH system. When RIT's Center of Excellence in Advanced and Sustainable Manufacturing was working on an emergency ventilator design, it was unable to 3D print some of the more complex prototypes needed to test functionality of the design. The AMPrint Center stepped in and was able to 3D print these complex parts. The AMPrint Center also worked with the world's largest 3D printer manufacturer (Stratasys) to fast-track FDA testing and approval of one of their 3D printing materials for use in the ventilator.

Although industry research was largely curtailed through Spring-Summer 2020 due to COVID restrictions and lab closures, the AMPrint Center continued its close working relationship with Xerox to develop and commercially release its new metal 3D printing technology. Xerox hired multiple new employees from the AMPrint Center, and it invested heavily in collaborative R&D with the AMPrint Center.

The AMPrint Center also spun out a new startup company called Prisam LLC during this period. Prisam's focus is on development of a new high-speed 3D printing process for large scale carbon fiber composite components. In addition to spinning out Prisam LLC, the AMPrint Center provided assistance in various forms to numerous other small businesses.

3DP and AM is still a relatively young and rapidly evolving industry. In order to support New York State manufacturers, it is critical that the AMPrint Center invest in state-of-the-art capabilities. During this reporting period, the AMPrint Center added several new machines to its already impressive list of equipment. The first addition was a Pinnacle x-ray CT scanner that is used to inspect 3D printed parts for defects. There is very high demand for CT scanning services, and the Center is only aware of two such machines (including this one) in all of Western NY. The AMPrint Center also added two different carbon fiber composite 3D printers. The Center believes that demand for 3D printing with high strength light weight composite materials will grow dramatically in the upcoming decade. Composite 3D printing is therefore a very high priority strategic focus area for the AMPrint Center. The two new composite 3DP equipment additions during this reporting period were an Impossible Objects CBAM machine, and an Anisoprint Composer A3 machine. While Impossible Objects is headquartered in Illinois, there are several New York State connections that include the inkjet print engine and raw material providers. Lastly, a new metal and ceramic part sintering furnace was installed. The AMPrint Center is one of New York State's youngest Centers for Advanced Technologies (5 years old), yet it has one of the most impressive arrays of cutting-edge 3D printing and additive manufacturing equipment in the world. It is a tremendous asset for New York State manufacturers.

Impacts:

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
8	13	\$50,000	\$2,823,700	\$215,000	\$225,000	\$0	\$3,313,700

Designations and Recognitions:

Nothing to report this period.

Federal or Not-for-Profit Grants Awarded:

Project	Principle Investigator	Source	Amount	Duration (yrs)	Summary
1915012206	Iris Rivero	Department of Energy	\$33,333	1.0	Study thermal spray process used to repair broken or damaged metallic components.

Education and Technology Commercialization Activities:

Industry-Oriented Education and Training

AMPrint Center faculty, staff, and students participated in numerous webinars, industry panels, workshops, conferences, and other formal external workforce development activities. Above and beyond formal events, the AMPrint Center hosted an average of 2-3 industry or government visitors per week to provide informal advising or guidance on additive manufacturing materials, processes, or applications.

A summary of other formal events (invited talks, webinars, etc.) during the reporting period are as follows:

1. Markforged User Group Meeting – gave talk to industry panel on uses of carbon fiber composite 3D printing, Jan. 6, 2020, Savannah, GA.
2. NIST Photopolymer 3D Printing Symposium “Panel Discussion: Industry Applications and Developing Markets”, Oct. 30, 2019, Boulder, CO.
3. IISE Manufacturing & Design Division Webinar “Multifunctional 3D Printing”, Oct. 23, 2019
4. EWI Additive Manufacturing Consortium Annual Meeting “Multifunctional Additive Manufacturing” Oct. 17, 2019, Buffalo, NY.
5. NYSTAR Innovation Summit “New Waves of Materials for Additive Manufacturing” Oct. 8, 2019, Rochester, NY.

6. GE Edge and Controls Symposium “Progress Towards Metal AM Via Droplet Jetting”, Oct. 1, 2019, Albany, NY.
7. Additive International Conference “Progress In Metal Additive Manufacturing Via Magnetohydrodynamic Metal Droplet Jetting” July 10, 2019 Nottingham England.

Commercialization:

The most significant commercialization activity for the AMPrint Center during this reporting period pertained to its assistance with Xerox in entering the 3D printing market. Xerox's sponsorship agreements with the AMPrint Center uses the Assigned Project Agreement contract that assigns exclusive ownership of all intellectual property developed as part of the AMPrint Center project to Xerox in exchange for a small fee (\$5,000 or 10% of the contract amount). Xerox has been much more willing to engage in collaborative R&D as a result of this contracting mechanism. During the reporting period, one new joint patent application was filed (below) in addition to two previously reported patent application that are still under review. Several additional invention disclosures were in preparation during the reporting period based on joint research between the AMPrint CAT and Xerox.

Invention Disclosures /Patents:

Disclosure /Patent Name	Licensing Partner	Research Sponsor	Description
Method and System for Operating a Metal Drop Ejecting Three-Dimensional Object Printing to Compensate for Geometric Variations	Xerox	Xerox	Pertains to molten metal droplet jetting strategies intended to improve geometric accuracy in metallic 3D printed components.

Start-up Companies Formed:

Company Name	City	Product/Service	Sector
Prisam, LLC	Rochester	High speed carbon fiber composite 3D printer	Manufacturing

Licensing Agreements:

Project	Inventor	Licensing Partner
1819001	Denis Cormier	Xerox

Royalties:

Nothing to report this period.

Small Business Assistance Provided:

The AMPrint Center launched one new small business startup (Prisam LLC) during the reporting period. The AMPrint Center assisted Prisam through prototyping services, technical advising, and help identifying funding opportunities. The following are examples of businesses helped:

- BonBouton is an NYC startup company developing sensors that go into shoes to detect warning signs that a patient may be at risk for developing pressure ulcers. BonBouton provided the AMPrint Center with its proprietary new carbon ink, and the AMPrint Center developed ultrasonic printing process development parameters for uniform deposition of the sensor material.
- R3 Manufacturing is an NYC startup company developing a new high-speed 3D printing machine. The AMPrint Center printed dozens of copies of R3's 3D print head design using a variety of different

polymer and metal materials so that R3 could iteratively assess performance under different conditions.

- Century Mold is a plastic molding company that is considering adoption of new additive manufacturing technologies in its business. The AMPrint Center worked with Century Mold to provide carbon fiber composite and metal prototypes of components for purposes of evaluating suitability within Century’s business.
- Additive Manufacturing Innovations is a startup company that was spun out of research at Clarkson University. The AMPrint Center helped AM Innovations by preparing samples of 316L stainless steel using the AMPrint Center’s hybrid laser cladding machine.
- Zero Valent previously developed copper nanoparticle inks through collaboration with AMPrint Center faculty, staff, and students. Progress this past year focused on increasing the electrical conductivity of ink formulations through chemistry modification and optimized curing processes.
- Acelorex is a 5-person Rochester, NY startup company founded in 2019 by former print industry engineers. The company is focused on designing and building bespoke digital printing and industrial automation solutions, novel sensors and the IoT.

Level of Matching Funds Provided and uses:

Expenses (include Federal State, local funds & in-kind)

Operating Expenses	NYSTAR Funding	Matching Funds		Total
		Company Cost Share	Other Sources	
Salaries & Fringe	\$421,392	\$113,798	\$60,672	\$595,862
Indirect Costs	\$63,210	\$11,814	\$18,936	\$93,960
Equipment	\$517,782	\$332,966	\$171,545	\$1,022,293
Materials & Supplies	\$21,456	\$6,005	\$57,339	\$84,800
Tuition	\$0	\$0	\$0	\$0
Travel	\$11,026	\$4,844	\$2,513	18,383
Subcontractors	\$86,638	\$36,000	\$77,325	\$199,963
Other	\$262,177	\$102,555	\$25,035	\$389,767
Total	\$1,383,681	\$607,982	\$413,365	\$2,405,028

Total Federal: \$5,003

Total In-kind: \$0

Center for Biotechnology Stony Brook University

Dr. Clinton Rubin, Director

Technology Focus:

Life Sciences, Enabling Sciences & Agricultural Sciences

Importance to NYS:

The Center for Advanced Technology in Biotechnology at Stony Brook University (hereinafter referred to as the "CfB") of the State University of New York (SUNY) is designated in the life sciences, enabling sciences, and biomedical technology focus. The CfB capitalizes upon the intellectual and physical resources of Stony Brook University to catalyze, accelerate, and enhance commercial opportunities to fuel the growth and economic impact of New York's life sciences industry.

Description of Achievements:

CfB continues to fulfill its mission to foster economic growth by serving as an important catalyst in the development of new technologies and emerging companies in New York State. During the reporting period July 1, 2019 - June 30, 2020, CfB's programs contributed to the generation of \$81.2M in new corporate revenues, \$28M in non-government funds acquired, \$11.5M in federal funds acquired, \$229K in cost savings, and \$630K in capital expenditure impacts. Total economic impact for the period was \$121.7M. Twenty-four and a half new jobs were created and 82 retained.

The CfB appointed a new BioEntrepreneur-in-Residence (B-EIR). The B-EIR initiative provides modest milestone-based compensation to select serial entrepreneurs to evaluate the intellectual property portfolios of Long Island's research institutions for the sole purpose of identifying technology they will build a company around. The last milestone payment is tied to completion of a licensing agreement. To date, 11 BEIRs have been recruited to date and have started 12 companies. These early-stage companies have already raised more than \$10 million dollars to date, and several are now looking to secure series A financing (\$20 million).

The Center continues to engage with New York State emerging companies to support their technology and business development needs. Emphasis is placed on supporting formal collaborations between the CfB, emerging bioscience companies and faculty, as well as helping company clients develop their business strategies to attract investment and strategic partnerships. Four new project collaborations between small NYS companies and Stony Brook University faculty have been launched as of July 1, 2019, with roughly \$200,000 awarded under the CfB's 2019-2020 Applied Research and Development Program (ARaD). The awards, along with matching funds from the recipients and other stakeholders, bridge the gap between early-stage technology discovery and later-stage commercial development.

The Life Sciences Summit 2019 took place on November 6th & 7th in NYC and attracted approximately 350 attendees. The objective of the event is to connect emerging biotech companies and academic innovators with the capital and strategic partners they will need to move new discoveries through clinical development. Participants included emerging companies developing next generation therapeutics, devices, diagnostics and research tools, key opinion leaders covering all aspects of discovery, development, and commercialization, strategic industry partners (Pfizer, Merck, Eli Lilly, Boehringer Ingelheim, Alexion, AstraZeneca, etc.), and early-stage investors (MPM Capital, Canaan Ventures, H.I.G. Capital, Osage University Partners, Pappas Ventures, etc.). More than 45 of the most promising emerging companies participated in the formal program and dozens

more attended. Companies invited to present in the Emerging Company Showcase at the Summit are professionally managed with preclinical through Phase 2A and have raised less than \$15M. Several are now in discussion with partners for financing or strategic investment.

Despite the required shut-downs and temporary closing of research labs in NYS due to the COVID-19 pandemic that struck in March 2020, the Cfb’s designation as a BARDA DRIVE business Accelerator allowed us to rapidly connect NYS businesses to the pandemic response and funding opportunities led by BARDA on behalf of the federal government. Similarly, the Cfb’s concurrent designation as a National Institute of Health (NIH) Research, Evaluation and Commercialization Hub helped us connect NYS companies to additional pandemic related funding opportunities available through the NIH. The Cfb developed a portfolio of 21 ventures and academic innovators directly involved in addressing the COVID-19 pandemic. The companies and innovators developed new therapeutic, diagnostic, medical device, PPE, tele-health, and AI enabled technologies to address the needs of New York’s residents.

