

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



**2020 Program Report
Centers for Advanced Technology**

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Introduction

Empire State Development (ESD)'s Division of Science, Technology and Innovation (NYSTAR), part of the state's economic development agency, is tasked with advancing technology innovation and commercialization in New York State. NYSTAR plays an integral role in ESD's economic development strategy by overseeing funding for university research centers and providing assistance to businesses through NYSTAR's Centers of Excellence, Centers for Advanced Technology, Manufacturing Extension Partnership centers, Innovation Hot Spots, New York State Certified Business Incubators, Science + Technology Law Center, and other assets. This approximately \$55 million portfolio of state-supported high-tech assets touches all points of the state's innovation economy, including but not limited to advanced materials, biotech and life sciences, renewable energy, materials processing, optics and imaging, software and digital media, and electronics technologies.

NYSTAR plays four key roles in supporting the innovation ecosystem in New York State:

1. Administering programs to ensure they are delivering established goals and purpose;
2. Encouraging collaboration to accelerate technology and company growth;
3. Creating new initiatives to further support innovation and fill gaps in available company assistance; and
4. Attracting additional federal and other funding into New York State by providing matching grants, assisting with consortium-building, and occasionally applying directly for federal funds.

New York State ranks highly for most measures of science and engineering strength, the strongest indicators of research and innovation. According to the National Science Foundations' (NSF) Science and Engineering State Profiles, New York ranks second in the nation for higher education R&D in science and engineering fields; second for state government R&D expenditures; sixth for federal R&D obligations; and third for the number of utility patents issued to state residents. New York State has made unparalleled investments in world-class technology assets and expertise in order to strengthen its position as a global hub of innovation. Annual state R&D investments of \$450 million are complemented by nearly \$16 billion in annual business R&D.

In addition to this report, NYSTAR releases reports for three individual programs periodically throughout the year. NYSTAR has separately issued reports for the following programs:

- Centers for Advanced Technology (covering the 2016-2017 and 2017-2018 contract years)
- Centers of Excellence (covering the 2016-2017 and 2017-2018 contract years)
- Manufacturing Extension Partnership (covering 2017 and 2018)

This report covers NYSTAR's remaining programs, initiatives, and updates not covered in these reports. Information included in this report includes: Requests for Proposals (competitions); federal awards; the Innovation Hot Spots & Certified Business Incubators Program; Matching Grants Leverage Program; Faculty Development Technology Transfer Incentive Programs; Science + Technology Law Center; and a summary of fields of technology with significant potential for the state's economy.

Requests for Proposals

In May 2019, through a Request for Proposals, two new Centers for Advanced Technology were selected by a review panel for a ten-year designation of up to \$921,200 per year per center:

- **City University of New York**, Advanced Science Research Center, Center for Advanced Technologies in Sensors for Exploration of Natural Systems and Environments (ASRC Sensor CAT)
- **Binghamton University**, Center for Flexible Hybrid Medical Device Manufacturing (FlexMed)

Individual CAT Reports

Individual CAT reports continue for the remainder of this document.

Center for Advanced Ceramic Technology (CACT)

Alfred University

Center Director: Dr. John Simmins

Technology Focus: Ceramics and Glass

Importance to NYS:

First designated in 1987, and renewed for another 10 years in 2018, the Center for Advanced Ceramic Technology (CACT) is one of 15 Centers for Advanced Technology (CAT) located across New York State, created to speed technology transfer from universities to the marketplace. The 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; Energy storage materials;
- **Modeling:** Microstructure; Atomistic structure of glass/ceramics; Defect behavior; Transport behavior; Multiscale modeling; 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); Traditional ceramic processing; and
- **Properties/Characterization:** Electrical properties; Structural analysis; Mechanical behavior and fracture; Optical properties; Biocompatibility; Surface behavior and catalysis; Thermal properties; Spectroscopy.

The Center for Advanced Ceramic Technology (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 to 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

During this reporting period, the CACT again was able to achieve significant economic impacts for the technical ceramics and glass sectors in the State of New York. During this period alone, the CACT worked with 17 NYS-based firms and an additional 14 companies from outside New York State. New York State companies included: Corning, Inc., Lockheed Martin, Boston Valley Terra Cotta, Foster Rush, ASK Chemicals, Belvac, Monofrax, Bionic Eye, Pall Corporation, Arvos, Inc., Ceralink, Cerion Nanomaterials, Curtis-Wright, Heany Industries, Momentive Performance Materials, Saint Gobain Ceramics and Vader Systems. These companies spent in excess of \$1 million in company cash at the University for 70 projects.

As Alfred University continues to undergo a significant effort to rebuild its preeminence in research around ceramics and glass, a number of major initiatives were undertaken during this period. This included the hiring of new CACT Executive Director, Dr. John Simmins, who also serves as Associate

Provost for Research and Economic Development. In this role, Dr. Simmins will not only oversee CACT operations, but will also be focused on broader economic development initiatives to support regional economic growth. Those efforts were identified as a priority of Alfred University to support faculty, staff, and student attraction and retention.

Another key initiative was the launch of the Ceramic Research Education and Technology Enterprise (CREATE) Center, supported by a \$7.75M award through the SUNY 2020 program. This initiative aligns with the CACT’s mission of supporting the State’s technical ceramics and glass sectors as the emphasis of CREATE is on ceramic and glass machining and finishing as well as the growing ceramic and glass additive manufacturing sector. The CACT is working to provide NYS firms with access to the unique technical resources that will be available at the CREATE Center in support of applied research projects, in the same way that it currently provides the industry with access to Alfred’s Center for High Temperature Characterization (CHTC) and the multilayer ceramics tape casting facility located at the IncubatorWorks facility in Alfred.

The CACT was also the driving force in the development of an affiliation agreement with the AHEAD Energy Facility located in Rochester, NY. This 20,000 square foot former solid-oxide fuel cell development facility has partnered with Alfred to secure Start Up New York designation. During the reporting period, the first approved company, MicroEra Power, located into the facility. A second tenant, Evolve Additive Solutions, has also taken a large portion of the building and is working with Alfred University to identify opportunities to develop polymer-ceramic composite materials for use in their high-speed xerography-based additive manufacturing process.

Outreach continues to be a top priority for the CACT, with regular attendance at the Fuzehub Solutions Forums held across the State. The CACT also continues to represent Alfred’s technical strengths in ceramics and glass at key industry conferences, including the Ceramics Expo, hosted in Cleveland, OH, the Materials Science & Technology (MS&T) conference hosted this year in Portland, OR, and at the International Conference & Expo on Advanced Ceramics and Composites (ICACC) held in Daytona Beach, FL. Additional in-state activities included, presenting to the membership of the Rochester Regional Photonics Cluster on key capabilities available at Alfred, and board-level leadership positions at MedTech and IncubatorWorks. The CACT was also the lead sponsor on Alfred’s AU Energy Conference, which represents a significant opportunity to promote engineering careers in materials science and the energy sector to prospective students and highlight applied research currently underway through AU’s renewable energy engineering program.

Impacts

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
1	1	\$100,802	\$440,260	\$150,000	\$0	\$0	\$691,062

Designations and Recognitions

Awards / Recognition	Date Received	Recognizing Organization	Link
N/A			

Federal or Not-for-Profit Grants Awarded

Project	Principle Investigator	Co-Investigator	Source	Amount	Duration (yrs)	Summary
N/A						

Education and Technology Commercialization Activities

Industry-Oriented Education and Training

CACT funding continues to support students at AU to work on industry projects to obtain experiential learning working on projects. The CACT also continues to provide support to bring students to the annual Ceramics Expo in Cleveland, providing students with exposure to a wide range of firms working in the technical ceramics and glass fields, the AU alumni network, and in providing direct support to the conference managers in running plenary and other educational programs throughout the Expo. This year's program ran May 1st through May 3rd at the IX-Center.

CACT is a major sponsor of the annual AU Energy Conference – conducted in partnership with AU's Renewable Energy Engineering department. The purpose of this program is to expose high school students to recent developments in the convergence of materials-science (ceramics) and renewable energy technologies. The 2018 program brought in about 75 high school students and included poster sessions from AU Renewable Energy Engineering students.

The CACT has also taken a leadership role in the Western New York Section of the American Ceramics Society (ACerS), in providing direct support for student engagement in developing ACerS programming, as well as scheduling events throughout the Western New York region at area employers focused on ceramics and glass. Events during the period were held at ASK HI-TECH, the Corning Museum of Glass, and Praxair.

CACT also provided matching funding through its associates program to support student employment opportunities at three NYS firms – ASK HI-Tech, Filtros Ceramic Products, and Saint Gobain.

Commercialization

Moving forward, CACT, and the other NYSTAR-supported Centers, are working to improve collaboration to better serve the needs to New York's industrial base. Alfred CAT, in partnership with other CAT's from Binghamton University, Clarkson University, and the Rochester Institute of Technology, met in Syracuse, NY at the first multi-CAT conference. This program focused on how the materials-science CAT's are working with industrial partners to solve some very difficult technical challenges and discussed how they can improve on the innovation ecosystem in New York. Work is underway now to identify additional areas of need faced by the industry, specifically in the areas of workforce development, and how the CAT's (including but not limited to CACT) can support those needs.

Recent outreach to the ceramics business community across the state has included a booth at the NY Clean Energy conference in NYC, a booth at the Ceramics Industry Conference in Cleveland OH (which NY manufacturers attend), the Clarkson University CAMP meeting in Canandaigua, and the Fuzehub regional resources meeting in Buffalo NY. Statewide and in WNY, CACT is leveraging new and renewing relationships with the University of Buffalo (NY Center of Excellence in Materials Informatics), Buffalo Manufacturing Works (additive manufacturing and metrology), Clarkson University CAMP (NY CAT with expertise in materials preparation and characterization), and RIT AMPrint (NY CAT in additive manufacturing) in order to provide a unique service to ceramics companies in NYS and ceramic users in a wide range of industries.

Invention Disclosures

Disclosure / Patent Name	Inventor	Co-inventor	Licensing Partner	Research Sponsor	Description
N/A					

Start-up Companies Formed

Company Name	City	Product/Service	Sector
N/A			

Licensing Agreements

Project	Inventor	Licensing Partner
N/A		

Royalties

Project	Principle Investigator	Co-Investigator	Company Partner	Royalty Income
N/A				

Small Business Assistance Provided

During this reporting period, CACT worked with the following small New York State companies: Boston Valley Terra Cotta, Foster Rush, ASK Chemicals, Belvac, Monofrax, Bionic Eye, Arvos, Inc., Ceralink, Cerion Nanomaterials, Heany Industries, Momentive Performance Materials, and Vader Systems. 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.