The Cfb leveraged its extensive network of large biopharma industry advisors (External Review Board), stakeholders (via our Federal NIH REACH & BARDA designations) e.g., Kaiser Permanente, Medicare/Medicaid, United States Patent and Trademark Office (USPTO), and independent regulatory, market access/general business advisors to accelerate life science technologies to the market. The Cfb is highly placed to enable SBU, Long Island, and NY to lead the way in treating this pandemic whilst developing proactive programs to address future emergencies.

Impacts:

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
19	57	\$81,271,868*	\$229,362	\$11,500,748	\$28,050,000**	\$630,555	\$121,682,533

*Includes \$35,757,752 disallowed in 18-19 because back-up was not provided. It was provided with this report

**Includes \$5.5M disallowed in 18-19 because back-up was not provided. It was provided with this report

Designations and Recognitions:

Awards / Recognition	Date Received	Recognizing Organization	Link
Seed/Angel Deal of the Year 2019	12/4/2019	Upstate Capital	https://www.upstatecapital.org/2019-annual-awards-winners-announced
2020 Space Florida Accelerating Innovation award	6/5/2020	Space Florida and the Florida Venture Forum	https://vyv.tech/press-releases/space-florida-florida-venture-forum-announce-winners-of-aerospace-innovation-tech-forum/

Federal or Not-for-Profit Grants Awarded:

Project	Principle Investigator	Source	Amount	Duration (yrs)	Summary
Molecular Functions of Cilia-Planar Polarity Effectors (CPLANES) in Skin	CHEN, JIANG	NIAMS	\$465,174	1	Examine the functions of the CPLANES in skin morphogenesis and homeostasis.
Roles of MIR-129 IN Colorectal Cancer	JU, JINGFANG	NCI	\$359,202	1	Test the hypothesis that miR-129 is indeed a tumor suppressor of colorectal cancer.

MELD: Accelerating MD Modeling of Proteins using Bayesian Inference	DILL, KENNETH A	NIGMS	\$317,007	1	Develop MELD, a computational Bayesian accelerator that “melds” together molecular dynamics simulations with external knowledge.
Irradiating a Mouse Model of Alzheimer’s Disease with X-Ray Microbeams	DILMANIAN, F. AVRAHAM	NIA	\$196,141	1	Propose to irradiate the brain of a mouse model of AD with arrays of parallel, thin planes of x-rays spaced about 1.0 mm on-center.
Mechanism of Slow Onset Snyzyme Inhibition and Translation to Time-Dependent Drug Activity	TONGE, PETER	NIGMS	\$326,975	1	Elucidate the molecular factors that dictate the impact of drug-target residence time on in vivo drug activity.
Novel PET Radiotracers for Imaging Infection	TONGE, PETER	NIBIB	\$350,142	1	Develop radiotracers that can be used for non-invasive PET imaging to detect and localize bacterial pathogens in humans.
Sphingosine-1-Phosphate and Cryptococcosis	DEL POETA, MAURIZIO	NIAID	\$498,277	1	Study the role of the host SK1-S1P pathway in controlling the infection by Cryptococcus neoformans (Cn).
Biomechanics Approaches and Technologies for Enhancing TAVR Outcomes	BLUESTEIN, DANNY	NIBIB	\$764,216	1	Develop next generation TAVR technology; combining imaging, computational, and in vitro tools in a refined biomechanical analysis methodology.
Optimizing the Immune Response by Targeting the STS Enzymes	CARPINO, NICHOLAS A	NIAID	\$572,094	1	Identify and characterize small molecule inhibitors of Sts-1 that can enhance leukocyte anti-microbial responses and demonstrate efficacy in whole animal infection models.
Targeting TSG101 to Identify Inhibitors of HIV-1 Budding by Experimental, Computational and Virtual Screening	CARTER, CAROL	NIAID	\$236,016	1	Goal is to identify small molecules compatible with the interfaces through virtual screening of large commercially available ligand libraries.
New Antifungals Targeting the Synthesis of Fungal Sphingolipids	DEL POETA, MAURIZIO	NIAID	\$590,457	1	Assess the therapeutic potential of novel antifungal agents, identified by our laboratory via screening a ChemBridge library, that target the synthesis of fungal but not mammalian glucosylceramide (GlcCer).

Education and Technology Commercialization Activities

Fundamentals of the Bioscience Industry Program (FOBIP)

The Fundamentals of the Bioscience Industry (FOBIP) is an 84-hour seminars and workshops program, led by industry executives. It provides participants with a comprehensive understanding of product development cycles, regulatory affairs, intellectual property, finance, corporate culture, and other issues unique to the bioscience industries.

In 2020, the program was offered at the Stony Brook University location. Twelve students participated in the 17th offering of the Fundamentals of the Bioscience Industry program. Of those 12 students, there were 4 graduate students pursuing an MS, 7 graduate students pursuing a PhD, and 1 trained scientist looking for a professional pivot. The areas of study and interest that the class of 2020 were involved in included, Biomedical Engineering, Chemistry, Molecular and Cellular Pharmacology, and Neurobiology and Behavior.

The program was fortunate to have all industry professionals who served as Course Directors in 2019 back for the 2020 program. These course directors are professionals working at ChemBio Diagnostics, Columbia University and Westbury Diagnostics. In addition to the Course Director's expertise, Guest Speakers and Reviewers participated in the program this year and represented the following organizations and companies: DevTech Partners, iCell Therapeutics, Traverse Biosciences, ChemBio Diagnostics, Pappas Ventures, Stony Brook Office of Technology Licensing and Industry Relations, and Orange Grove Bio.

Commercialization Fellowships

CfB has continued its Commercialization Fellowship which aims to provide a select number of alumni with time limited appointments (usually 1-3 years) at the CfB. They work side-by-side with CfB senior staff members and industry advisors to develop commercialization strategies and help position clients for their first round of professional financing. Fellows are involved in all aspects of the start-up process. In addition, they attend CfB Advisory Board meetings and Strategy Sessions, serve as team members in the Pre-Seed Workshop/Boot Camp, and serve as moderators and program committee members for the Life Sciences Summit. They also mentor current year participants and oversee graduate students working on client projects.

SBIR/STTR Workshops

CfB provided assistance to eight proposals for the September 5, 2019 SBIR/STTR submission deadline, including supporting a Fast track submission, Phase II submission and Phase IIB submission (August).

CfB held two SBIR/STTR Intensive Workshops and subsequent one-on-one proposal development assistance. The first workshop was in January 2020 and CfB assisted three proposals for the April 6, 2020 SBIR/STTR deadline. Due to COVID-19, the second workshop was offered virtually and in collaboration with Columbia University in May 2020. CfB assisted with ten proposals for the September 8, 2020 SBIR/STTR deadline.

Commercialization:

Long Island BioMentor Initiative

The purpose of the Long Island BioMentor Initiative (LMBMI) is to provide intensive team mentoring to first-time entrepreneurs. The program is modelled after the successful MIT Venture Mentor Service (MIT-VMS), and will continue to be modified to meet the specific needs of the Long Island bioscience ecosystem. Potential mentees are recruited through the Center for Biotechnology's extensive network and are required to formally apply to the program.

During the period of 7/1/2019 – 12/31/2019, CfB hosted 2 mentor breakfast meetings, which included 2 new mentors and 1 new entrepreneur. The mentee introduced themselves and their work to assembled mentors allowing an opportunity for questions by mentors in order to provide enough information to allow mentors to self-select willingness to volunteer for each mentor team.

In January 2020, efforts were made to revitalize LIBMI program and the first couple of months were spent training and evaluating the program. As a result, changes to the program were discussed and implemented, one of which involved merging this program with the CfB’s BioStrategy Sessions with the initial introduction of new entrepreneurs to the LIBMI, instead of being introduced at the Quarterly Mentor Breakfast’s meetings. There will now be Quarterly Mentor meetings to introduce new mentors and entrepreneurs to the program, discuss updates on existing entrepreneurs and other program related topics. CfB’s BioStrategy Sessions provide entrepreneur applicant mentees an opportunity to introduce themselves and their work to assembled mentors allowing opportunity for questions by mentors providing enough information to allow mentors to self-select willingness to volunteer for their mentor team.

Due to the COVID-19 pandemic, meetings are held virtually. The first virtual Quarterly Mentor meeting took place on June 26, 2020, where changes to the program were finalized.

Life Sciences Summit

The Life Sciences Summit 2019 took place on November 6th & 7th in NYC and attracted approximately 350 attendees. The Life Sciences Summit is an early stage investor and business development conference that highlights innovation. The objective of the event is to connect emerging biotech companies and academic innovators with the capital and strategic partners they will need to move new discoveries through clinical development. Participants included emerging companies developing next generation therapeutics, devices, diagnostics and research tools, key opinion leaders covering all aspects of discovery, development, and commercialization, strategic industry partners (Pfizer, Merck, Eli Lilly, Boehringer Ingelheim, Alexion, AstraZeneca, etc.), and early-stage investors (MPM Capital, Canaan Ventures, H.I.G. Capital, Osage University Partners, Pappas Ventures, etc.).

Invention Disclosures /Patents:

Disclosure /Patent Name	Inventor	Co-Inventor	Description
Disclosure	Mei Lin (Ete) Chan	Clinton Rubin	Acceleration of human T-cell expansion In-Vitro using low intensity vibrations to improve bio-manufacturing process.
Disclosure	Labros Meimetis	Eszter Boros	Immunostimulant-cytotoxic conjugates for targeted cancer therapy.
Patent Number: 10,669,227	Lorne Golub		This invention provides a compound having the structure ##STR00001## wherein, .alpha., .beta., X, Y, and R.sub.1-R.sub.11 are defined herein.
Patent Number: 10,658,530	Amirhossein Goldan	Wei Zhao	Provided is a field shaping multi-well detector and method of fabrication thereof.
Patent Number: 2,994,816	Avraham Dilmanian		Radiation therapy with Orthovoltage x-rays and a special collimator.

Patent Number: EP3206488B	Lorne Golub	Frances Johnson	This invention provides a compound having the structure, wherein α , β , X, Y, and R1-R11 are defined herein.
Disclosure	Arie Kaufman	Konstantin Dmitriev, Shreerai Jadhav	Development of a non-invasive diagnostic device to detect cancer.
Disclosure	Anthony Lubinsky	Meredith Beckert, Adrian Howansky, Jacqueline Johnson, Russell	Development of an advanced bioprocessing device that delivers low intensity vibration to different types of cells.
Disclosure	Anthony Lubinsky	Charles Bond, Adrian Howansky, Jacqueline Johnson, Russell Leonard	Development of an advanced bioprocessing device that delivers low intensity vibration to different types of cells.
Patent Number: US 10,427,160	Strey, Helmut	Kimmerling, Robert; Bakowski, Tomasz	This invention relates to microfluidic devices and, more particularly, to microfluidic devices that include a field generator to manipulate tagged analytes, including nucleic acids in single cells to generate cDNA libraries.
US Patent Number: 10,413,383	Abboud, Marcus	Rugova, Sihana Hana	A multi-diameter drill bit for implant bed preparation.
Patent Number: EP 3206488	Golub, Lorne	Johnson, Francis	This invention provides a compound having the structure, wherein α , β , X, Y, and R ₁ -R ₁₁ are defined herein.