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	\$576,107	\$179,152	\$92,052	\$271,204
Indirect Costs	\$86,415	\$44,506	\$22,395	\$66,901
Equipment	\$223,996	\$2,658	\$0	\$2,658
Materials & Supplies	\$19,595	\$14,774	\$16,744	\$31,518
Tuition	\$2,351	\$9,404	\$4,000	\$13,404
Travel	\$26,550	\$1,953	\$2,909	\$4,862
Subcontractors	\$10,599	\$0	\$0	\$10,599
Other	\$265,282	\$1,288	\$3,250	\$4,538
Total	\$1,210,895	\$253,735	\$141,350	\$395,085

Total Federal: 0

Total In-kind: 0

Integrated Electronic Engineering Center

Binghamton University

S.B. Park

Technology Focus: Semiconductors and Microelectronics

Importance to NYS:

The Integrated Electronic Engineering Center (IEEC) CAT works with electronic packaging as an enabling technology to spur economic growth in areas including biomedical, photonics and sensor applications, military and homeland security applications, Micro-Electro-Mechanical Systems (MEMS), intelligent manufacturing processes, and wireless and secure networked computer and telecommunications systems. Many of the large companies within NY State are major suppliers of electronic devices and assemblies, these companies include IBM, Lockheed Martin, BAE Systems, L3-Harris, General Electric, Unison, Amphenol, Anaren, Raymond Corp and McIntosh, there are more companies that are in electronic assembly such as Universal Instruments, ADC, IEC, Sanmina and Jabil. The IEEC work with a majority of these named companies to assist in improving their electronic products, understanding failures and root causes and to help them with their needs as electronics evolve with advance packaging trends such as Wafer Level Fanout Packaging (WLFOP), 3D die stacking, Heterogeneous Integration and others to come.

Description of Achievements

In 2018-2019, IEEC continued its efforts to fulfill the commitments to NYSTAR/ESD. IEEC has kept an upbeat trend of generating economic impact for New York State, developing quality workforce, and pushing the envelope of technology edges.

Additional Companies joined IEEC (Full and Participating Members)

In this period, Ashlawn Energy joined as a new IEEC full member. Ashlawn is a minority owned New York State company that provides a unique solution on energy management. The company was attracted by the technical excellence of the center and multidisciplinary nature of technical bandwidth, including Data Center Research and Flexible electronics. IEEC also received two additional participating member companies, Snake Creek Laser and L3-Harris Corporation. Among the members is L3-Harris Corporation, a New York State company known for its excellence in electronic systems manufacturing business in defense and security sectors. IEEC is reaching out New York State companies, especially mid to small sized companies that cannot afford sophisticated and quite often expensive equipment. An example of a small startup company is Tarform from Brooklyn. They are a new startup that is building a boutique electric motorcycle, which has just sold their initial group of Founders series of motorcycles and will be starting to move into mass production in Brooklyn. They have asked the IEEC to review their electronics and battery management systems to ensure their reliability in the field.

SEML (Smart Electronics Manufacturing Laboratory) Expansion

Smart Electronics Manufacturing Laboratory (SEML), the laboratory focusing on the surface mount assembly technology (SMT) with Artificial Intelligence (AI) and Internet of Things (IoT) for manufacturing equipment, has been expanded in its technical contribution and participating equipment makers. Three Binghamton University (BU) faculty members are investing their time on research to automatically optimize solder paste stencil printing process as well as chip mounting process. In January, BU researchers attended the annual IPC APEX Expo where new technology imbedded equipment were displayed, and supported Koh Young Technology, an IEEC research partner and a full member. In addition, Fujii, a leading SMT equipment maker based in Japan, placed their chip mounting tool at the

SEML of IEEC. With the addition together of the chip mounter by Universal Instrument Corp., researchers can explore if their solution is vendor dependent.

Using this capability and vision, IEEC submitted a planning grant to National Science Foundation (NSF) to form an IUCRC (Industry-University Collaborative Research Center). Since NSF encourages having a multi-institution proposal, IEEC teamed up with CALCE of University of Maryland. CALCE is renowned in Product Life Time assessment and reliability engineering.

Continuation of Workforce Development

IEEC has restructured and upgraded an electronic packaging introduction course that was offered in the fall 2018. It was quite successful in the sense of workforce development. There have been many inquiries about the course from industry members for their own education to new engineers and to gauge the qualification of students who took the course. In the Spring 2019, the second part of the course was developed and offered to 10 students who registered for in class training and via remote learning. IEEC is planning to convert the courses for many smaller modular lectures for specific subtopics using the two course materials. It could be more effective in disseminating to industry settings and as a potential revenue source for the center. This course is also open to our industry members to help new packaging engineers understand some of the terms used as well as show how their part in packaging relates to the full spectrum of electronics packaging.

Pushing the Envelope of Technology Edges

IEEC works closely with Binghamton University faculty members, especially, the Principal Investigators (PI) who received funding from IEEC as pooled researcher for member companies. A total of nine PIs completed their 2018-19 research projects in June 30, 2019 and a total of \$400,000 has been awarded to the PIs. In May 2019, the 2019-2020 cycle pooled research proposals were selected, and ten new research proposals were awarded for research projects that started July 1, 2019 and finished on June 30, 2020. These pooled research projects have resulted in more than 20 research papers and many federal grant proposals and awards.

Outreach and Networking

The IEEC worked with the following organizations during the report period:

- Cornell University – Imaging Facility: IEEC partnership with Cornell for the High Resolution 3D Compute Tomography of Advanced Electronic Packages.
- Upstate Medical University – Central New York BioTech Accelerator: IEEC business / technology mentor for 2018 – Medical Device Innovation Challenge (MDIC) participant: “Avant Medical Systems”.
- Upstate Medical University – Central New York BioTech Accelerator: IEEC participation with Medical Start-Ups “CelltOmics, LLC” as technical resource for innovation, research, development and prototyping.

Many of the IEEC staff are also involved in electronic packaging societies such as IEEE Electronic Packaging Society, International Microelectronics Assembly and Packaging (iMAPS), IEEE Electronic Component and Technology Conference (ECTC), IEEE EPS Heterogeneous Integration Roadmap, International Electronics Manufacturing Initiative iNEMI. Having roles in these societies / organizations IEEC gains a better understanding of the issues / challenges the advance packaging industry faces, which they can disseminate to member companies.

Near Future

IEEC is organized an annual Electronic Packaging Symposium with GE in September 5 and 6. The two day event will be held at GE Global Research Center in Niskayuna, NY. IEED expects to have equal or better success than last year's symposium, which had a historical high number of participants and exhibitors. The previous year's symposium was the largest in IEEC history, close to 400 attendees, 53 exhibitors and 50 posters. IEEC plans on expanding the reach of this symposium by getting better speakers and exposing to the industry and academics the research being done on electronics to a larger audience.

Impacts

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
35	16	\$2,010,000	\$5,172,200	\$2,096,809	\$745,000	\$800,000	10,824,009

Designations and Recognitions

Awards / Recognition	Date Received	Recognizing Organization	Link
SB Park, director of the IEEC received the Excellence in Mechanics Award	August, 2018	American Society of Mechanical Engineers	https://www.binghamton.edu/news/story/1278/sb-park-to-receive-excellence-in-mechanics-award
SB Park et al, Outstanding Interactive Presentation Paper, ECTC conference	May 30, 2019	ECTC	https://www.ectc.net/about/69highlights.cfm
Benson Chan, Associate Director IEEC received Outstanding Educator Award	October, 2019	International Microelectronics Assembly and Packaging Society (iMAPS)	https://www.imaps.org/society_award_winner_history.php#Outstanding%20Educator%20Award

Federal or Not-for-Profit Grants Awarded

Project	Principle Investigator	Source	Amount	Duration (yrs)	Summary
NSF CAREER: Intermetallic Interfacial Thermal Transport for Advanced Electronics Manufacturing	Prof. Scott Schiffres	NSF	\$500,000	5	Measure the interfacial resistance between semiconductors and intermetallics that can bond to them.
CHIRP: Minimizing Thermal Interfacial Resistance in Heterogeneous Integrated Integration	Prof. Scott Schiffres	SRC	\$41,667	1	Measure local conductivity of thermal interface materials used in electronics packaging, particularly for heterogeneous integration (as a function of varying gap size).
CHIRP: Alternative fine Pitch Interconnect Technologies for SiPs	Prof. Peter Borgesen	SRC	\$41,667	1	Approaches to microjoint assembly, typically attachment of Cu pillar to contact pad at fine dimensions.
NYSERDA XFC Charging for electrified Bus	Prof. Pritam Das (Watson ECE)	NYSERDA	\$340,000	18 months	Working with BAE Systems and ConEd to understand the impact to installing XFC Charging systems in

					NYC for full electric buses, build prototype XFC system and test within BAE Systems
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Education and Technology Commercialization Activities

IEEC has revised and improved an electronic packaging introduction course. This course was offered in the fall of 2018. It was quite successful in the sense of workforce development. This class exposed students to the various aspects of electronics packaging, from basic materials, designs, methods of interconnects to advance assembly and up to date 2.5D and 3D packaging. This class is also open to IEEC member companies to increase their new engineer’s knowledge in what packaging is. The class is taught by Watson faculty as well as experts from industry. IEEC exposes the students to real world concerns and problems that most often do not show up in textbooks. In the Spring 2019, the second part of the course was developed and total of 10 students registered for in class training and via remote learning. IEEC is planning to convert the courses for many smaller modular lectures for specific sub-topics using the two course materials. It could be more effective in disseminating to industry settings and be a potential revenue source for the center.

The IEEC supports all of the FuzeHub events and serves as a resource for companies looking for help with electronics packaging or materials development.

The IEEC works with our member companies to help them with any problems related to electronic packaging. IEEC works with them to understand the root cause of fails, field returns or how to improve their electronics to survive a very competitive marketplace.

The IEEC supports and funds 8-10 research projects in the field of electronic packaging every year. These projects are reviewed and mentored by our member companies to advance their understanding of new materials, basic understanding of solders and their intrinsic weaknesses, new substrate materials, and other topics that will help companies be successful. All inventions that result from these pooled research projects are shared by our member companies which helps them maintain their advantage in their packaging technologies.