Start-up Companies Formed:

Company Name	City	Product/Service	Sector
Point 7, Inc.	Queens, NY	Medical Device (X-Ray Minibeam therapy)	

Licensing Agreements **

Project	Inventor	Licensing Partner
		LineaRx, Inc.
		Curamir, Inc.
		Analogic Canada

**Terms and financial payments to the institution are inter-agency material agreements through The Research Foundation of SUNY's Office of Technology Licensing and Industry Relations (OTLIR). Royalty income associated with the CAT is distributed under proprietary conditions through OTLIR as well; therefore, an aggregate figure is provided below.

Royalties:

Project	Principle Investigator	Co-Investigator	Company Partner	Royalty Income
N/A				\$1,047,826.48

Small Business Assistance Provided

Nothing to report this period.

Level of Matching Funds Provided and uses
Expenses (include Federal State, local funds & in-kind)

Operating Expenses	NYSTAR Funding	Matching Funds		Total
		Company Cost Share	Other Sources	
Salaries & Fringe	\$897,322	\$534,207	\$1,859,554	\$3,291,083
Indirect Costs	\$130,641	\$133,551	\$464,888	\$729,080
Equipment	\$0	\$0	\$46,044	\$46,044
Materials & Supplies	\$64,007	\$176,046	\$247,572	\$487,625
Tuition	0	\$8,860	\$42,028	\$50,888
Travel	\$5,508	\$27,021	\$20,541	\$53,070
Subcontractors	\$25,575	\$0	\$525,203	\$550,778
Other	\$19,790	\$64,630	\$128,277	\$212,697
Total	\$1,142,843	\$944,315	\$3,334,107	\$5,421,265

Total Federal: \$3,229,900

Total In-kind: \$0

Center for Integrated Electric Energy Systems (CIEES)

Stony Brook University

Prof. Benjamin Hsiao, Director

Technology Focus:

Renewable energy

Importance to NYS:

The Center for Integrated Electric Energy Systems (CIEES) work is focused on assisting New York State businesses and utilities in realizing New York State Climate Leadership and Community Protection Act (CLCPA), which envisions transformation of the State's electricity grid to 70% renewable generation by 2030, zero-emission electricity by 2040, and an 85% economy-wide reduction in greenhouse gas emissions from 1990 levels by 2050. The CLCPA also specifies minimum amounts of clean energy generation, including 9,000 MW of offshore wind generation by 2035. To this end, the Center works with businesses engaged in all the aspects of renewable energy generation, storage, energy-related materials and other supporting technologies. In addition, offshore wind resource development is another thrust area of the Center. Located on Long Island, the Center is well-positioned to play a significant role in deployment of wind resources.

Description of Achievements:

During the reporting period, the CIEES made significant progress in advancing its primary mission of promoting economic growth and job creation in the Long Island area of downstate New York. Specifically, the Center executed seven projects with local businesses: Chem Cubed LLC, Bren-Tronics LLC, Flower Turbines LLC, CATNK, MEAn Technology, Pall Corp and Estee Lauder. The new projects coincide with three thrust areas of the center: energy materials, energy generation and energy storage. In addition, we have made solid stride on ongoing projects with existing partners involving Power2Gas (P2G), SWF Technologies, StorEn Technologies, BAH Holdings LLC, Aqua Vectors, Inc., Omnitek, Island Pyrochemical Industries (IPI), Unique Technical Services (UTS), ThermoLift, Inc., National Grid, and Green Power LLC.

Some notable new accomplishments were achieved during the reporting period. First, the Center assisted a traditionally defense-oriented business of Long Island with diversification and re-designing defense-oriented products for the civilian markets. This activity was directed towards making the company more competitive and resilient to federal funding cycles. One of the Center's clients, Bren-Tronics, is such an example. The company derives over 90% of its revenue from defense contracts. Some of the products, such as medium-scale Li-ion battery with an integrated inverter, would be highly suitable in residential storage in areas with high peak demand. CIEES's team assisted Bren-Tronics in developing a marketing and regulatory strategy for the civilian version of its 5 kW/h integrated storage unit. Second, CIEES completed a critical project concerning evaluation of a large-scale battery for StorEn LLC. The battery stayed in an outside enclosure for 15 months.

The CIEES team also assisted in the development of both mechanical and thermodynamic models of a free-piston Vuilleumier heat pump (VHP) under development by ThermoLift, Inc. (Stony Brook, NY). Due to the superior demonstrated performance of ThermoLift heat pumps, in May 2018 Natural Gas Innovation Fund and Emissions Reduction Alberta awarded ThermoLift \$426,500 for the demonstration of an advanced natural gas-driven heat pump and air conditioner in Canada. If the technologies funded by the Fund are adopted at commercial scale, by 2030, nine projects are estimated to reduce the growth in emissions from business-as-usual by up to 4.1 million tonnes of CO₂-equivalent on an annual basis. Currently, ThermoLift heat pumps are undergoing pilot testing in British Columbia, Canada, by the local utility, Fortis BC. Ten customers, five

residential and five small commercial businesses, are testing their natural gas heat pump technology for space and water heating. The ThermoLift heat pump provides space and water heating in one system and is reported to offer efficiencies as high as 160%. This pilot, the first in North America, will test the efficiency, reliability and customer acceptance of the technology. ThermoLift CEO, Paul Swartz, credits CIEES for providing expertise and assistance during the critical stages of the technology development.

Furthermore, CIEES continued to fulfill the mission of training the future workforce and nurturing a new generation of entrepreneurs. For example, the Center cost-shared a program, “Next Generation Engineering Laboratories”. The program was funded as an educational grant by National Grid. This activity aimed to serve students in high needs schools and from underrepresented groups and to meet the requirements of the “Next Generation Science” identified by Stony Brook University. Moving forward, CIEES is teaming up with the College of Engineering and Applied Sciences (CEAS) at Stony Brook University to launch a new program designed to support student startups in engineering with focus on energy technologies. The program will support student teams in STEM fields who are interested in converting their senior projects into startup prototypes and launch entrepreneurial activities. To this end, CIEES will be working with the Vertically Integrated Projects teams from the undergraduate student body in CEAS at Stony Brook University.

Impacts:

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
25	10	\$720,037	\$370,700	\$1,515,000	\$8,842,253	\$262,850	\$11,710,840

Designations and Recognitions

Awards / Recognition	Date Received	Recognizing Organization	Link
Dr. Benjamin S. Hsiao, has been elected a member of Academy of Distinguished Engineers	2019	University of Connecticut, Academy of Distinguished Engineers	https://news.engr.uconn.edu/2019-uconn-academy-of-distinguished-engineers-inductees-speak-about-road-blocks-adversity.php#
Prof. Esther Takeuchi received 2019 Sigma Xi Walston Chubb Award for Innovation	2019	Sigma Xi Walston Chubb Award for Innovation	https://www.sigmaxi.org/programs/prizes-awards/william-procter/award-winner/esther-takeuchi

Federal or Not-for-Profit Grants Awarded

Project	Principle Investigator	Source	Amount	Duration (yrs)	Summary
Building Commercialization-ready Low-cost Deployable Room-temperature Quantum Memories	Mael Flament Eden Figueroa (co)	U.S. Department of Energy	\$1,500,000	2	Engineering of a state-of-the-art, deployment-ready quantum memory based on room-temperature atomic ensembles.
SnappyXO, a robotics platform	Anurag Purwar	National Science Foundation	\$225,000	2	Development of novel robotic platforms.

Institute of Gas Innovation of Technology (I-GIT)	Devinder Mahajan	National Grid	\$100,000	Annual	I-GIT supports advanced concepts in gas technology development and deployment for homes and businesses enabling a sustainable and safe environment.
The Center for Mesoscale Transport Properties (m2m), renewal	Esther Takeuchi	U.S. Department of Energy	\$12 M	5	Focused on understanding and providing control of transport properties in complex battery systems.

Education and Technology Commercialization Activities:

In the 2019-2020 period, CIEES executed a contract with ChemCubed, LLC. The company needed an experienced post-doc in order to synthesize and test the jet-printed materials for flexible electronics. CIEES post-doctoral researcher, Dr. Luyao Li, led the effort in the evaluation of jet printed composites.

In addition, a project with Bren-Tronics is being carried out by a Stony Brook University graduate student, John Fernandez. During the project, John developed a deep knowledge of the regulatory requirements for residential energy storage as well as markets for energy storage in downstate NY.

A project with SWF Technologies also employed three post-doctoral researchers: Drs. Kai Chi, Tom Lindstrom and Priyanka Sharma. The team continues to work on scale-up demonstration of a biomass reactor that can produce energy-efficient water purification nanomaterials from underutilized resources such as agriculture residue.

CIEES also supported the Next Generation Engineering Laboratories (NGELs) program. This program is administered by The Department of Electrical & Computer Engineering at Stony Brook University. During the past year, the program offered two components, one targeting students; and the other targeting counselors, teachers and school administrators. The programmatic interventions were extensions of previous initiatives supported by National Grid, as well as newly designed activities and workshops.

During 2019, about 30 schools brought approximately 800 students across grades 6-12 to Stony Brook University to participate in Design and Build/Create Labs. The majority of these students (73%) attended high-need schools on Long Island and in New York City. The summer camps were offered to 70 middle school students coming from different regional schools. Unfortunately, similar programs were halted because of the pandemic in 2020.

In 2019, CIEES started collaborating with the Vertically Integrated Projects Program (VIP) (<https://www.stonybrook.edu/commcms/vertically-integrated-projects/about/>) under a new “VIP to student startup assistance program”. The purpose of the new program is to promote creation of student startups in STEM areas, such as electrical, chemical and mechanical engineering. The long-term nature of the projects provides students with the opportunity to grow as a team member, make substantial contributions, and rise through the ranks of team leadership. This program will offer grants to student teams (pre-startups) dedicated to take their technology to the startup level. CIEES staff will connect the pre-startups with strategic partners from the business network of Center clients. The program will also provide the necessary training for developing the successful funding strategy, using both federal (for example, NSF SBIR) programs and private funding sources.

CIEES continued to work with the Department of Electrical & Computer Engineering at Stony Brook University on its outreach program during the academic year 2019-2020, as well as the summer of 2020. This effort is committed to serve students in high needs schools and from underrepresented groups and meet the requirements of the Next Generation Science Standards (NGSS)/New York State Science Learning Standards (NYSSLS).

Commercialization:

Bren-Tronics (BT) is a New York based (Commack, Long Island) small business that has been operating continually since 1973. Over the last 47 years, BT developed an array of energy storage products for U.S. Army, Special Forces and Navy. BT derives over 95% of its revenue from Department of Defense (DoD) deliveries. The company recognizes that relying on a sole customer is a risky business position.

CIEES and BT developed a joint proposal and won a NYSTAR military vendor assistance award. The program provides assistance in establishing civilian applications for military products. In this project, BT and CIEES re-designed an existing 5 kWh, 48V battery, currently offered by Bren-Tronics to DoD customers under brand name "Brenergy 480". The CIEES team identified markets and regulations needed to promote the BT battery storage system for civilian applications. Based on the CIEES study, BT is currently re-designing the battery for the residential energy storage market. Specifically, the study identified flood-prone areas, such as South Fork of Long Island as the most promising market for the civilian version of Brenergy 480 unit. If successful, the system can be used in residential household or small developments to address any energy crisis after natural disasters.

StorEn is commercializing the vanadium flow battery (VFB), which is a rechargeable flow battery that employs vanadium ions in different oxidation states to store chemical potential energy. During the reporting period, the CIEES team concluded testing of the battery. The battery was charged up to 100% of the stored energy capacity, 20 kWh, more than 100 times. The team confirmed the high-round trip efficiency and charge retention of the battery. The battery demonstrated stable operation up to the maximum 5 kWh power. However, the tests also revealed certain design flaws that were communicated to the industrial partner and will be considered when StorEn designs their next version of the battery for field-testing.

CIEES teamed with a new startup, **SWF Technologies**, to evaluate the scale-up process of extracting cellulose nanofibers (CNF) from local and underutilized biomass (e.g., agriculture waste) as a sustainable resource, and used these nanofibers for effective adsorption of toxic contaminants (e.g., organics and heavy metals) from contaminated water. Instead of discarding biomass wastes into the environment, waste will be chemically converted into low-cost materials for use in water purification, e.g., adsorbents to remove water pollutants such as, heavy metals, dyes, organic toxicants and ammonium ions.

During the reporting period, CIEES installed four (4) water-processing units at the Advanced Energy and Technology Center. The units will be used to evaluate SWF's technology on a scale of tens of gallons of wastewater. The Center finished a search and hired a post-doctoral researcher, Dr. Kim, who will be performing tests of the water-processing units, including chemical analysis thereof and generating reports for the industrial sponsor.

BAH Holdings is a start-up company developing optical sensing solutions for the petrochemical industry. The company is interested in developing a new generation of gas sensors using the mid-infrared lasers and light-emitting diodes (LED) that are being developed at the University's Electrical Engineering Department. During the reporting period, the company extensively used CIEES facilities for testing of an infrared methane sensor.

The company is entering a testing agreement with National Grid on pilot testing of 200 sensors in the New York City service area. The Center is assisting the company with preparing sensor samples for validation and finding vendors for pilot production of 200 sensor units for the National Grid Field trials. Additionally, the company is working with an established international supplier of portable natural gas sensors on a joint development agreement that would allow BAH's expansion into the portable gas sensing market. CIEES assisted BAH with designing the optical system and validation of this sensor design. Currently, BAH Holding is delivering gas sensors for pilot trials on the National Grid distribution network. In the future, the company will expand the technology to hydrogen and methane-hydrogen sensing.

Invention Disclosures /Patents:

Disclosure /Patent Application Name	Inventor	Co-inventors	Licensing Partner	Research Sponsor	Description
62/777,370- Nanocomposite Scaffolds Containing Cellulose Substrate and Metal Oxide Nanocrystals as Adsorbents for Removal of Toxic Impurities	Benjamin Hsiao	Sunil K. Sharma and Priyanka Sharma	SWF Technologies	RF SUNY	A method for using renewable carboxycellulose nanofibers for treating municipal and industrial wastewater and purifying contaminated water sources in developing countries
62/967,101 entitled Cellulose based substrate derived from biomass to remove Arsenic and other toxic impurities	Benjamin Hsiao	Sunil K. Sharma and Priyanka Sharma	N/A	National Science Foundation	Nanocomposite Scaffolds containing cellulose substrate and metal oxide nanocrystals as adsorbents for removal of toxic impurities
PCT/US19/48603 entitled "Method for Nitrogen Removal and Nitrogen Salts Recovery Using Carboxylated Cellulose Extracted by Nitro-Oxidation"	Benjamin Hsiao	Sunil K. Sharma, Priyanka Sharma and Ken Johnson	N/A	National Science Foundation	A method for removing dissolved nitrogen salts, suitable to cleaning municipal and industrial wastewater from nitrogen

Start-up Companies Formed:

Company Name	City	Product/Service	Sector
SWF Technologies	East Setauket	Nitro-cellulose filter media for energy efficient water treatment	Water treatment

Licensing Agreements

Nothing to report this period.

Royalties

Nothing to report this period.

Small Business Assistance Provided

ThermoLift is a New York-based (Stony Brook, Long Island) small business that was founded in 2012 by Paul Schwartz and Prof. Peter Hoffbauer. For the last 8 years, ThermoLift has been developing natural gas-powered heat engine systems, TCHP, that offer significant advantages over competing HVAC systems and will significantly reduce primary energy consumption, costs, and associated greenhouse gas emissions (GHG). As a three-in-one HVAC system (heating, cooling, hot water), the system will have a smaller physical footprint

compared to conventional HVAC equipment with an approximate size of 48" x 20" x 20". The system is designed to easily integrate into existing buildings (hydronic and air distribution). However, to compete with existing HVAC systems, the TCHP system needed optimization.

During two projects, CIEES engaged University faculty, Professor Jonathan Longtin and Professor Anurag Purwar, who performed extensive thermodynamic analysis of the TCHP system. The analysis suggested several design changes, which made the system more efficient. This development improved the value proposition of the technology over the well-established Freon-based HVAC systems. Improved ThermoLift heat pump systems are undergoing pilot testing in British Columbia, Canada where utility providers set an ambitious target to reduce customers' greenhouse gas emissions by 30% by the year 2030 as indicated above.

Level of Matching Funds Provided and uses
Expenses (include Federal State, local funds & in-kind)

Operating Expenses	NYSTAR Funding	Matching Funds		Total
		Company Cost Share	Other Sources	
Salaries & Fringe	\$783,717	\$161,543	\$1,147,954	\$2,093,214
Indirect Costs	\$89,335	\$37,308	\$286,987	\$413,630
Equipment	\$60,791	\$0	\$5,942	\$66,733
Materials & Supplies	\$93,616	\$1,363	\$63,987	\$158,966
Tuition	\$1,350	\$8,097	\$11,539	\$20,986
Travel	\$12,963	\$8,103	\$107,908	\$128,974
Subcontractors	\$60,763	\$0	\$60,234	\$120,997
Other	\$59,251	\$14,601	\$39,097	\$112,949
Total	\$1,161,786	\$231,015	\$1,723,648	\$3,116,449

Total Federal: \$721,761

Total In-kind: \$0

Center for Advanced Technology in Nanomaterials and Nanoelectronics State University of New York Polytechnic Institute (SUNY Poly)

Michael Fancher, Director

Technology Focus:

Nanotechnology

Importance to NYS: As New York State has made significant efforts and investments to become and remain a leader in high tech fields and to attract companies and jobs to the State, the Center for Advanced Technology in Nanomaterials and Nanoelectronics (CATN2) has supported much of the advancements in the semiconductor and related technical fields that have driven and supported New York's position as a high tech leader.

Description of Achievements:

- **CATN2 Launched Two More Rounds of Successful Matching Investment Program (MIP):** The CATN2 successfully issued two more competitions for funding under the Center's MIP. The MIP was developed to address the research, development, and deployment needs of NY based companies to work with the CATN2 and collaborate with SUNY Poly faculty and to successfully leverage and build upon the capabilities available at SUNY Poly. The third round leveraged \$395,000 of Empire State Development/NYSTAR funding to enable \$1.53M in Matching Commitments supporting four industry partners in clean energy, power electronics, quantum computing, and gene therapy-centered faculty research. The fourth round was launched to strengthen New York's response to the global COVID-19 pandemic and was initiated late during this reporting period.
- **Production of PPE for Health Care Workers:** CATN2 faculty have used 3D printing technology previously purchased with CATN2 MIP funds for another project to help mitigate a national shortage of personal protective equipment (PPE) for health care workers by manufacturing parts for face shields. The parts being fabricated are based on a design shared by a team at SUNY New Paltz. Face shield components were printed 24/7. This project supported the front-line medical workers at eight local hospitals and medical facilities with nearly 300 face shields that were desperately needed in the early days of the COVID-19 pandemic.
- **SUNY Research Seed Grant program:** The CATN2 also leveraged its capabilities to support four COVID-19 pandemic related projects that were funded through the SUNY Seed grant program administered by SUNY Poly.
- **Start Up Founder Selected for Forbes 30 Under 30:** During this reporting period SUNY Poly alumni and co-founder of Eonix Energy Don Derosa was honored by Forbes Magazine as a 30 Under 30 Innovator in the energy industry. The CATN2 has in the past and continues to support Eonix through project development and sponsorship as well as business support and advice as well as preparing grant materials and practicing for various pitch events.
- **Co-Hosted the Inaugural Corporate Venture Exchange:** A new activity that was launched during this reporting period is the CATN2's sponsorship of the Corporate Venture Exchange which was hosted at SUNY Poly in co-sponsorship with NY CREATES and in partnership with Center for Economic Growth and several others. This event was to support early stage companies to pitch to, meet with, and ultimately

receive equity investment from the venture arms of large international advanced electronics companies.

Impacts:

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
22	18	\$362,000	\$2,139,745	\$20,869,386	\$13,505,000	\$2,674,500	\$39,550,631

Designations and Recognitions:

Nothing to report this period.

Federal or Not-for-Profit Grants Awarded:

Project	Principle Investigator	Source	Amount	Duration (yrs)
Improving SiC Wafers and Processing for Lower Costs and Higher Reliability	Sung, Dr. Woongje	Alliance for Sustainable Energy LLC	\$250,000	2.5
Development and Implementation of a Semiconductor Workforce Certificate Program based on a Unified Advanced Manufacturing Competency Model	Geer, Dr. Robert	National Science Foundation	\$6,000,000	3
SMART SiC Power ICs	Sung, Dr. Woongje	US Department of Energy	\$678,540	2.5
SOI Wafer Development and Post CMOS Devices for NRL/DOD requirements	Lee, Dr. Ji Ung	US Naval Research Laboratory	\$450,400	2
A Search for Novel Efficient P-Type Nitride Materials	Shahedipour-Sandvik, Dr. Fatemeh	National Science Foundation	\$254,862	3
Pervasive Manufacturing Infrastructure of GaN Qualified Electric Device Vehicle Power Electronics	Shahedipour-Sandvik, Dr. Fatemeh	Structured Materials Industries Incorporated (federal flow through)	\$66,000	.75
Long Life High Brightness Photocathodes Using III-nitride Materials	Shahedipour-Sandvik, Dr. Fatemeh	Structured Materials Industries Incorporated (federal flow through)	\$33,500	.75
I-Corps: High Purity Metal Additive Manufacturing	Denbeaux, Gregory	National Science Foundation	\$50,000	1.5
SUNY-IBM AI Collaborative Research Alliance-Resistive Random Access Memory (RRAM) for AI Applications	Cady, Nathaniel	SUNY	\$50,000	1
SUNY-IBM AI Collaborative Research Alliance-Group III-Sb Alloys for Multilevel Phase Change Memory	Oktyabrsky, Serge	SUNY	\$50,000	1
Processes for Fabrication of Atomically Precise Strongly Correlated Materials	Cady, Nathaniel	Xallent (federal flow through)	\$71,401	1
Role of the Phosphoprotein Phosphatase PTP1B in Cardiac Hypertrophy 20-23	Boivin, Benoit	National Heart Lung and Blood Institute	\$449,603	3.25
OIC Business Model Strategy	Ference, Stephen	Griffiss Institute	\$53,820	.75