Industry-Oriented Education and Training

The IEEC’s flagship event, the 30th Electronics Packaging Symposium, was held at the Binghamton University campus in September 18 – 19, 2018. The event was the biggest ever, with over 360 attendees, 52 exhibitors and 56 student posters. Of the attendees, 93 were from New York State industry. IEEC added a panel discussion on Supply Chain readiness for Flexible and Wearable Electronics, a new Power Electronics Workshop and our continuing support of the Heterogeneous Integration Roadmap workshop.

On November 29-30, 2018, a SUNY-wide Quantum Computing Workshop was held in Griffith Institute at Rome, NY and IEEC director SB Park led the Packaging Work Group brainstorming session.

The IEEC took part in the annual Binghamton University Day at the Mall on February 23, 2019. The center set up a display featuring 3D printing. This display is always very popular and draws an audience. Planning has begun for the 2019 Electronics Packaging Symposium, which will be held at GE Research in Niskayuna, NY, on September 5-6, 2019.

On March 3, 2019, Benson Chan of the IEEC made a presentation on 3D printing at TEDX Binghamton University and about 300 people attended.

Center personnel continue to train students and industry personnel on use of the equipment in the labs. IEEC and Advanced Diagnostic Lab (ADL) staff documented 64 hours spent on training in the January – June 2019 period.

The IEEC reaches out to the electronic industry in NY State to understand their challenges and devises a course of action to answer their needs. The IEEC cannot solve all their problems, but can reach out to resources within Binghamton University as well as other Center for Advance Technologies in NY State that may have the expertise to assist them. With COVID, the IEEC has started using ZOOM to reach out to these companies.

The IEEC will be starting a series of webinars focusing on the research being conducted within Binghamton in electronics related topics. These webinars will allow existing member companies know what is being done and serve as an outreach to the broader electronic users that may not know who or what the IEEC is. This is also being done also to attract new members to the center.

Commercialization

IEEC researchers Bahgat Sammakia and Hao Wang received one patent in 2018-2019. Patent number 10,308,856, Pastes for Thermal, Electrical and Mechanical Bonding, develops a new Thermal Interface Material (TIM). This TIM would find application across the electronics industry, especially in instances where the electronic components have very high heat dissipation requirements. Examples include, very high-performance integrated circuits and transistors in power electronics used for electrified vehicles and control equipment for alternative energy.

Invention Disclosures

Disclosure / Patent Name	Inventor	Co-inventor	Description
Pastes for Thermal, Electrical and Mechanical Bonding	Prof. Bahgat Sammakia	Prof. Hao Wang	In an electronic assembly, heat from the active components is dissipated directly to the air by convection and radiation. Each interface in the thermal path creates resistance to heat flow. This thermal resistance can be reduced by use of a thermal interface material (TIM) that assures good contact between the mated components. This invention greatly increases the thermal conductivity of paste-like TIMs.
Multilevel Bridge Taped Resonant Converter	Kalyan Yenduri	Pridam Das, Benson Chan, Sunil Dube	A multilevel power factor correction converter merged with a switch network of the resonant converter resulting in reduced number of semiconductor switches resulting in higher power density, higher efficiency at a lower cost

Start-up Companies Formed

Company Name	City	Product/Service	Sector
N/A			

Licensing Agreements

Project	Inventor	Licensing Partner
N/A		

Royalties

Project	Principle Investigator	Co-Investigator	Company Partner	Royalty Income
N/A				

Small Business Assistance Provided

IEEC has been a supporter and source of information for the CNY Biotechnology Incubator and their tenants, it provides services to new bio startups for their electronic device needs. It can also provide prototyping service to build early electronics as well as support for early production by utilizing its electronic assembly line in the SEML.

IEEC is working with Watson ECE department and Endicott Research Lighting in developing high performance LED drivers for commercialization. This product is intended for LED retrofitting commercial buildings as well as large lighting displays such as sports stadiums

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	\$711,520	\$283,068	\$433,872	\$716,940
Indirect Costs	\$106,728	\$54,553	\$93,399	\$147,952
Equipment	0	\$0	\$0	\$0
Materials & Supplies	\$67,692	\$46,800	\$28,353	\$75,153
Tuition	\$9,440	\$11,771	\$77,546	\$89,317
Travel	\$2,215	\$31,894	\$71,099	\$102,993
Subcontractors	\$0	\$0	\$0	\$0
Other	\$73,759	\$87,520	\$35,734	\$123,254
Total	\$971,354	\$515,606	\$740,003	\$1,255,609

Total Federal: 0

Total In-kind: 0

CENTER FOR ADVANCED MATERIALS PROCESSING

CLARKSON UNIVERSITY

Center Director: Devon Shipp

Technology Focus: Advanced Materials & Materials Processing

Importance to NYS:

The Center for Advanced Materials Processing (CAMP) at Clarkson University 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 the North Country and New York State industries. Over the past decade, CAMP has helped NY State companies achieve approximately \$250M in economic impact and create and retain over 350 jobs.

Description of Achievements

CAMP's expertise in materials science and processing supports companies interested in understanding and exploiting state-of-the-art, advanced, tailor-designed materials and processes to improve products, solve manufacturing challenges, increase yield, lower cost and foster innovation. CAMP faculty and industrial partners produce research that combines applied science with innovation and engineering to transfer unique solutions from the lab to practical applications. CAMP is also a collaborative resource partner with the ability to work cooperatively with CATs and COEs across New York State to provide solutions for industry needs.

Some example achievements during the reporting period include:

- CAMP, in a coordinated effort with the NSF-funded Center for Metamaterials at Clarkson University, supported collaborative research efforts with Corning Inc. to design, develop and test a new device, a Forked Grating Coupler. One patent and nine papers were developed over the course of this project.
- A Memorandum of Understanding was signed between Clarkson and Clinton Community College that lays the foundation for creating a robust workforce development curriculum for the North Country, especially the Plattsburgh region.
- In late 2017, Estée Lauder Companies Inc. approached CAMP to assist with developing fast and reliable tools to predict the emulsion stability of its products by using available measurement techniques and predictive analytics. The collaboration demonstrated the feasibility of building a predictive model that would reduce the stability evaluation time by as much as 90% without compromising its accuracy and consequently increase efficiency and throughput. Based on the promising results, the company has also decided to invest \$250,000 in new instrumentation to expand the research on rapid stability characterization. Estée Lauder is also considering adding one full-time dedicated employee to continue and elevate the work conducted between CAMP and the Estée Lauder Companies.

Impacts

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
4	4	\$1,150,000	\$623,144	\$1,148,991	\$120,000	\$40,000	\$3,082,135

Designations and Recognitions

Awards / Recognition	Date Received	Recognizing Organization	Link
Prof. Richard E. Partch: Xerox Faculty Fellow	7/2018 until 6/2019	Xerox, Webster NY	https://www.clarkson.edu/news/clarkson-senior-university-and-camp-research-professor-richard-partch-receives-xerox-fellow
Prof. Mario Wriedt: John W. Graham Jr. Faculty Research Award	May 2019	Clarkson University	https://www.clarkson.edu/news/mario-wriedt-zijie-yan-receive-graham-faculty-research-award-clarkson-university
Prof. Evgeny Katz: Katsumi Niki Prize for Bio-electrochemistry	May 2019	International Society of Electrochemistry	https://www.clarkson.edu/news/clarkson-professor-receives-prestigious-katsumi-niki-prize-bioelectrochemistry
Prof. Devon A. Shipp: Appointed Associate Editor for <i>Polymer Reviews</i>	March 2019	<i>Polymer Reviews</i> (published by Taylor & Francis)	https://www.tandfonline.com/action/journalInformation?show=editorialBoard&journalCode=lmssc20
Prof. Mario Wriedt: Appointed Kodak CAMP Distinguished Professor	May 2019	Clarkson University	
Prof. Silvana Andreescu: Research on portable biosensors and smart labels for food safety monitoring highlighted	Fall 2018	IEEE Magazine	https://spectrum.ieee.org/semiconductors/materials/the-internet-of-disposable-things-will-be-made-of-paper-and-plastic-sensors
Prof. Daniel ben-Avraham/ Leon LeBeau <i>SOARing Educator Award</i>	2018	SOAR North Country	https://www.nny360.com/news/soaring-award-presented-to-professor/article_2eee23eb-b41e-5796-8856-a46e23ffc197.html
Prof. Jan Scrimgeour/ NSF Career Award	2018-2019	NSF	https://www.nsf.gov/awardsearch/showAward?AWD_ID=1847786&HistoricalAwards=false
Prof. Maria Gracheva/ NSF Career Award	2018-2019	NSF	https://www.nsf.gov/awardsearch/showAward?AWD_ID=1352218&HistoricalAwards=false
Prof. Ross Taylor/ CAPE-OPEN 2017 Award	2018-2019	CO-LaN	https://www.colan.org/cape-open-awards/5644-2/
Prof. Ruth Baltus/ American Chemical Society Award for Encouraging Women into Careers in the Chemical Sciences	April 2019	American Chemical Society	https://cen.acs.org/acs-news/programs/ACS-2019-national-award-winners/96/i37
Prof. Elizabeth Podlaha-Murphy/ Founding Associate Editor for new Electrochemistry section	July 2018	<i>Frontiers in Chemistry</i>	https://loop.frontiersin.org/people/558905/overview
Prof. Abul BM Baki/ Karl Emil Hilgard Hydraulic Prize	2018	American Society of Civil Engineers, Journal of Hydraulic Engineering.	https://www.asce.org/templates/award-detail.aspx?id=614&all_recipients=1

Prof. Andrea Ferro/ Distinguished Service Award	2018	AEESP	https://www.aeesp.org/awards/2019/andrea-r-ferro
Prof. Stefan Grimberg/ Committee Service Award	February 2019	New York Water Environment Association	http://www.nywea.org/SiteAssets/2019-Awards-Book.pdf

Federal or Not-for-Profit Grants Awarded

Project	Principle Investigator	Co-Investigator	Source	Amount	Duration (yrs)	Summary
100039	Maria Gracheva		NSF	\$400,000	5 years	CAREER Coupling Nanoscale Device Modeling with Coarse-Grained Biomolecular Simulations
100557	Sulapha Peethamparan		NSF	\$199,938	4 years	Collaborative Research Development of a Novel Strategy for Using Waste Concrete in Mitigation Industrial Nitrogen Dioxide Emissions and to Inhibit Corrosion
100734	Emanuela Silvana Andreescu		NSF	\$315,697	3 years	Scalable Manufacturing of Nanostructured Bioassemblies for Low-Cost Portable Sensors
100774	Emanuela Silvana Andreescu		NSF	\$390,000	4 years	Single Particle Investigation of Environmental Chemical Processing Using Nano Techniques
100800	Selma Mededovic	E. Paek and D. Bohl	NSF	\$450,000	3 years	Interdisciplinary Study of Chemical and Transport Processes at a Plasma-Liquid Interface
100830	David Crouse	C. Cetinkaya	NSF	\$500,000	5 years	Phase II IUCRC Clarkson University Center for Metamaterials
101206	Emanuela Silvana Andreescu		NSF	\$16,000	2 years	REU Scalable Manufacturing of Nanostructured Bioassemblies for Low-Cost Portable Biosensors
101252	M. Gracheva		NSF	\$3,000	2 years	Project support of 100039 Coupling Nanoscale Device Modeling w/ Coarse-grained Biomolecular Simulations
101658	David Crouse		NSF	\$50,000	1 year	IUCRC Fellowship

Education and Technology Commercialization Activities

Xerox Corporation Visiting Scientist Appointment – Xerox is continuing the visiting scientist program with Clarkson. This year, Ngoc-Tram Lee (graduate student, Chemical and Biomedical Engineering) traveled to perform research on particular subject matters important to the corporation, i.e., materials

development for functional surface design and coating methodologies for device fabrication. The experience is intended to expose students to the corporate working environment as a contributing team member and furthering the goals and objectives of the R&D leadership at the corporation.