Education and Technology Commercialization Activities

Industry-Oriented Education and Training

- **Engage, Enrich, and Educate (E3):** CATN2 has successfully implemented a comprehensive E3 approach in preparing the high-tech workforce by focusing on 1) Engagement, to attract potential workers; 2) Enrichment, to build a workforce pipeline; and 3) Education and training, that is industry-oriented. E3 efforts have included management leadership of regional, state-wide, national, and international activities. These activities were coordinated by the Office of Educational Outreach and include students from more than 50 school districts and community organizations. Engagement efforts have emphasized exposure to careers in nanotechnology. Enrichment efforts have targeted high school students through internships and high school classwork.
- **Future Leaders in Integrated Photonics (“FLIP”) program:** In the FLIP program, undergraduate students are matched with projects and mentors in integrated photonics for a summer; the program’s goal is to expose students to the technology and spark an ongoing interest. Rising seniors from across the country participate in hands-on research internships at select American Institute Manufacturing (AIM) Photonics academic member institutions. The internships give the students practical experience and exposes them to professional opportunities available in the field of integrated photonics.
- **Northeast Advanced Technological Education Center (NEATEC):** The NEATEC supported training facility occupies 15,000 SF of space in SUNY Poly’s Donovan Hall at the Utica campus. Utilizing significant financial investment by the CATN2, this facility includes workforce training specific toolsets for Mechatronics and Advance Manufacturing workforce training. These latter components leverage SUNY Poly’s NSF Northeast Advanced Technological Education Center (NEATEC), which is implementing workforce training programs in various technology areas that are relevant to regional employers. The NSF and SUNY capital investment includes multiple telepresence facilities for distance delivery and online training programs.
- **Advanced Manufacturing Training for Fort Drum Soldiers_Career Services Programs :** NEATEC provided seven Career Services Program Briefings promoting post-military service careers in Advanced Manufacturing at the Fort Drum Army Base in Watertown. These on-base workshops reached approximately 420 soon to be veterans who will be re-entering the private sector workforce and are seeking fulfilling careers that build on the skills they have developed in the military and what additional skills would be required by potential employers. Additionally, NEATEC provided career and training information to attendees at two on base Career Fairs. Each event drew approximately 180 soldiers, spouses and retirees.
- **Advanced Manufacturing Technician Training Workshops:** NEATEC provided two Advanced Manufacturing Technician trainings at the Lewis County Jefferson Community College Education Center in Lowville. These trainings were provided to 18 soon to be veterans who will be re-entering the private workforce and are seeking the skills needed by national employers. In 2020, the workshop series was expanded from 64 hours to 72 hours. Based upon soldier feedback and observation, the professors created a new, 16-hour section covering Basic Electricity/Electrical Controls concepts to help prepare the soldiers for fault detection and remediation during the Mechatronics part of the training. The entire series now consists of the following topics: Advanced Manufacturing Practices, Pnuematics Technology, Basic Electricity/ Electrical Controls and Mechatronics. Throughout the training, the soldiers received 15 presentations from advanced manufacturers from across the US highlighting their

maintenance/tool technician job opportunities in an effort to entice the soldiers to apply. These companies included: Anaren, Applied Materials, Boeing (presented to both classes), Danfoss, Huhtamaki, Indium (presented to both classes), GlobalFoundries, Panasonic, Simmons Power Tool, TECH Power, WestRock and ETS Jobs (representing manufacturers from throughout Northern NY and New England). As a result of the training, many of the participating soldiers applied for and secured interviews with the presenting companies.

- **GlobalFoundries Technician Training Session:** The CATN2 continues to provide administrative and logistical support towards the GlobalFoundries technician training sessions to provide them with technician level training to upskill their current and growing workforce. One of the key goals of the NSF funded NEATEC program is to focus on building a highly skilled technical workforce in the northeastern region of the US to create a career pipeline that builds interest in the semiconductor and nanotechnology manufacturing fields.
- **Pathways in Technology Early College High Schools (P-TECH):** The CATN2's supported NEATEC facilities were leveraged to support the IBM P-TECH program, which is part of a global effort by IBM encompassing more than 200 P-TECH schools reaching more than 100,000 students in 18 countries. Although much of the anticipated P-TECH related activities were cancelled due to the COVID-19 pandemic, NEATEC did host P-TECH groups for facility tours to more than 40 students.

Commercialization:

To support broad commercialization impacts the CATN2 supported the establishment of an ongoing outreach and networking through referral networks in 1) RD&D Industry Alignment Frameworks (Manufacturing Institutes and Centers); 2) RD&D Shared-Use Facilities; 3) Strategic Economic Development Initiative Partnerships; and 4) Entrepreneurial Programs.

RD&D Industry Alignment Frameworks (Manufacturing Institutes and Centers):

The CATN2 has developed and implemented a successful RD&D industry alignment framework by establishing manufacturing scale test-beds with significant investment from industry, state and federal government, and the educational institution resulting in the launch of manufacturing institutes and centers. These investments have: incentivized capital expenditures; enabled cost savings by providing access to billions of dollars in specialized equipment; enabled increased acquisition of funds to support shared projects; and created and retained jobs including directly with industry partners that use the test-beds as well as at the shared-use facilities operated on behalf of the industry partners. This model results in a hybrid outcome where multiple companies share in the consortia activities without directly operating the facilities, owning the assets, acquiring the outside funding, or expending the resources exclusively.

RD&D Shared-Use Facilities:

The CATN2 is co-located within the SUNY Poly's CNSE Albany campus and provides critical support encouraging collaboration between private industry and SUNY Poly by enabling applied research, development, and technology transfer.

- **SUNY Poly's Albany NanoTech Complex (200 and 300mm pilot lines):** SUNY Poly's Albany NanoTech Complex, home to CNSE and the CATN2, is a one-of-a-kind fully-integrated research, development, prototyping, and educational facility that among other things encompasses over 135,000 sq. ft. of state-of-the-art manufacturing scale clean rooms to support the >\$300 billion nanoelectronics industry. The success of the complex results from providing strategic support through outreach, technology

acceleration, business incubation, pilot prototyping, and test-based integration support for onsite corporate partners, including IBM, GlobalFoundries, Samsung, Applied Materials, Tokyo Electron Limited, ASML, and Lam Research, as well as other “next generation” nanotechnology research activities. During this reporting period, the CATN2 has been working to expand business outreach and development efforts, to develop new streamlined pathways for NYS companies to perform preliminary research and development work, and to bridge their product concepts into the 300mm wafer fab in order to rapidly commercialize their innovations.

Entrepreneurial Programs

- Corporate Venture Exchange:** The CATN2 collaborated with NY CREATES to launch the inaugural Corporate Venture Exchange (CVE) hosted at SUNY Poly. This event gives early stage companies an opportunity to meet with and receive equity investment from the venture arms of large international advanced electronics companies. Pravina Raghavan, EVP, Small Business and Technology Development provided one of the keynote addresses. The format resembled other business pitch competitions; however, the goal was not to win a plaque or trophy, but to receive equity investment in the range of \$2,000,000 to \$100,000,000 from one of the corporate venture groups.

Twenty-three early stage companies participated in the event and presented to five strategic corporate venture organizations and one institutional venture organization, the ESD Venture Fund. These pitches led to forty-eight one-on-one follow up meetings with all the venture firms having four to six meetings with each participating company. Several of these meetings have led to ongoing interest and discussions. Given the size of the investment and the due diligence required no investments were made during the reporting period, but the feedback received has been promising.

Invention Disclosures/Patents:

Invention Disclosure Name	Inventor	Co-inventor
Encapsulation in Hydrogel Tubular Structure and Methods of Making the Same for Biological Applications	Matthew Jorgensen	Sujith Kollampally, Yubing Xie
Deuterated SiCOH Low-K Dielectric to Prevent Time-dependent Dielectric Breakdown in Nanostructured Semiconductor Devices	Patrick Lenahan	James Lloyd, Niaz Mahmud
Ixodes (Tick) Neuropeptide G-protein Coupled Receptors Useful as Targets for Acaricides and Compounds Identified Using the Same	Barry Knox	Cory Knox
Method for Improving Polishing of Metal and Non-metal CMP by Cerium oxide Nanoparticles with Engineered Valence States	Kathleen Dunn	Christopher Netzband
GaN anneal-activation	Vincent Meyers	Fatemeh Shahedipour-Sandvik
ReRAM performance stabilization via TEL COR clean	Karsten Beckmann	Nathaniel Cady, Martin Rodgers, Shyam Sridhar (TEL), Sergey Voronin (TEL), Qi Wang (TEL)
Multiplexed Quantitative Fluorescent Detection of Antibodies and Biomarkers for Serological Diagnosis	Nathaniel Cady	
Extended P-well Region for SiC MOSFETs	Woongje Sung	
Air-treatment device for face masks	Iulian Gherasoiu	

Design for SiC MOSFETs for increased channel density	Woongje Sung	
Photonic Biosensors for Diagnostics	Nathaniel Cady	
Issued Patent Name	Inventor	Co-inventor
Integrated Photonics Including Waveguiding Material	Thomas Adam	Douglas Coolbaugh, Gerald Leake
Wafer Scale Bonded Active Photonics Interposer	Douglas Coolbaugh	Douglas La Tulipe, Gerald Leake
Submitted Patent Application Name	Inventor	Co-inventor
Deuterated Low-k Dielectrics to Prevent Time Dependent Dielectric Breakdown in Semiconductor Devices	Patrick Lenahan	James Lloyd, Niaz Mahmud
Photonics Structure with Integrated Laser	John Bowers	William Charles, Douglas Coolbaugh, Douglas La Tulipe, Gerald Leake
Photonics Optoelectrical System	John Bowers	William Charles, Douglas Coolbaugh, Douglas La Tulipe, Gerald Leake
Resistive Random Access Memory Device	Karsten Beckmann	Nathaniel Cady, Joseph Van Nostrand
Selector Devices for a Memory Cell	Karsten Beckmann	Nathaniel Cady
Hetero-Nuclear and Homo-Nuclear Clusters of Tellurium and Iodine as EUV Resists	Robert Brainard	
Cerium Based Chemical Mechanical Polishing Slurries	Kathleen Dunn	Christopher Netzband
Molten Micro-/Nano-Droplet Deposition for Additive	Gregory Denbeaux	
Integrated Photonics including Waveguide Material	Thomas Adam	Douglas Coolbaugh, Gerald Leake
Ceria Based Chemical Mechanical Polishing Slurries	Kathleen Dunn	Christopher Netzband
Machine and System for Automated Cutting and Delivery of Tape and Composite Prepreg	Jonathan Hall	Daniel Long, Margaret Matson, Andrew Wichelns, Yu Zhou
Enhancing Lithography Via Photoresist Surface Charging and Induced Electric Field	Gregory Denbeaux	
Devices and Methods for Producing Tubular Systems Useful in Cell Culture	Matthew Jorgensen	Sujith Kollampally, Yubing Xie
Fabricating Photonics Structure Conductive Pathways	Douglas Coolbaugh	Gerald Leake
Vacuum Particle Detection, Capture and Measurement System	Gregory Denbeaux	Yashdeep Khopkar
A Novel Fluid Cooling System using a Combination of Embedded Channels and Cold Plates	Leila Choobineh	Bahgat Sammakia
Wafer Scale Bonded Active Photonics Interposer	Douglas Coolbaugh	Douglas La Tulipe, Gerald Leake

Start-up Companies Formed:

Nothing to report this period.

Licensing Agreements:

Nothing to report this period.

Royalties:

Nothing to report this period.

Small Business Assistance Provided:

Throughout this reporting period the CATN2 provided various services and assistance to NY based small businesses including the following:

- Access to state-of-the-art process and metrology equipment and expertise
- Proof-of-concept support
- Pilot-prototyping services
- Manufacturing Scale-up
- Technology demonstration and test including metrology, characterization, and reliability
- Business development support
- Federal and state outreach support, including grant proposal drafting
- Funding for collaborative research projects
- Identify and assist in securing SUNY Poly students to serve as interns, research assistants, etc.
- Access to expertise and subject matter experts through faculty, students, and other partners
- Develop and provide a wide range of specifically tailored workforce development programs
- Entrepreneurship support – including business plan drafting, company introductions, guidance, pitch preparation, supporting business plan competitions and corporate venture exchange, etc.