Xerox visit. Xerox Fellow Dr. Chieh-Min Chen was invited to visit CAMP in May 2019, to present a seminar to CAMP faculty and their students. The seminar focused on Xerox's interest on future technology, including 3D printing. The visit resulted in invitations to two faculty to go to Xerox to share their expertise with Xerox personnel.

Technology Road Mapping with New York Air Brake. On November 30, 2018, New York Air Brake, a supplier of innovative train control systems for the railroad industry and long-time member of CAMP, visited the campus to meet with CAMP staff and faculty to plant the seeds of a technology roadmap for the company. Laying out the New York Air Brake engineering vision, the VP for Engineering of the company, Bill Kleftis, participants actively engaged in discussions focusing on specific technology topics of importance to New York Air Brake. Several research areas were identified as particularly important to build upon for further collaborations. This comprehensive discussion provided company employees the opportunity to learn about the holistic approach to driving innovation and provided insight into corporate vision of technology that they usually do not get. In turn, CAMP faculty were provided with an opportunity to learn about corporate priorities so that they can coordinate students' learning with a corporate vision in mind.

STEM Outreach and Industry Support

Industry Related Activity: Prof. Richard Partch has served as technical advisor to the NNY region CITEC to connect area industry with faculty technology experts in CAMP. Prof. Partch has travelled with CITEC personnel K. Chepeleff and Steve Lockwood to improve product manufacture at Schluter Systems Co. in Plattsburg and 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, Prof. Partch arranged for CAMP to do analyses on OX Paper Co. paperboard; and starting in May 2019, arranged for Contextere Co. in Ontario, CA to use CAMP expertise in artificial intelligence. Prof. Partch also interacts regularly with Tom Plastino and John Pinkerton of the NNY region Industrial Development Agency when questions arise about what technical expertise is available in CAMP for advancing their NY State business.

Educational Outreach Activity: As he has annually for over 40 years, Prof. Partch continues to reach out to area high school science teachers who invite him to return to present in their classes on the advances in chemistry that improve and/or save peoples' lives. The STEM activity during this 2019 reporting period was at Massena, NY HS (K. Cook) and presented to the biology as well as chemistry classes. Prof. Partch has shared expertise on chemistry for remediation of Opioid overdose for Canton, NY HS teacher J. Burdick to use in NY State Teacher Conferences and classroom presentations.

The 2019 Annual IUPAC Potsdam Global Women's Breakfast in February 2019 drew 120 participants from school districts all across St. Lawrence County. CAMP supported the event which included presentations and hands-on demonstrations to excite young women to consider a career in the sciences. CAMP is committed to providing opportunities for workforce development and to engaging with K-12 to expose young students in SLC to technology and science.

CAMP faculty are engaged in activities with national and local professional societies such as the American Chemical Society (ACS) and the Electrochemical Society. Prof. Andreescu serves as the vice president of the local ACS section, and both her and Prof. Shipp are active members of these societies, presenting regularly at local and national meetings materials-related research.

CAMP is building collaborative efforts with the Brookhaven National Laboratory (BNL) in Long Island, NY to increase the 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 Clarkson graduate students that were mentored by CAMP faculty participated and visited the BNL labs. Prof. 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, was invited to present his research and discuss opportunities for collaboration with BNL. His presentation at Clarkson on March 15, 2019, highlighted the research and capabilities offered by BNL and informed CAMP faculty on how to reach out and access these facilities. These interactions will continue with a presentation by Prof. Andreescu at BNL on Sept 23, 2019.

CAMP Instrumentation Training:

CAMP offers user training for all shared user instrumentation. The breadth of training depends on the level of involvement required to operate a certain instrument. The most requested training program is for Scanning Electron Microcopy (SEM) which consists of 120 minutes of lecture on fundamentals followed by 8 hours of one-to-one hand-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.

All CAMP instrumentation training follows this general recipe, with the goal in mind that users are well equipped to not only properly utilize the techniques made available but also succeed in processing the data generated and getting meaningful characterization of their data for their projects.

Industry-Oriented Education and Training

Xerox Corporation Faculty Fellow Award – Senior University Professor Richard Partch, Department of Chemistry and faculty member of CAMP, was appointed as a Faculty Fellow in Webster NY from July 2018 through June, 2019 with the goal to synthesize in his CAMP lab new charge control agents for use in toners, to determine how to mitigate fading of 3D printing ink, and to provide seminars and intensive knowledge sharing with Xerox technical and scientific staff, including demonstrations of analytical instrument use and interpretation of data, and to promote innovative ideas and research expertise at the company.

Commercialization

CAMP, in collaboration with Clarkson University's Sponsored Research Services and Shipley Center for Innovation, actively seeks opportunities to bring technologies developed in their laboratories to the commercial market for the benefit of the State and country at large. During this period, CAMP saw royalty income from both the long-standing relationships with industry, in this case Ferro Corporation, as well as from faculty start-up companies, D-Max Plasma in this instance. CAMP find it advantageous to support both licensing of technologies to established companies as well as start-ups to give its technologies the best chance of success. In addition, to CAMP royalty activity, it received a number of invention disclosures from the faculty during this period, many from industry-sponsored projects, which indicates an enthusiastic research enterprise that creates a pipeline for commercialization in the future.

Invention Disclosures

Disclosure / Patent Name	Inventor	Co-inventor	Research Sponsor	Description
System and method for identification of contamination of Cobalt CMP slurry	Suryadevara V. Babu	Jihoon Seo, Sri Siva Rama Krishna Hanup Vegi	Global Foundries	For nodes at 7 nm and below, cobalt (Co) has received considerable attention as a contact and interconnect metal to replace tungsten (W) for middle-of-the-line (MOL) process. Typically, Co chemical mechanical planarization (CMP) is a two-step process. Co overburden (step I) is removed and polishing (step II) is stopped on low-k dielectric after the removal of residual Co on the liner/barrier. Wafer surface can be contaminated with various defects such as residual particles, foreign materials, metallic impurities, which makes comprehending the contamination process a crucial one. In this invention, we developed a simple system for identification of contamination of Co CMP slurries used for 2 nd step, which is a replica of the patterned wafer composed of Co, titanium nitride (TiN), silicon nitride (Si ₃ N ₄), and silicon dioxide (SiO ₂) surfaces.
Material Compositions and Methods for Porous Graphite-Polymer Composite Bipolar Plates	Sitaraman Krishnan	Michael Harrington (US Hybrid), Aswin Pitchiya, Zackary Putnam, Daniel Orłowski (US Hybrid)	US Hybrid	Bipolar plates are conductive plates used to connect individual cells in a fuel cell stack. The bipolar plate not only serves as an electrical connection in a fuel cell, but also plays a key role in distributing oxidant and fuel gas over the active surface area of the membrane-electrode assembly. Prior research on materials development for bipolar plates has been focused on improving the electrical conductivity, flexural strength, acid resistance, and resistance to gas permeation. In contrast, the present invention pertains to an additional different use of the bipolar plate, namely, in fuel cell water management. We disclose novel compositions and a simple process for the preparation of porous bipolar plates with pore volume density and pore size that can result in high water uptake by the plates, while providing the desired resistance against gas permeation. The porous bipolar plates have high electrical conductivity and flexural strength.
Inducing desirable surface finish for additively manufactured parts	Ajit Achuthan	Goodarz Ahmadi, Rasool Mazruee Sebdani	N/A	A novel post-build process system that can potentially achieve very fine levels of surface finish for geometrically complex additive manufactured (AM) parts (and for conventionally manufactured as well) uniformly across the part surfaces.
All-Analog Scatter Filtering Device for Optical Sensors	William Jemison	Austin Jantzi, Luke Rumbaugh	Office of Naval Research	The all-analog scatter filtering device for optical sensors improves imaging and detection in scattering limited environments. This device filters unscattered light from scattered light using passive optical methods prior to detection by the opto-electronic sensor. This decreases the processing time, reduces shot noise at the detector, and removes clutter from the scene.

Interferometric Method for Generating Laser Beams with Wide Bandwidth, High Modulation Depth Intensity Modulation	Luke Rumbaugh	William Jemison	Office of Naval Research	This patent describes a novel method for generating laser beams that allows for manufacture of smaller, lighter, and less expensive high-resolution laser range finding, laser imaging, and laser 3D mapping systems. The method is an improvement over the previous state of the art because it uses 1) readily commercially available laser diodes and 2) a passive, all-optical approach to signal generation.
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Start-up Companies Formed – None during time period.

Company Name	City	Product/Service	Sector
N/A			

Licensing Agreements – No new license agreements executed during time period

Project	Inventor	Licensing Partner
N/A		

Royalties

Project	Principle Investigator	Co-Investigator	Company Partner	Royalty Income
N/A	SV Babu	America and Srinivasan	Ferro Corporation	\$48,722.37
N/A	Selma Mededovic	Thomas Holsen	DMAX Plasma	\$7,500.00
N/A	Sitaraman Krishnan		New World Consumer Products LLC	\$16.28

Small Business Assistance Provided

Clarkson University supports several faculty and student start-ups where CAMP is critical in providing academic expertise and instrumentation capabilities to advance the company’s understanding of technological and scientific challenges. CAMP’s expertise and resources are critical in raising technology readiness levels of their products towards commercialization. CAMP works directly with the following companies and is engaged through multi-year research collaborations: DMAX Plasma, LLC; Ducted Wind Turbines LLC, RemWell LLC, AM Innovations LLC, Phoebus Optoelectronics, and Potsdam Sensors. Additional information on projects are included in the annual NYSTAR reporting templates. In addition to Clarkson startups, CAMP also supports local small businesses such as LC Drives and Queenaire through internships and technical support.

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	\$527,038	\$319,579	\$359,793	\$679,372
Indirect Costs	\$79,056	\$47,937	\$49,555	\$97,492
Equipment	\$41,385	\$18,409	\$10,845	\$29,254

Materials & Supplies	\$65,813	\$79,579	\$69,113	\$148,692
Tuition	\$4,164	\$44,158	\$63,292	\$107,450
Travel	\$49,116	\$12,649	\$24,858	\$37,507
Subcontractors	\$0	\$0	\$0	\$0
Other	\$23,656	\$20,482	\$143,588	\$164,070
Total	\$790,228	\$542,793	\$721,044	\$1,263,837

Total Federal: 0

Total In-kind: 0

Center for Advanced Technology Center for Life Science Enterprise

Cornell University

Matt DeLisa

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 business development services at all points of development, from business idea development to securing a 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 and engineering sectors in New York.

Description of Achievements

1. Fueled the development of promising biotechnologies through matching grants to Cornell researchers who partnered with life sciences companies in human medicine and agriculture.
2. 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.
3. Supported 10 new companies through the Kevin M. McGovern Family Center for Venture Development in the Life Sciences through onsite, intensive business incubation.
4. Hosted technology commercialization training through a biotechnology-focused NSF iCorps short course, SBIR/STTR informational programs, and monthly technology licensing office hours.
5. Supplied scientific services and expertise to NYS companies through the Biotechnology Resource Center (BRC) core facilities.

Impacts

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
39	5	\$2,666,985	\$161,077	\$3,729,859	\$6,778,022	\$803,763	\$14,139,706

Designations and Recognitions

Awards / Recognition	Date Received	Recognizing Organization	Link
2018 Climate Fellow	2018	Echoing Green	https://fellows.echoinggreen.org/fellow/abriel-rodriguez-calero/

Federal or Not-for-Profit Grants Awarded

Project	Principle Investigator	Co-Investigator	Source	Amount	Duration (yrs)	Summary
Vitisgen2: Application of Next Generation Technologies to Accelerate Grapevine Cultivar Development	Bruce Reisch	Qi Sun, Peter Schweitzer	USDA-NIFA	\$6,550,976	4	Methods to improve wine, table, and raisin grape taste, quality, and appearance through plant breeding and genomics. Develop methods to improve pest and disease resistance and improve crop efficiency.
Mitochondrial Dysfunction in Neurodegeneration/ Aging”	Sheng Zhang		NIH – National Institute on Aging	\$498,954	5	Characterize human brain KGDHC complex associated with neurodegeneration and aging
Probing the Pathophysiology of Post-exertional Malaise by Metabolomics and Proteomics	Maureen Hanson	Sheng Zhang	NIH U54	\$5,567,833	5	Investigate basis of post-exertional malaise through cardiopulmonary exercise tests and blood sampling, on large cohort
Developing Choline Technology to Mitigate Fatty Liver Disease in Dairy Cattle	Joseph McFadden	Rodrigo Bicalho	Foundation for Food & Agriculture Research (FFAR)	\$1,472,785	5	With commercial support from seven private companies (Balchem, Vetagro, Phibro Animal Health, Berg+Schmidt, AB Vista, Adisseo, and Elanco), the project investigates choline supplementation for dairy cattle with “leaky gut.”

Education and Technology Commercialization Activities

Industry-Oriented Education and Training

March 2019 – NSF iCorps short course focused on entrepreneurs interested in forming biomedical and biotechnology start-ups in NYS. Five teams completed the course, with technologies in biomedical devices, cell therapies, and agriculture.

June 2019 – SBIR/STTR informational series including SBIR/STTR overview, and commercialization strategies as related to SBIR phase II grants. Thirty-four attendees, including regional start-up companies and Cornell faculty, researchers, and students attended the events.

In partnership with the Entrepreneurship@Cornell program, conducted a summer internship program with NYS start-up companies in the life sciences fields, including medicine, software, and materials science. 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:

1. Capro-X
2. Ecoelectro
3. iFyber, LLC

4. MiTeGen
5. Orthofit
6. VitaScan
7. ZYMtronix

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:

1. Marie Caudill, PI, partnered with Balchem Corporation, examined DHA delivery to fetal tissue to improve human fetal brain development and neurological health.
2. David Matteson, PI, partnered with Applied BioPhysics, developed the next phase of a Cell Anomaly Detector to assist researchers with assessing the likelihood of cell contamination during research.
3. Joseph McFadden, PI, partnered with Balchem Corporation, examined choline supplementation to dairy cow feeding to reduce disease in in dairy cattle and improve animal health and farm productivity.
4. David Putnam, PI, partnered with Bausch and Lomb, established a new class of polymers for use in development of new treatment for dry eye disease.
5. Heidi Reesink, PI, partnered with Dynamic Boundaries, evaluated potential treatments for osteoarthritis.
6. Frank Schroeder, PI, partnered with ZYMtronix, developed tools for the toxicity screening industries, for securing FDA approval and improving product safety.
7. Pengbo Zhou, PI, partnered with Repairogen, developed new chemical compounds for future development of topical skin disease therapeutics.

Invention Disclosures

Disclosure / Patent Name	Inventor	Co-inventor	Licensing Partner	Description
Topical Therapeutics for Skin Diseases Associated with DNA Damage	Pengbo Zhou	Chenyi Yang	Repairogen	Described use of active compounds to enhance DNA repair activity by inhibiting CUL4A

Start-up Companies Formed

Company Name	City	Product/Service	Sector
Hemp Hunter	Orange County	Industry hemp processing facility	Agriculture

Licensing Agreements

Project	Inventor	Licensing Partner
N/A		

Royalties

Project	Principle Investigator	Royalty Income
Bovine Viral Diarrhea Virus Serum Antigen Capture	Edward Dubovi	N/A
Overexpression System of Phytase Gene in <i>Saccharomyces cerevisiae</i>	Xingen Lei	N/A
appA2 Phytase Gene from e.coli isolated from pig colon	Xingen Lei	N/A
Site directed mutagenesis of e.coli phytase in yeast	Xingen Lei	N/A
QTLs to Predict Morphological Traits in Dogs	Adam Boyko	N/A
Methods and systems for detection and tracking of mastitis in dairy cattle	Daryl Nydam	N/A
		Aggregate Total = \$861,249

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:

1. Conamix – <http://conamixtech.com/>
Increasing power and adding longer life to lithium batteries
2. Dimensional Energy – <https://www.dimensionalenergy.net>
Converts waste carbon dioxide from industrial emissions into solar fuels and feedstocks
3. Dynamic Boundaries
Developing biomimetic materials as injectable treatments for osteoarthritis.
4. Ecoelectro – <http://www.ecoelectro.com/>
Improving fuel cell performance, at lower cost thresholds.
5. Esper BioSciences, Inc.
Enabling improved, faster, and more portable DNA sequencing technologies.
6. Ionica Sciences – <http://www.ionicasci.com>
Rapid use diagnostic testing platform to detect Lyme disease, mosquito-borne diseases, and STIs.
7. ORLink – <https://myorlink.com>
Cloud-based software that reduces surgical supply waste, makes operating rooms more efficient, and improves patient safety.
8. Repairogen – <http://www.repairogen.com/>
Enhancing efficiency of skin's natural DNA repair process through protein inhibition technology.
9. VitaScan Technologies – <http://vitascan.me>
Smartphone enabled point-of-use diagnostic platform for micronutrients.

10. 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:

1. Advanced Biological Marketing, Inc.
2. Applied Biological Laboratories
3. Carrera Bioscience
4. Cotyra
5. Covance Food Solutions
6. Exprimary
7. iFyber, LLC
8. Jan Biotech
9. Kionix, Inc.
10. MitoT, Inc.
11. Optigen
12. Polar Genomics
13. Rheonix

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	\$531,549	\$103,696	\$273,528	\$377,224
Indirect Costs	\$79,732	\$25,924	\$41,029	\$66,953
Equipment	\$0	\$5,200	\$0	\$5,200
Materials & Supplies	\$227,403	\$71,877	\$0	\$71,877
Tuition	\$41,780	\$52,282	\$0	\$52,282
Travel	\$1,165	\$552	\$0	\$552
Subcontractors	\$67,996	\$0	\$10,950	\$10,950
Other	\$2,384	\$184,483	\$0	\$184,483
Total	\$952,009	\$444,014	\$325,507	\$769,521

Total Federal: 0

Total In-kind: 0

Center for Advanced Technology in Telecommunications

NYU-Polytechnic University
Shivendra Panwar Center Director

Technology Focus: Information Technology & Telecommunications

Importance to NYS:

The Center for Advanced Technology in Telecommunications (CATT) at New York University, with research support from Columbia University, is designated in the information technology and telecommunications technology focus and will operate as a collaborative research center consisting of researchers from the electrical engineering and computer science departments. The CATT conducts collaborative applied research within the industry leading to technology transfer and economic impact, 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

A nation-wide search for a new Dean led to the choice of Jelena Kovacevic, previously the department head of Electrical and Computer Engineering at Carnegie Mellon University. The School is excited as she plans to move ahead and take the school to an even higher level. During the past year, her focus has been on further building up the research strengths of the School.

Towards that goal, she is very involved in recruiting top PhD students via Dean's Fellowships as an investment in the school's research vision. This has led to a perceptible increase in PhD student quality and a doubling in the number of PhD students in the last five years. This has greatly boosted CATT and other research centers. Indeed, she is very supportive of the CATT program and vision. The CATT Director now serves in the school's leadership and executive team.

A new faculty member in robotics, Farokh Atashzar, has joined Tandon, in addition to two faculty members who joined the year before: Ludovic Righetti and Giuseppe Loianno. The field of robotics is the confluence of mechanical engineering, control theory, artificial intelligence and communications.