Some of the NY based small business that were provided these services during this reporting period included: BESS Tech; Cytocybernetics; Eonix Energy; Glauconix Biosciences; Hocus Locus; Lux Semiconductors; Magnolia Optical Technologies; Marktech Optoelectronics; Menlo Microsystems; Neutral Physics Corporation; NY Wired for Education; SeeQC; and sxRNA Technologies

Level of Matching Funds Provided and uses:

Expenses (include Federal State, local funds & in-kind)

Operating Expenses	NYSTAR Funding	Matching Funds		Total
		Company Cost Share	Other Sources	
Salaries & Fringe	\$368,675	\$195,370	\$137,660	\$701,705
Indirect Costs	\$55,143	\$36,091	\$28,204	\$119,438
Equipment	\$184,644	\$0	\$37,731	\$222,375
Materials & Supplies	\$37,074	\$34,527	\$14,553	\$86,154
Tuition	\$0	\$9,067	\$16,628	\$25,695
Travel	\$5,312	\$13,265	\$13,868	\$32,445
Subcontractors	\$0	\$0	\$0	\$0
Other	\$37,749	\$10,727	\$65,073	\$113,549
Total	\$688,597	\$299,047	\$313,717	\$1,301,361

Total Federal: \$0

Total In-kind: \$0

**Center for Advanced Technology in Computer Applications and Systems
Engineering
Syracuse University
Pramod Varshney, Director**

Technology Focus:

Information and Telecommunications Technology

Importance to NYS:

The Computer Applications and Systems Engineering (CASE) Center for Advanced Technology at Syracuse University is designated in the information technology and telecommunications technology focus.

CASE works with company partners to conduct research aimed at developing and improving products and services that utilize large quantities of different types of information about the environment (physical, biological, cyber) or human behavior (marketing, financial, social networks), analyze the information and determine an appropriate action or response. These systems depend on sensors, hardware, software, humans and on reliable and secure information networks both wired and wireless. Specific applied research areas include high assurance software and systems including cyber security and verification, distributed networks and data mining including information fusion, situation awareness for unmanned systems, real-time targeted customer data delivery, and wireless telecommunications. The CASE's capabilities are expressed as interdisciplinary expertise in complex information intensive systems, including monitoring and control, predictive analysis, intelligence, security, and assurance.

Description of Achievements:

CASE at Syracuse University (SU) continued to realize outlined goals and objectives, focusing activities to increase measurable economic impact and position CASE for continued success. CASE continued to be instrumental in delivering on the commitments of Upstate Revitalization Initiative, providing: support to GeniusNY finalist companies, access to unmanned aerial vehicles (UAVs) and Federal Aviation Administration (FAA) licensed pilot for faculty and industry partners, technical support for UAVs and data security activities, assisting CenterState CEO with attraction activities, and working with key industry partners from start-ups to multinationals on related projects. Center leadership and staff continue to engage the Industry Advisory Board, faculty researchers, industry partners, and key university and community constituents in serving the New York State industry and scientific communities.

Collaborations across Boundaries: CASE remains an active member of NUAIR and was instrumental in securing broad University-wide participation in NUAIR's annual conference by being a main conference sponsor in partnership with various other SU departments, as well as SU's Autonomous Systems Policy Institute (ASPI). CASE continued facilitating faculty and industry use of the FAA-designated UAS Test Bed. In addition, CASE continues to play a key role in the CNY Defense Alliance and to support the Cyber Research Institute.

CASE has continued to broaden capacity across academic disciplines and industry fields, including engaging new faculty, continuing expansion into UAV and autonomous vehicle research, and growing collaborations across all SU colleges. CASE continues to partner with the College of Engineering and Computer Science for a range of research activities. It is also actively involved in NYSTAR's newly launched effort to re-engage CAT's more

actively via a newly formed committee facilitated by the Commission on Independent Colleges, although this effort was paused due to the pandemic.

CASE, Fuzehub (in place for CNY TDO) and NYS Science & Tech Law Center and SUNY Upstate’s Biotech Accelerator (CNYBAC) partnered to present the Center’s annual NEXT Conference in November 2019 to over 30 exhibitors and 150 visitors. CASE continues to engage with local economic development organizations to promote university-industry interactions to advance economic vitality for the region. In October 2019, CASE attended New York State Innovation Summit in Rochester, as part of NYSTAR’s annual meeting.

Incubator: CASE’s incubator averaged 70% capacity during the reporting period. CASE was able to quickly fill the large space that SU’s Corporate and Foundation Relations left vacant. Several new companies have expressed interest in the space and negotiations are ongoing. CASE works closely with the CenterState CEO/Syracuse Technology Garden, StartFast, Launch NY and other partners in the Innovation Hotspot to provide supportive services and information for incubator companies.

Impacts:

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
36	18	\$4,800,866	\$1,379,021	\$8,484,862	\$1,079,787	\$1,044,500	\$16,789,036

Designations and Recognitions:

Nothing to report this period.

Federal or Not-for-Profit Grants Awarded:

Project	Principle Investigator	Source	Amount	Duration (yrs)	Summary
19210004	Dr. Varshney	Thales USA	\$125,000	1.2	Assessment of sensor data behavior using post analysis tools.
19210005	Dr. Zoli Dr. Bhatia (co)	Quanterion Solutions Inc.	\$46,541	1	HDIAC BCO monitors and extracts Scientific and Technical Information documents, databases and electronic paper and other media.
20210001	Dr. Sanyal	Akrobotix	\$31,981	1	Conducting software-in-the-loop (SITL) simulations of the guidance, navigation and control (GNC) algorithms

Education and Technology Commercialization Activities:

- CASE, in partnership with the Department of Electrical Engineering and Computer Science (EECS), continues to support an annual colloquium series on technical topics, from distributed sensor networks, information fusion and machine intelligence, to AI.
- The CASE Industry Co-op program continues to be successful, placing students in a variety of short- and long-term positions within local companies to gain direct work experience and provide opportunities and encouragement to remain in the region after graduation. The Co-op program continues without

interruption and conducts a range of recruiting and promotional activities. During this reporting period, our co-op program placed 70 students with 37 employers.

- We also featured a sports-panel discussing innovation in sports, with a focus on fan engagement as a potential new cluster in the greater Syracuse region. As usual, the event included several educational workshops for workforce development, updates to our UAV cluster, and on how to bolster regional industry capabilities, as well as a Technology Showcase featuring IP from presenting partners (including CAT IP) with commercial potential and funding opportunities to bring it to market.
- CASE continues to work with the New York State Science and Technology Law Center to deliver commercialization and intellectual property training.
- CASE continued to work closely with the Syracuse Technology Garden, LaunchNY, StartFast and other organizations offering events and learning opportunities for technology start-ups throughout Central New York.

Commercialization:

- CASE has worked closely with CenterState CEO and NUAIR to attract new business to the region. CASE hosted Elbit, Sentinel Blue, MDP Partners, NSIN and several other companies brought to the region by CenterState CEO.
- CASE regularly refers businesses to CNYTDO for training and assistance with various aspects of improving operational performance, as well as sending faculty and industry partners there for SBIR/STTR information and guidance.
- CASE is a member of NUAIR, which has a waiver for Class C airspace, including parts of the Syracuse University campus. Our new laboratory assistant is working towards his PART 107 certification to become a UAV pilot.
- CASE is a founding member and active supporter of the Central NY Defense Alliance, an industry group that supports all information-related industry activities in the region.
- CASE helps to promote CEO’s NYGenius and Grants for Growth Programs, working together with CEO, The Technology Garden, CNY TDO, other universities, and range of representatives from industry to refer companies seeking funding to enable university-industry collaboration with significant commercial potential. CASE is working with other winners of the Genius awards to assist them in achieving their business goals, especially prototype design and hiring students to assist with research and development.

Invention Disclosures /Patents:

Disclosure /Patent Name	Inventor	Co-inventor	Description
Optically and Mechanically Active Nanoscale Media	Patrick Mather	Ryan Mather, Amir Torbati	See issued patent 10,519,568 https://patents.google.com/patent/US10519568B2/en?q=10%2c519%2c568 Development of a polymer that can coat medical devices that would be implanted in the human body, aids in imaging of the placement of the device without the use of x-ray equipment that may be harmful.

Functionally Graded Shape Memory Polymer	Patrick Mather	Xiaofan Luo, Andrew M. DiOrio, Kyung-Min Lee	Patent 10,471,648 https://patents.google.com/patent/US10471648B2/en?q=10%2c471%2c648 This technology allows for packaging labels with specific visual properties that can inform the inspector of the highest temperature that a package experienced in transit, which is useful in the transport of temperature sensitive materials – drugs, chemicals and food.
Efficient Channel Estimation and Symbol Detection for Massive MIMO-OFDM	Biao Chen	Michael Gans, John Matyjas	Patent 10,411,913 https://patents.google.com/patent/US10411913B2/en?q=10%2c411%2c913 This system may be used to improve broadband wireless communications, satellite to ground communications and air to ground communications (including UAVs). There are existing commercial applications for this technology including in broadband wireless communications including 4 and 5G.
Dried Attractive Lure and Kill Stations for the Control of Aedes Aegypti	David Larsen	Anna Stewart, Marco Neira	Patent 10,400,084 https://patents.google.com/patent/US10400084B2/en?q=10%2c400%2c084 Bait stations have lower ecological impact over spraying insecticides to control Aedes Aegypti, the yellow fever mosquito. There is a potential for this technology to reduce the Aedes Aegypti population (found in limited locations in the world), which would reduce the spread of diseases such as dengue fever, yellow fever, Zika as well as other diseases.
Shape Memory-Actuated Materials for Accelerated Healing of Orthopedic Injuries	James Henderson	Patrick Mather	Patent 10,368,993 https://patents.google.com/patent/US10368993B2/en?q=10%2c368%2c993 This technology is system of shape memory polymers that can repair critically sized bone defects by filling defects, providing stabilization and engineering grafts that support remodeling. This would negate the need to harvest bone grafts from the patient and reduce the number of surgeries on a patient.
Amphiphilic Graft Copolymer for Waterborne Shape Memory Coatings	Patrick Mather	Xinzhu Gu	Patent 10,336,911 https://patents.google.com/patent/US10336911B2/en?q=10%2c336%2c911 This is a waterborne shape memory polymer that can be used as a coating for flexible substrates, like hair, fabric, paper and plastic film. The substrate can be trained to a particular shape by applying heat and cooling, and then return to original shape
Exciton Qubit Array	Bruce Hudson	Steluta Dinca, Michael Sponsler	This invention would provide quantum computing elements that operate at room temperature. The commercial market is still in development.
Improved Protein Binding for Treatment of Cancer and Cystic Fibrosis	Robert Doyle	Brandon Milliken	This invention would use a protein binding to screen for analogs that would improve treatment of cancer and cystic fibrosis.