CATT has started research in the area of 5G cellular network assisted robotics, which has greatly interested corporate sponsors.

The New York Tech economy continues to grow and is now firmly established as the nation's second largest tech hub, after Silicon Valley. Technology is now second only to Wall Street in terms of its contribution to New York City's economy. CATT intends to leverage this growth. An example is CATT's work with Justin Hendrix, Executive Director of NYC Media Lab, which itself was co-founded by Shiv Panwar, on a new AR//VR center in the Brooklyn Navy Yard called Rlab. It is expected to attract startups in this rapidly growing area. Another example is our work with NYU Tandon incubators, which has facilitated our work with a large number of startups. This is documented in the report.

NYU Wireless, now with eighteen corporate sponsors, has established itself as the leading center for fifth generation (5G) cellular wireless research in the U.S. As 5G matures, CATT is working on several projects with corporate sponsors on the systems that support it, and the new applications that are enabled by this technology. CATT is also working closely with its partner Columbia University (as well as Rutgers) in an NSF funded 5G research testbed called COSMOS, the first such testbed in the U.S.

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.

CATT, along with associated research centers and academic departments, has now moved into a purpose-built space in 370 Jay Street. The new space has room for expansion in terms of labs, faculty and graduate students. This attractive new location will provide a further fillip to CATT and help strengthen its position as a leading research center.

During the past two years, CATT has created 173 new jobs and had an aggregated (non-job) economic impact of \$187.8 million in New York. With six new projects initiated in the last six months, as listed in this report, CATT expects a pipeline of new impacts in the future.

Impacts

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
71	67	\$5,931,543	\$300,000	\$1,020,000	\$27,000,000	\$0	\$34,251,543

Designations and Recognitions

Awards / Recognition	Date Received	Recognizing Organization	Link
N/A			

Federal or Not-for-Profit Grants Awarded

Project	Principle Investigator	Source	Amount	Duration (yrs)	Summary
CAREER: A Peer-to-Peer Approach to Electricity Supply	Yury Dvorkin	ECCS- Division of Electrical, Communication & cyber Security	\$292,899	March 1, 2019 – February 29, 2024	Re-engineer current US power grid architecture to accommodate a massive penetration level of customer-end distributed energy resources, while improving the overall reliability, resiliency, and efficiency.
I-Corps: All-digital transceivers for millimeter wave communications	Shivendra Panwar	IIP- Division of Industrial Innovation & Partnership	\$50,000	April 15, 2019 – September 30, 2019	Design of an all-digital transceiver radio for mmWave communications. The mmWave frequencies of above 28 GHz are necessary to alleviate spectrum crunch in traditional cellular bands and make ultra-fast 5G use cases a reality.
SHF: EAGER: Toward Energy-Efficient Heterogeneous Computing Integrating Polymorphic Magnetic and CMOS Devices	Shaloo Rakheja	CCF- Division of Computing and Communication Foundations	\$299,420	July 01, 2019 – June 30, 2021	The integration of non-conventional materials and devices with silicon Complementary Metal Oxide Semiconductor (CMOS) technology can enable a new type of computing platform with potential benefits related to area, energy efficiency, and resiliency.

CAREER: Game-Theoretic Analysis and Design for Cross-Layer Cyber-Physical System Security and Resilience	Quanyan Zhu	ECCS- Division of Electrical, Communication & cyber Security	\$293,589	March 01, 2019 – February 29, 2024	The proposed research uses electric power systems and the cloud-enabled autonomous systems as two case studies to illustrate the designs of cyber defense strategies, resilience control mechanisms, and CPS security-aware contracts as the holistic cyber, physical, and human solution for next-generation high-confidence infrastructure systems.
CAREER: Learning from When, Where and by Whom Data is Generated for Advancing Public Health Studies	Rumi Chunara	IIS- Division of Information and Intelligent System	\$104,850	June 01, 2019 – May 31, 2024	The project will also provide a highly-integrated research and educational program for public health practitioners, students, and community members in the context of Person-Generated Data and public health by: (1) preparing students to use computer science in today's job landscape via a problem-based learning class; (2) increasing high-school students' exposure to computer science in the real-world with a focus on applications of computer science; and (3) disseminating scientific understanding of computer science in the public health and general community.
SaTC: CORE: Small: Collaborative: Understanding and Mitigating Adversarial Manipulation of Content Curation Algorithms	Rachel Greenstadt	CNS- Division of Computer and Network Systems	\$249,999	January 01, 2019 – June 30, 2021	This project will conduct open research to improve our understanding of current algorithmic curation attackers. The team will devise content curation algorithms and defenses which are hardened against manipulation and that can be adopted by these Online Social Networks (OSNs) platforms, providing a systematic approach to improving design and practice in an area of critical national importance.
SaTC: CORE: Medium: Collaborative: Safety and Security for Targets of Digital Violence	Damon McCoy	CNS- Division of Computer and Network Systems	\$349,970	October 01, 2019 – September 30, 2023	The proposed work weaves together research activities including building measurement platforms for making sense of abuser communities that are found online, designing tools for detecting spyware or apps usable as spyware on victim devices, developing a theory of adversary-aware human computer interaction that will guide user interface design in the face of adversaries that have a victim's login credentials, analyzing the efficacy of general consumer privacy legislation

					for abuse contexts, and seeking out pragmatic law and policy recommendations.
Student Travel Support: Privacy Enhancing Technologies Symposium (PETS) 2019	Damon McCoy	CNS- Division of Computer and Network Systems	\$18,000	May 01, 2019 – April 30, 2020	This travel grant provides support for 18 U.S. based students to attend the Privacy Enhancing Technology Symposium (PETS) to be held in Stockholm, Sweden from July 16-20, 2019. PETS brings together privacy and anonymity experts from around the world to discuss recent advances and new perspectives. PETS addresses the design and realization of privacy services for the Internet and other data systems and communication networks.
CAREER: Cryptocurrency Forensics Tools	Damon McCoy	CNS- Division of Computer and Network Systems	\$198,183	February 15, 2019 – January 31, 2024	This project will conduct open research that will improve our understanding of how to devise improved cryptocurrency forensic techniques that can be adopted by researchers, companies and investigators.
ASPIRE: An SFS Program for Interdisciplinary Research and Education (Renewal)	Nasir Memon	DGE- Division of Graduate Education	\$1,851,917	July 01, 2019 – June 30, 2024	This project aims to build on and extend the success of the current CyberCorps® Scholarship for Service (SFS) program at New York University, including implementing several creative modifications and enhancements to the SFS program to increase gender diversity in 'YU's cybersecurity program.
BIGDATA: F: Collaborative Research: Foundations of Responsible Data Management	Julia Stoyanovich	IIS- Division of Information and Intelligent System	\$230,950	January 01, 2019 – August 31, 2021	The focus of this project is on using Big Data technology responsible-in accordance with ethical and moral norms, and legal and policy considerations. This project establishes a foundational new role for data management technology, in which managing the responsible use of data across the lifecycle becomes a core system requirement.
CAREER: Enhancing the User Experience of Privacy Preference Specification	Sameer Patil	CNS- Division of Computer and Network Systems	\$144,126	June 01, 2019 – May 31, 2024	This research aims to overcome challenges by developing and testing techniques to enhance the people's experience with their privacy preference specifications.
SaTC: EDU: Collaborative: Incorporating	Sameer Patil	DGE- Division of Graduate Education	\$283,961	September 01, 2018 – August 31, 2020	The modules will be used in capstone courses at Informatics at the University of California, Irvine (UCI) and Indiana University (IU). The researchers will

Sociotechnical Cybersecurity Learning Within Undergraduate Capstone Courses					utilize the modules to create an assessment for the most critical and essential cybersecurity knowledge and skills.
CHS: Small: Collaborative Research: Ubiquomics: HCI for augmenting our world with pervasive personal and environmental omic data	Oded Nov	IIS- Division of Information and Intelligent System	\$257,912	August 15, 2018 – July 31, 2021	The project will conduct research on human-computer interaction for UbiqOmic environments: living spaces and social interactions where omic data is available about people, plants, animals, and surfaces. In particular, the team will identify user needs and develop web-based visual tools that integrate omic data sets from heterogeneous resources and multiple samples. In addition, the project will harness the power of Augmented Reality (AR) to visualize the invisible, designing, developing, and evaluating an AR interface which overlays timely and actionable omic data in the environment and on the users' own body (oral, gut, skin).

Education and Technology Commercialization Activities

Industry-Oriented Education and Training

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. This program will be offered in September 2019.

CATT continues to work with NYU-Tandon's Office for Enterprise Learning; the Center's PIs have developed customized programs and course offerings for a number of industry partners, most notably AT&T, Goldman Sachs, SAIC, ConEdison, and IBM. The PIs have developed these offerings for the ongoing education and training of the workforce. In particular, certificate programs have been developed for working professionals in the areas of mobility, data centers and power engineering.

In addition to our commitment to corporate education and training, the Center has been involved for a number of years with high school students up to doctoral students through the summer research ARISE program and the Cyber Security Awareness Week competition. The competition was started by CATT PI Prof. Nasir Memon, Cyber-security, and is now in its eighteenth year and growing.

The CSAW program has expanded to Europe, Israel, India, Tunisia and Mexico. Additionally, it has also attracted corporate interest since it is a venue for them to interact with academics in this critical area and recruit cyber security talent. For more information, please see (<https://csaw.engineering.nyu.edu/>).

Commercialization

January 2019

- Intel/NYU sync-up on “TCP-over-mmWave Research” (monthly) (01/12)
- Bell Labs meeting (01/16)
- IEEE Future Networks Webinar – mmWaves in 5G NR Cellular Networks (01/23)
- Interdigital : (project technical proposal-accepted)

February 2019

- Intel/NYU sync-up on “TCP-over-mmWave Research” (monthly) (02/12)
- Discuss BBR LTE edge experiments with AT&T(02/07)
- Sony/NYU Wireless Call (02/26)
- Pressman et al, Start-up: Target synchronization for wireless gun-sight: Patent transition to product.

March 2019

- Intel/NYU sync-up on “TCP-over-mmWave Research” (monthly) (03/12)
- Richard Li Huawei Meeting (03/12)
- Sony/NYU Wireless Call (03/28)
- BAE Systems : Advanced multimode modem architecture proposal

April 2019

- Intel/NYU sync-up on “TCP-over-mmWave Research” (monthly) (04/12)
- AT&T Research collaboration kick-off meeting (04/18)
- Brooklyn 5G Summit (04/23)

May 2019

- Intel/NYU sync-up on “TCP-over-mmWave Research” (05/12)
- Sony/NYU Wireless Call (05/22)

June 2019

- Intel/NYU sync-up on “TCP-over-mmWave Research” (06/12)
- Raw Corporate list meeting (06/20)
- Meeting with Office of the DoD CIO (06/18)
- Telebyte : License agreement for mm Wave Channel Emulator.
- Telebyte : CATT project to support development of new 5G test bed product to be funded by Telebyte.

Invention Disclosures

Disclosure / Patent Name	Inventor	Co-inventor	Licensing Partner	Research Sponsor	Description
N/A					

Start-up Companies Formed

Company Name	City	Product/Service	Sector
N/A			

Licensing Agreements

Project	Inventor	Licensing Partner
Mililabs Project	Aditya Dhananjay, Sundeep Rangan	Telebyte www.telebyteusa.com : License agreement for mm Wave Channel Emulat-r - Jan-Jun 2019, signed July 2019

Royalties

Project	Principle Investigator	Co-Investigator	Company Partner	Royalty Income
N/A				

Small Business Assistance Provided

None

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	\$677,647	\$1,751,370	\$1,263,644	\$3,015,014
Indirect Costs	\$101,649	\$191,013	\$100,399	\$291,412
Equipment	\$5,232	\$26,509	\$22,350	\$48,859
Materials & Supplies	\$17,793	\$769,750	\$781,049	\$1,550,799
Tuition	\$98,295	\$28,091	\$2,805	\$30,896
Travel	\$3,328	\$116,912	\$128,768	\$245,680
Subcontractors	\$0	\$0	\$0	\$0
Other	\$124,649	\$0	\$110,464	\$110,464
Total	\$1,028,593	\$2,883,645	\$2,409,479	\$5,293,124

Total Federal: 0

Total In-kind: 0

Center for Automation Technologies and Systems (CATS)

Rensselaer Polytechnic Institute

Dan Walczyk

Technology Focus: Advanced Manufacturing, Automation and Robotics

Importance to NYS:

CATS helps New York (NY) solve serious production and operational problems that lack commercially available solutions by implementing smart automation, robotics, and advanced manufacturing processes. The Center also actively engages NY assets and Manufacturing USA Institutes and pushes into new areas of manufacturing, automation and robotics technology based on needs of its client base.

Description of Achievements

June-Dec. 2018 Period

A summary of the Center's on-going R&D projects includes 13 with NY-based manufacturers, 11 with the federal government (NSF – 7, DOD – 2, Manufacturing USA – 1, NASA – 1), three with other universities, two with NY State entities (NYSERDA – 1, ESD – 1), and one with a non-NY company. CATS three biggest NY clients currently are IBM, Simmetrix and Plug Power. The Center is happy with the trend towards more industry projects, especially those involving NY State manufacturers.

Jan.-June 2019 Period

CATS had 25 active research and development (R&D) projects. Slightly over half of the projects involve industry R&D with support coming from a combination of direct company outlays and grants from Fuzehub, ESD, NYSERDA and the ARM Institute. Nine projects were federally supported (in order of number of grants) by NSF, ONR and NASA. Finally, support from two projects came from other research universities (Yale, Northeastern).

Impacts

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
22	60	\$5,273,491	\$281,000	\$1,845,130	\$1,650,260	\$195,212	\$9,245,093

Designations and Recognitions

Awards / Recognition	Date Received	Recognizing Organization	Link
N/A			

Federal or Not-for-Profit Grants Awarded

Project	Principle Investigator	Co-Investigator	Source	Amount	Duration (yrs)	Summary
Robot Raconteur: an Interoperable Middleware for Robotics	John Wen	Glenn Saunders	ARM Institute	\$692,400	1	Cost and complexity involved with integrating software capabilities with multiple networked devices from different vendors often hinders innovation. This project addresses this issue through a plug-and-play solution.

Education and Technology Commercialization Activities

Industry-Oriented Education and Training

June-Dec. 2018 Period

CATS staff and faculty mentored 32 undergraduate students on industry-focused research along with numerous graduate students. Through involvement with Advanced Robotics for Manufacturing (ARM) Institute, Glenn Saunders, Research Engineer, continued his campaign to engage K-12 and community college students around NY State in STEM-related fields, especially robotics. He also keeps honing his robotics technology skills through training at three different events.

Jan.-June 2019 Period

The Center provided significant industry-oriented education and training. The marquee event was the 2019 NY Manufacturing Conference attended by 213 attendees (2/3^{rds} from industry) that featured 31 speakers covering 14 sessions, 20 exhibitors, and a student poster presentation. Research Engineer, Glenn Saunders, was the most active staff member in this arena with participation in pre-college training for women and minorities, technical tours provided to high schools from Harlem Academy and Greenwich High, various robotic welding demonstrations for American Welding Society events, and mentoring of Rensselaer engineering students through the Rock Raiders (robotics team) and ASME student section. All Center staff and affiliated faculty also hired scores of undergraduate researchers to work on various R&D projects.

Commercialization

June-Dec. 2018 Period

CATS personnel are very active in outreach and networking activities around NY State. Six Center staff participated in the NYSTAR Annual Meeting with one person providing an additive manufacturing talk and another performing a robotics demo at the Emerging Tech Showcase. CATS also recently formed (1) the Empire State Advanced Robotics Alliance (ESARA) jointly with Fuzehub with the inaugural meeting held the day before the NYSTAR event and (2) the Bio-industrial Materials Institute made up of a consortium of NY academic institutions and businesses. The Center remains very active in engaging NY industry, including discussions with 50 companies and adding 26 companies to its pipeline (13 of whom are prospects for projects), 16 company visits, six on-site manufacturing audits, and six new clients. CATS also has actively engaged a variety of NY organizations including: Fuzehub; Manufacturing USA hubs at Rensselaer (ARM, CESMII, NIMBL); the Business Council of NYS; SUNY @ Stony Brook, Binghamton, New Paltz, ESF and Morrisville; independent NY schools such as Union College, Cornell University and Syracuse University; NYSP2I and Buffalo Manufacturing Works; the Fund for Lake George; and Brookhaven National Lab. Finally, two CATS staff members were featured in interviews with WMHT (Capital Region) and Spectrum News (statewide) related to the Center's work with the Jefferson Project at Lake George.

Jan.-June 2019 Period

CATS was involved in outreach and networking with NY industry and other partner organizations. Key achievements during this six-month period include:

- Promoting and holding our very successful and well-received NY Manufacturing Conference on May 1, 2019, as previously mentioned;
- Hosting 11 companies for meetings and tours of the Center;
- Conducting 68 company meetings in total, including events, site visits, Center tours, and calls;
- Conducting six on-site manufacturing audits for prospective clients and;
- attending and participating in seven state-focused networking events.

NY assets that the Center interacted with are ESD, Fuzehub, CFES, Empire State Advanced Robotics Alliance (ESARA), Center for Economic Growth, Mohawk Valley Community College, SUNY ESF, NY Department of Environmental Conservation.

Invention Disclosures

Disclosure / Patent Name	Inventor	Research Sponsor	Description
Position reference system for water column profiling	Glenn Saunders	IBM	The invention is for a position reference system for water column profiling. The commercial potential includes any organization (company, government agency, etc.) that wants to monitor freshwater quality on a regular basis.

Start-up Companies Formed

Company Name	City	Product/Service	Sector
United Aircraft Technologies (UAT)	Troy, NY	Cable Clamps for Military Helicopters	Aerospace

Licensing Agreements

Project	Inventor	Licensing Partner
N/A		

Royalties

Project	Principle Investigator	Co-Investigator	Company Partner	Royalty Income
N/A				

Small Business Assistance Provided

The Center received five FuzeHub manufacturing grants to help small NY businesses address intractable manufacturing issues involved in production.

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	\$740,096	\$802,449	\$602,058	\$1,404,507
Indirect Costs	\$110,841	\$200,559	\$148,388	\$348,947
Equipment	\$202,850	\$19,717	\$23,596	\$43,313
Materials & Supplies	\$65,273	\$50,407	\$51,045	\$101,452
Tuition	\$0	\$30,742	\$426,969	\$457,711
Travel	\$13,663	\$18,349	\$26,203	\$44,552
Subcontractors	\$0	\$63,488	\$0	\$63,488
Other	\$95,417	\$84,471	\$20,507	\$104,978
Total	\$1,228,140	\$1,270,182	\$1,298,766	\$2,568,948

Total Federal: \$899,930

Total In-kind: 0

Center for Advanced Technology Future Energy Systems (CFES)

Rensselaer Polytechnic Institute

Center Director – Dr. Jian Sun

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 locus 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 2018-2019

The Center was awarded 13 new research projects from NY companies resulting in \$2,822,000 of research funding. CFES committed \$588K cost share to support these projects. The Center was also awarded \$1,435,000 new research funding from non-NY sources. Together, these awards added \$4,257,000 of new research funds to CFES research portfolio.

NYSERDA has been an important funding source for CFES collaboration with NY companies. In the latest round of Program Opportunity Notices (PON), NYSERDA awarded eight new projects to CFES and its industry partners in three topical areas:

- Battery Storage: ORION Polymer, StorEn, EnerMat Technologies
- High Performing Grid: NYPA, JEM Consulting, Pterra, EPRI
- Advanced Clean Energy: General Electric Company

Partnership with CFES also enabled several other NY companies to win research grants from federal funding sources, including a DoE SBIR grant to Applied Power Systems to develop new overvoltage protection schemes for DERs, and an ARPA-E grant to GE Global Research Center to develop and characterize advanced wide bandgap semiconductor power devices.

Center industry partners reported over \$4M economic impacts for 2019 and \$25.7M for 2017-2019 as results of their research collaboration with CFES. Significant impacts were reported by small and startups companies, including:

- ActaSys Inc.: An RPI start-up that develops synthetic jets for EV sensors and is now engaged in full-scale testing of its prototypes with OEM and Tier 1 Suppliers of the automotive industry.
- MIMiC: A company that makes modular indoor solid-state HVAC systems. The company won a \$1.3M grant to support new product prototype design and fabrication.
- ORION Polymer: Another RPI start-up that develops ionic polymers for energy storage application and starts to sell sample product (\$200,000+) to OEM's.
- Plug Power: A long-time partner that recently reengaged with CFES to work on automated hydrogen refilling. Sales are forecasted to reach \$1B in the next 4 years with ancillary product sales of \$50M.