Binding Assay	Yan-Yeung Luk	Arizza Chiara S. Ibanez	This invention is an assay that may be used to screen drug candidates for efficacy in preventing bacterial swarming to help treat bacterial infections.
Spray-Coated Filtration Material	Ian Dean Hosein	Saeid Biria	This invention is a coating that can be applied to fabric to improve the filtration value of cloth masks.
Battery Formulation to Enable Cold Conditions Operation	Ian Dean Hosein	Saeid Biria	This invention is an electrolyte for use in lithium ion batteries and could increase performance of lithium ion batteries in extremely cold temperatures.
Wastewater Surveillance Platform	David Larsen	Mary B. Collins; Hyatt Green; Brittany Kmush; Lee McKnight; Frankl Middleton; Teng Zeng	This technology is a testing and monitoring system for community wastewater to identify viral hot spots before symptoms appear in that population. This invention has market potential for municipalities to help prepare for the medical and health services needs of a population.
Exosomes Generation for Treatment	Zhen Ma	Tackla Winston	This technology would allow large-scale production of stem cells for therapeutic purposes and reduce the need for perinatal stem cells.
Room and Building Condensate Testing	Eric Allan Schiff	Paul K. McCarthy	This invention would collect room aerosols to test for pathogens, which could help monitor the air quality of an indoor space.
Steerable Robotic Needles	Wanlian g Shan		This invention is a needle that can be used by robotic systems during surgical operations that would improve maneuverability during biopsies and cancer treatments.

Start-up Companies Formed:

Company Name	City	Product/Service	Sector
Cantius Therapeutics, LLC	Lansdale, PA & Syracuse, NY	TBD	Technology
3D Microfluidics	Liverpool, NY	TBD	Technology

Licensing Agreements:

Project	Inventor	Licensing Partner
203	NA	Sensgard LLC
100727	NA	Canusia LLC
100667, 100754	NA	A Therapeutics Startup in Boston
244		Cooper Atkins
100851		Niche Vision
100814		Garwood

Royalties:

Nothing to report this period.

Small Business Assistance Provided:

From July 1, 2019, to December 31, 2019, CASE supported 8 small businesses with a total of \$80,846 in support. From January 1, 2020, to June 30, 2020, CASE was able to support 7 small businesses with a total of \$68,474 in support. The beginning of the pandemic in March of 2020 only slowed the second half of our project year by 15%. The CASE team was still able to provide small businesses with a cumulative total of \$149,320 in support during the 2019-2020 project year, allowing those small businesses to continue production, growth, and employment.

Level of Matching Funds Provided and uses:

Expenses (include Federal State, local funds & in-kind)

Operating Expenses	NYSTAR Funding	Matching Funds		Total
		Company Cost Share	Other Sources	
Salaries & Fringe	\$620,904	\$889,746	\$153,206	\$1,663,856
Indirect Costs	\$78,980	\$55,991	\$22,981	\$157,952
Equipment	\$0	\$0	\$0	\$0
Materials & Supplies	\$583	\$3,260	\$0	\$3,843
Tuition	\$0	\$0	\$5,740	\$5,740
Travel	\$1,625	\$8,184	\$2,216	\$12,025
Subcontractors	\$0	\$0	\$20,185	\$20,185
Other	\$106,506	\$52,043	\$168	\$158,717
Total	\$808,598	\$1,009,224	\$204,496	\$2,022,318

Total Federal: \$0

Total In-kind: \$0

Center for Advanced Technology in Big Data and Health Sciences University at Buffalo

Dr. Norma Nowak & Jeffrey Dunbar, Co-Directors

Technology Focus:

Life Sciences, Enabling Sciences and Agricultural Sciences

Importance to NYS:

The University at Buffalo Center for Advanced Technology in Big Data and Health Sciences (UBCAT) resources comprise the necessary interdisciplinary life sciences technology and faculty portfolio to advance the development of innovative products at the intersection of big data and medicine, emphasizing pharmaceuticals, medical devices, and diagnostics. The Center identifies and develops industry partnerships resulting in economic impacts through Center project funding with companies fitting the Center's technology focus following a formal review and selection process. In addition, the UBCAT Co-Directors and Business Development team actively work with New York State companies to develop future project prospects on an ongoing basis, in line with its strategic imperative to expand the Center's outreach to small, medium, and large companies across New York State. The Center works collaboratively with academic, technology transfer and business development partners to provide these elements to foster technology development, creation of start-up companies, expansion of existing businesses locally and across NYS, and attraction/relocation of outside firms.

Description of Achievements

The UB CAT completed its third year under the technology focus of big data at the intersection of medicine as it pertains to diagnostics, therapeutics, and medical devices. UB CAT's business development and marketing teams have worked to coordinate and enhance outreach to connect innovative UB faculty and companies locally and across the state. There were 19 active projects in the 2019-2020 reporting period with 10 granted a no cost extension to 2020-2021.

UB CAT's faculty experts continue to engage with industry partners through CAT funded collaborative projects or establish startups of their own to diversify the CAT portfolio of companies. While several faculty members continue their engagement through CAT funded projects with industry partners, new faculty have been attracted to participate in the program across several schools including UB's School of Dental Medicine, the Jacob's School of Medicine and Biomedical Sciences and the School of Engineering and Applied Sciences.

Projects funded during this reporting period span Health Sciences areas that include the generation, analysis, and integration of big data sets. Examples include: medical device development for preventing wound infections post joint replacements (Garwood Medical Devices); real-time monitoring of biomarkers in the body during drug treatment (**Efferent Labs**); biomarker validation to detect unruptured brain aneurysm (**NeuroVascular Diagnostics**); and drug discovery and novel methods of drug delivery to treat various cancers (Concarlo Holdings, **For-Robin**, POP Biotechnologies).

The NYS Center of Excellence in Bioinformatics and Life Sciences (CBLS) and UB's Center for Computational Research (CCR) continue to provide access to core technologies and data analytics for the funded company projects. Examples are: NeuroVascular Diagnostics is leveraging the CBLS Genomics and Bioinformatics Core and the Biorepository to collect patient samples, detect and validate blood based genomic biomarkers.

Enhanced Pharmacodynamics and Veronomics are leveraging CCR's high performance computing capabilities and technical staff.

Impacts:

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improv's	Total Impacts
106	15	\$5,855,047	\$1,227,999	\$5,619,905	\$15,121,197	\$1,063,913	\$28,888,061

Designations and Recognitions:

Awards / Recognition	Date	Recognizing Organization	Link
Dr. Norma Nowak received the Industry Beacon award for her impact that extends beyond the C-Suite to advance the interests of the New York's bio/med industry.	October 2019	MedTech	
Garwood Medical - Top 10 medical device companies to watch in 2020	June 2020	Qualio	10 Impressive Medical Device Startups to Watch in 2021 (qualio.com)
Garwood Medical - Breakthrough Device designation	October 2019	FDA	https://www.prnewswire.com/news-releases/fda-grants-breakthrough-device-designation-to-bioprax-biofilm-disruption-device-300943042.html
Rheonix - Received Emergency Use Authorization (EUA) for their COVID-19 assay	April 2020	FDA	https://rheonix.com/rheonix-inc-receives-fda-emergency-use-authorization-rapid-fully-automated-molecular-covid-19-test/
Circuit Clinical™ Selected as a 43North Winner in the 2019 Competition	Nov 2019	43North	https://www.prnewswire.com/news-releases/circuit-clinical-selected-as-a-43north-winner-in-the-2019-competition-300965365.html
Circuit Clinical received the Industry Pioneer award for blazing a trail of innovation, integrity and ingenuity	October 2019	MedTech	

Federal or Not-for-Profit Grants Awarded:

Project	Principle Investigator	Source	Amount	Duration (yrs)	Summary
Exosome protein microRNA one stop (Exo-PROS) biosensor: a new liquid biopsy for precision cancer immunotherapy	Dr. Yun Wu	Cancer Research Institute Incorporated	\$100,000	1	Develop a cutting-edge liquid biopsy test which uses a small chip-like device to quantify circulating biomarkers in blood to screen patients for immunotherapy and monitor treatment.

Co-delivery of Pfs230C1 and CSP with CoPoP, a versatile, potent liposomal adjuvant system for multi-stage malaria vaccine	Dr. Jonathan Lovell	PATH Malaria Vaccine Initiative	\$325,212	1	Evaluate the capacity of CoPoP liposomes to co-deliver Pfs230 and circumsporozoite protein (CSP), two leading malaria vaccine candidates with demonstrated efficacy in Africans for blocking human-to-mosquito and mosquito-to-human transmission.
SBIR Phase II: A Blood-Based Test to Identify Patients with Intracranial Aneurysm	Dr. John Kolega	Neurovascular Diagnostics Incorporated	\$39,701	1	Optimize gene expression signature in blood to be used for diagnostics and begin transferring assessment of the biomarker to a cheaper diagnostic platform.
Development of Tumor Targeted Nanoparticles to Combat EGFR TKI Resistance	Dr. Yun Wu	Health Research Inc.	\$37,500	1	Test the potential of Axl-VDCTA091-LP as a novel therapeutic agent to sustain vitamin D signaling and combat EGFR TKI resistance by co-targeting quiescence and EMT.
Targeting Histone K4 Methylation for Treatment of Alzheimer's Disease and Related Dementia	Dr. Zhen Yan	National Institute on Aging	\$506,436	5	Propose to further reveal the role of H3K4me3 in AD pathophysiology and treatment.
A Cobalt Porphyrin Nanoliposome Adjuvant for MHC-I-Restricted Cancer Peptide Vaccines	Jonathan Lovell	National Cancer Institute	\$1,907,104	5	An approach to effectively generate antigen-specific CD8+ T cells. AH1 is a MHC-I H-2Ld model CD8+ epitope derived from the gp70 murine leukemia virus antigen.
Rationally Designed, Spontaneous-Particleized Pfs48/45 for a Multivalent Malaria Vaccine	Jonathan Lovell	National Institute of Allergy & Infectious Disease	\$2,123,955	5	Developing a highly effective malaria vaccine is likely required to eradicate the disease.
An adjuvanted influenza vaccine platform for dose sparing, multiplexing, and rapid deployment	Bruce Davidson	STTR - POP Biotechnologies LLC.	\$134,246	1	This STTR Phase 1 proposal involves the development and characterization of a unique vaccine platform that has been developed by the company POP BIO.

Education and Technology Commercialization Activities:

Industry-Oriented Education and Training

UB CAT supports and partners with Sandra Small, Ph.D., Science Education Manager, who leads a multitude of workforce development opportunities for a variety of ages and education levels. Her duties include science career education outreach, genomics and bioinformatics education in formal and informal K-16 environments through UB's Genome, Environment and the Microbiome Community of Excellence (GEM), and interfacing with new and growing companies to help fulfill their workforce needs.

During this reporting period, UB CAT implemented a pilot workforce development and internship program for UB students registered in an undergraduate or graduate program focused on Genomics, Proteomics, Bioinformatics, Medical Informatics, Machine learning, AI (Artificial Intelligence) and Data Science. A partnership was developed with UB's Genomics, Genetics and Bioinformatics Graduate program to offer paid internship opportunities during summer. One student was selected to intern as a pilot in the CBLS Genomics and Bioinformatics Core. The student trained with our bioinformatics team and received hands-on experience analyzing and managing large volumes of genomic data. As a result of the internship the student has accepted a position at ThermoFisher Scientific located in Grand Island. ThermoFisher Scientific recently set up an Omics R&D Laboratory in the Center of Excellence in Bioinformatics and Life Sciences (CBLS) and serves as an anchor tenant. Additional UB departments will be engaged and extend this opportunity to prepare students for the new wave of job opportunities requiring skills in big data analytics. This program also organically leverages the talent, expertise, and the technology infrastructure at the CBLS.

Student-Oriented Workforce Development

- **Health Sciences Symposium:** In 2018, Dr. Small organized the first annual Health Sciences Symposium for high school juniors who are part of area Health or Life Sciences Academies. This was a one-day event with concurrent sessions focused on all aspects of health sciences, including surgery, dentistry, research, drug development, and infection control. Over 100 students, from three school districts, participated. The response from participating students and teachers was overwhelmingly positive and planning began for the second annual Health Sciences Symposium, which was postponed due to the COVID-19 pandemic.
- **Science Exploration Day:** Science Exploration Day (SED) is a science conference for area high school students, held annually in March. Students spend a day on UB's North Campus and select 3 sessions to attend, from a list of 26. Dr. Small continues her role on the planning committee for this event and secured funding from National Grid for 300 Buffalo Public School students to attend. She has also been instrumental in recruiting new presenters for the small group sessions. This event was scheduled for March 18th and was postponed due to the COVID-19 pandemic.
- **Partnership with GEM:** UB's "Genome, Environment and Microbiome" Community of Excellence (GEM) was initiated in 2015. One of GEM's missions is to increase education and awareness of genomics, the microbiome and the effect of the environment on both. Dr. Small works with both GEM and UB CAT on genome and microbiome education in the community and in K-12 schools. Dr. Small has worked with local educators to develop new lessons to encourage genome and microbiome education in schools. This partnership broadens the educational reach already being supported by UB CAT. School visits were occurring with Buffalo Public Schools but were suspended due to the COVID-19 pandemic.

Invention Disclosures:

The University of Buffalo reports eight (8) invention disclosures, however these are CONFIDENTIAL, and the information has been redacted from this report.

Start-up Companies Formed:

Nothing to report this period.

Licensing Agreements:

The University of Buffalo reports five (5) licensing agreements, however these are CONFIDENTIAL, and the information has been redacted from this report

Royalties:

The University of Buffalo reports 11 royalties totaling \$93,968; however, these are CONFIDENTIAL and the information has been redacted from this report.

Small Business Assistance Provided

Nothing to report this period.

Level of Matching Funds Provided and uses:

Expenses (include Federal State, local funds & in-kind)

Operating Expenses	NYSTAR Funding	Matching Funds		Total
		Company Cost Share	Other Sources	
Salaries & Fringe	\$452,324	\$56,333	\$321,761	\$830,418
Indirect Costs	\$69,849	\$8,450	\$48,147	\$124,446
Equipment	\$23,081	\$8,874	\$124,628	\$156,583
Materials & Supplies	\$115,092	\$98,290	\$23,510	\$236,892
Tuition	\$5,655	\$7,560	\$0	\$13,215
Travel	\$1,174	\$0	\$679	\$1,853
Subcontractors	\$0	\$0	\$0	\$0
Other	\$231,692	\$270,425	\$67,333	\$569,450
Total	\$898,867	\$449,932	\$586,058	\$1,934,857

Total Federal: \$80,406

Total In-kind: \$0

Center for Advanced Technology in Emerging and Innovative Sciences

University of Rochester

Mark Bocko, Director

Technology Focus:

Photonics and Imaging Science Systems

Importance to NYS:

Photonics, Optics and Imaging constitutes a major industry cluster centered in the Rochester and Finger Lake region of New York State. Global revenues for photonics enabled products from displays to telecommunications exceeds \$2 trillion dollars annually and New York State is a major source of the goods and technologies that serve and drive these global markets. Cooperative innovation and technology transfer between our region's Universities and the NY photonics industry cluster has been the priority of Center for Advanced Technology in Emerging and Innovative Sciences (CEIS) from its founding 28 years ago, and we continue to drive innovation and investment in regional resources like American Institute of Manufacturing (AIM) Photonics, to provide technology support for major industry partners like L3Harris and Carestream, and to support the growth of startup companies like Clerio Vision, LighTopTech and many others.

Description of Achievements:

For the period July 2019 through June 2020, CEIS awarded close to \$400,000 to 22 faculty researchers collaborating with 14 companies on 18 different projects. These collaborations have allowed 25 students the opportunity to receive training relative to the research. On October 30th, CEIS sponsored the annual Veteran Business Expo and Procurement Technical Assistance Center (PTAC) Matchmaker event. This event is an opportunity for Veteran businesses to meet and present their products and services to dozens of Prime Contractor/Government Agency buyers and purchasing agents. In addition to the networking opportunity, there are professional development and training programs available. The Veterans Business Council reported a record number of attendees and Primes/Agencies attended the event. On the anniversary of the 2nd moon landing (Apollo 12 mission), RIT Professor Zoran Ninkov attended a meeting of lawmakers and academics convened by Assemblyman Clyde Vanel to promote the development of space technology in New York State. Professor Ninkov represented RIT as well as CEIS (Zoran is a long-time CEIS affiliated researcher) and brought along copies on the CEIS annual report to highlight the space-related efforts that already exist. A follow-up meeting is under discussion.

Impacts:

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
18	15	\$1,916,467	\$2,807,309	\$23,031,808	\$14,036,000	\$53,000	\$41,844,584

Designations and Recognitions:

Awards / Recognition	Date Received	Recognizing Organization	Link
WetWare BioSystems, LLC/ Swarm Starter winner	10/5/2019	Ain Center for Entrepreneurship at University of Rochester	https://www.rochester.edu/aincenter/2019/10/17/swarm-starter-2/

Molecular Glasses/Audience Choice Award	7/2/2019	Luminate NY "Light Today with Tomorrow" Demo Day	https://www.youtube.com/watch?v=zqJYT2qErTM
Molecular Glasses/Finalist	11/19/2019	FuzeHub NYS Commercialization Competition	https://fuzehub.com/commercialization-competition-apply-2019/

Federal or Not-for-Profit Grants Awarded:

Project	Principle Investigator	Source	Amount	Duration (yrs)	Summary
Development of Flow-Through Sensors for the Detection of Bladder Cancer in Urine Samples	James McGrath	NSF Partnership for Innovation	\$249,435	6 months	The project will develop technologies for the capture of diagnostically valuable exosomes and extracellular vesicles on silicon nanomembranes using tangential flow microfluidics.
Ultrafast Laser Welding and waveguide inscription for Hermetic Packaging of Nano-implant Chips	Jie Qiao	DOE/Lawrence Livermore National Lab	\$120,000	11 months	
Deep Transfer Learning Across Domains, Modalities and Classes	Andreas Savakis	Air Force through Integrated Fusion Technologies	\$60,000	10 months	Transfer learning is valuable in practice where classification systems operate across different domains, sensors, and classes.

Education and Technology Commercialization Activities:

Internal Workforce Development

- A.N. Jordan Scientific - One PhD student was involved in this work, and it will contribute toward her dissertation.
- Corning, Inc. – Three RIT students have been working on this project during this reporting period. MS graduate student (Rahnuma Chowdhury) is now working for GlobalFoundries in Malta, NY.
- Clerio Vision, Inc. - PhD students work closely with several Clerio employees on certain projects directly related to their thesis work. We have developed an excellent model for interactions with Clerio wherein students can get an education and experience with the corporate ('startup') environment.
- SiMPore, Inc. - One MS student received training on this project and formed the start-up, parVerio, after graduation.
- LC Orthopedics - Two MS students worked on this project, one graduated May 2020, the other will graduate Dec 2020.
- Kitware – An MS and PhD student, Brian Blakeslee and Navya Nagananda, have received training on this project and our student Abu Taufique (Imaging Science PhD student), worked at Kitware as full-time co-op during the summer term of 2019.
- L3Harris – Two PhD students were trained on this project; one of them, Francis Smith, defended his thesis in August 2019 and joined Cisco Corporation.

Commercialization:

- Optimax -Prof. Brown had discussions about the project with a variety of prospective industrial sponsors
- Thermo Fisher Scientific - Collaboration with RIT SMFL, NIST Gaithersburg and NASA Goddard Space Flight Center (use of Carey 5000+UMD).

Invention Disclosures /Patents:

Disclosure /Patent Name	Inventor	Co-inventor	Licensing Partner	Research Sponsor	Description
U.S. Patent No. 10,399,292 High numerical aperture optomechanical scanner for layered gradient index microlenses, methods, and applications	Wayne H. Knox	Jonathan D. Ellis		Clerio Vision, Inc., CEIS	A high numerical aperture optomechanical scanner for writing refractive index modifications includes a fast axis scanner having a fast scanning axis.
US Patent Application 20190254875 A1 Method of Modifying the Refractive Index of Ocular Tissues US Patent 10,649,115 issued May 12, 2020	Wayne H. Knox	Krystal R. Huxlin		Clerio Vision, Inc., CEIS	A method for providing vision correction to a patient.
US Patent Application 20190240002 A1 Optical device and method for modifying the refractive index of an optical material	Wayne H. Knox, Ding; Li, Kunzler; Jay F., Jani; Dharmendra			Clerio Vision, Inc., CEIS	An optical device comprising an optical hydrogel with select regions that have been irradiated with laser light having a pulse energy from 0.01 nJ to 50 nJ and a wavelength from 600 nm to 900 nm.

Start-up Companies Formed:

Company Name	City	Product/Service	Sector
parVerio	West Henrietta, NY	Kits for microplastic assessment in water and beverages.	Consumer

Licensing Agreements:

Nothing to report this period.

Royalties:

Nothing to report this period.

Small Business Assistance Provided:

With CAT's assistance in developing the femtosecond laser materials process, Alchlight was able to continue progress on an existing government contract. This work provided the necessary foundation to progress on the

contract despite delays in purchasing Alchlight’s femtosecond laser. Continued innovation on the processes developed at UR has secured a promising future for Alchlight. This future includes a burgeoning partnership with a leading imaging corporation. Due to the success of this contract, and CAT’s support, Alchlight was able to create two full-time scientific jobs.

CEIS partner Clerio Vision, Inc. was able to close a second tranche of the Company’s Series D Preferred Round of Financing for \$12.5M lead by Safar Partners Fund in order to support the development of Clerio’s multifocal contact lens and non-invasive vision correction products. Clerio Vision was able to realize at least \$900,000 in cost savings for the year as a result of the CEIS/CAT assistance. Without the programs, Clerio would have needed build, staff, and train a femto-second laser lab with expertise in modifying biological tissue in trained animal models, which can be tracked with wavefront sensing instrumentation. Additionally, Clerio would have needed to build an adaptive optics system for testing contact lenses inhouse. These resources were used to refine Clerio’s treatment nomogram for non-invasive LASIK as well as advanced contact lenses and is currently generating enhanced results that feed directly into product commercialization. Clerio created a total of ten full-time equivalent positions (FTEs) as a result of the programs.

Level of Matching Funds Provided and uses:
Expenses (include Federal State, local funds & in-kind)

Operating Expenses	Matching Funds			Total
	NYSTAR Funding	Company Cost Share	Other Sources	
Salaries & Fringe	\$535,656	\$642,159	\$0	\$1,177,815
Indirect Costs	\$73,282	\$97,397	\$0	\$170,679
Equipment	\$9,304	\$66,078	\$0	\$75,382
Materials & Supplies	\$14,211	\$106,586	\$0	\$120,797
Tuition	\$1,070	\$2,590	\$0	\$3,660
Travel	\$1,045	\$47,440	\$0	\$48,485
Subcontractors	\$130,455	\$38,670	\$0	\$169,125
Other	\$29,892	\$19,199	\$0	\$49,091
Total	\$794,915	\$1,020,119	\$0	\$1,815,034

Total Federal: \$0

Total In-kind: \$0