The Center held a Faculty Research Retreat in October 2018, to review new research directions and interests being pursued by Center faculty. The Retreat was attended by a dozen faculty members along

with two invited industry guests who shared their perspectives on the development and application of energy storage and offshore wind.

The Center held its flagship Future Energy Systems Technology Conference on April 10. The event was attended by over 200 delegates from the energy industry, government and academic institutions. Additionally, 21 partners of the Center participated in the conference as Exhibitors to showcase their collaboration with CFES. The conference highlighted CFES research capabilities and accomplishments through a technology-focused poster session (>50 posters by RPI faculty and researchers) in addition to three concurrent technical sessions:

- 1) Advanced Component Technologies for Electrified Transportation
- 2) New Materials and Designs for Solar and Wind Energy
- 3) Renewable Energy, Offshore Wind and Smart Grid

Impacts

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
6	6	\$433,162	\$920,722	\$1,830,636	\$781,000	\$119,000	\$4,084,520

Designations and Recognitions

Awards / Recognition	Date Received	Recognizing Organization	Link
NA			

Federal or Not-for-Profit Grants Awarded

Project	Principle Investigator	Source	Amount	Duration (yrs)	Summary
Simulation of Flexible AC Transmission Systems	Luigi Vanfretti	Dominion Power	\$100,000	1 Year	Enhance models and simulations of FACTS devices for improved operations and control functionality
Cyclic Olefin Copolymer based Alkaline Exchange Polymers and reinforced Membrane	Chulsung Bae	Los Almos National Lab, Xergy	\$400,000	2 Years	Development of alkaline exchange membranes with high ion conductivity, good chemical stability and mechanical durability
Non-PFSA Proton Exchange Membrane for Fuel Cells	Chulsung Bae	DOE, Xergy	\$300,000	2 Years	Enhanced fuel cell technology through utilization of hydrogen produced from renewable energy sources
Development of High Efficient Ion Selective Membrane Separator for Lithium Polysulfide Redox Flow Batteries	Chulsung Bae	DOE SBIR Phase I, Xergy	\$150,000; RPI \$45,000	10 Months	A novel ion exchange membrane is proposed for increased mechanical robustness in flow batteries
Novel Membranes for Electrochemical Hydrogen Compression	Chulsung Bae	DOE SBIR Phase II, Xergy	\$1,050,000; RPI \$240,000	24 Months	Phase II development will focus on temperature and humidity extremes
Novel Polymer Electrolyte Membrane Development	Chulsung Bae	DOE SBIR; OPUS 12	\$150,000 RPI \$50,000	10 Months	Synthesize novel meta-terphenyl anion exchange polymers for catalytic reduction of CO2

for CO2 Conversion to Solar Fuel					
Increasing DER Value and Utilization for NYS through “Learning Smart Inverters”	Jian Sun	EPRI (NYSERDA)	\$110,000	18 Months	Evaluate PV inverter control systems to introduce signals that will enhance current perturbations on the grid

Education and Technology Commercialization Activities

Industry-Oriented Education and Training

The CFES Future Energy Systems Technology Conference was held on April 10 and was well-attended (200+) by energy industry, government and academic partners. The technology-focused conference provided an opportunity for the industry to learn about the latest development in the areas of renewable energy, offshore wind, power electronics, energy efficiency, power systems and smart grids, chemical and biochemical energy conversion, energy storage, and fuel cells. The conference also provided an opportunity for graduate students to present their work and interact with the industry.

CFES research collaborations helped support 6 postdocs (\$193,953), 5 Research Scientists (\$149,833), 22 grad students (\$235,549), and 4 undergrads (\$4,496). CFES also enabled the learning experience of 7 undergraduate students in a capstone project with the RPI Multidisciplinary Lab. The project was an extension of the Wood Chip Drying NYSERDA grant (2016) with Troy Boiler Works (TBW) to complete the conceptual design of a 25 ton/day woodchip drying system that could be transportable. The students presented to the MDL team, GE - a Sponsor and the CEO of TBW.

CFES facilitated the participation of Center partner Actasys Inc. in the Lally School Masters Student Research Program (MSRP), which will challenge 2-3 graduate students on technology market maps and product perceived value in the marketplace.

Professor Vanfretti received a gift (\$100,000) from Dominion Power to develop simulation models for FACTS devices for training of utility engineers.

Commercialization

The majority of the new projects started this year were with small and startup companies. Partnership with CFES was an integral part of their technology development and commercialization strategy. Additional, industry outreach activities included interface with Startup Tech Valley, Venture B, local commerce chamber meetings and industrial development agencies, and Northeast Clean Energy Council.

CFES also supported energy organization activities including NY BEST Technology Conference, Alliance for Clean Energy Conference, FUZEHUB (2) and the NY Solar Energy Society. Professor Sun spoke at the latter and presented an overview of Offshore Wind Development.

Twenty-one CFES partners participated in the CFES Future Energy Systems Technology Conference as exhibitors to showcase their work with CFES. CFES was also an exhibitor supporting NY BEST (March) and National Grid Energy Solution Summit in Utica (June) and National Grid Northeast 80x50 Pathway Forum.

Invention Disclosures

Disclosure / Patent Name	Inventor	Co-inventor	Licensing Partner	Research Sponsor	Description
Alkaline anion exchange membranes derived from diphenylethylene and co-monomer	Chulsung Bae	Sangwoo Lee, Musahi Briem	ORION Polymer, Xergy	National Science Foundation	The new polymers display highly desirable chemical and mechanical properties as alkaline anion exchange membranes for energy storage.
Preparation of ion exchange polymers based on polyolefins and polycycloolefins using acid catalyst	Chulsung Bae	Jong Yeob Jeon	ORION Polymer	National Science Foundation	The new functionalization method of polyolefins using haloalkyl substrates and acid catalysts allows chain modification with a variety of ionic and polar groups
Channeling engineering of hydroxide ion	Chulsung Bae	Eun Joo Park, Santaik Noh		ARPA-E	The invention relates to the development of dimensionally stable membranes using unique ionic polymers.

Start-up Companies Formed

Company Name	City	Product/Service	Sector
N/A			

Licensing Agreements

Project	Inventor	Licensing Partner
N/A		

Royalties

Project	Principle Investigator	Co-Investigator	Company Partner	Royalty Income
N/A				

Small Business Assistance Provided

CFES supported eight small business partnerships this reporting period and in particular awards with startup companies EnerMat Technologies, ORION Polymer, GPT Energy, OPUS 12, and Storen Technologies. This included partnerships to acquire research grants and provide cost share on sponsored research. In addition, CFES worked with several small business partners including JEM Engineering Services, ActaSys and Pterra, many of whom (21 companies) exhibited at the CFES Technology Conference in April 2019 to showcase their technology. CFES maintains contact with previous small business partners to follow progress and offer assistance, including Blasch Precision Ceramics, BioChemInsights, Advanced Polymer Sales, Custom Electronics, EcoCeramics, Comined Energies, MicrOrganic Technologies and Self Array.

Level of Matching Funds Provided and uses

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

Operating Expenses	Matching Funds			
	NYSTAR Funding	Company Cost Share	Other Sources	Total
Salaries & Fringe	\$452,322	\$543,406	\$713,512	\$1,256,918

Indirect Costs	\$67,848	\$97,184	\$150,198	\$247,382
Equipment	\$31,422	\$6,929	\$17,470	\$24,399
Materials & Supplies	\$11,668	\$61,287	\$152,253	\$213,540
Tuition	\$27,494	\$0	\$0	\$0
Travel	\$8,913	\$24,087	\$75,059	\$99,146
Subcontractors	\$0	\$0	\$607,740	\$607,740
Other	\$25,415	\$9,611	\$0	\$9,611
Total	\$625,082	\$742,504	\$1,716,232	\$2,458,736

Total Federal: \$1,136,966

Total In-kind: 0

**Additive Manufacturing and Multifunctional Printing (AMPrint) Center
for Advanced Technology
Rochester Institute of Technology
Denis Cormier, Center Director**

Technology Focus: 3D Printing and Additive Manufacturing

Importance to NYS:

The AMPrint Center was founded in late 2015 and began operations in 2016 with the aim of promoting the 3D printing (3DP) and Additive Manufacturing (AM) industry in New York State. The importance to NYS is profound. The Finger Lakes region of NYS was long viewed as an epicenter of document printing and imaging technologies thanks to companies such as Xerox, Kodak, and others. Those companies have shed tens of thousands of jobs as the trend towards the paperless office has accelerated. A large part of the AMPrint Center's mission is to help those companies reinvent themselves by applying their technologies to the 3DP/AM market that has averaged 30%+ compound annual growth for much of the last decade. Companies elsewhere in NYS, including General Electric, nTopology, and Shapeways, suggest that NYS has the foundation needed to become viewed as a global leader in 3DP/AM technologies. The AMPrint Center is young and is in ramp-up mode, however, it already features one of the most impressive 3DP/AM research facilities in the world.

Description of Achievements

A major achievement for the reporting period pertains to the AMPrint Center's early work with a Buffalo startup company (Vader Systems) and Xerox. The AMPrint Center worked with Vader Systems when it was still operating out of the basement of the home where its founders lived. The AMPrint Center was Vader Systems' first customer, and proceeds from sale of the beta machine allowed Vader Systems to grow operations while simultaneously engaging in collaborative product development research with the AMPrint Center. Meanwhile, Xerox engaged AMPrint Center leadership to help it develop a strategy for entering the 3DP/AM market. When Vader Systems was entertaining investment offers that would have resulted in their exit from NYS, the AMPrint Center Director brought Xerox and Vader Systems together in a process that led to Xerox's acquisition of Vader Systems. This not only kept the startup company's jobs in NYS, but it also led to Xerox's formal entry into the 3DP/AM market. Since Xerox's public announcement of its entry into the 3DP/AM industry in January 2019, the AMPrint Center has worked hand-in-hand with Xerox to continue helping it develop the groundbreaking new liquid metal droplet jetting process. Xerox made major commitment to commercializing new 3D printing technologies through the addition of new engineering and marketing jobs, construction, and internal R&D investments.

Impacts

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
4	5	\$0	\$2,000,000	\$0	\$0	\$0	\$2,000,000

Designations and Recognitions

Awards / Recognition	Date Received	Recognizing Organization	Link
N/A			

Federal or Not-for-Profit Grants Awarded

Project	Principle Investigator	Co-Investigator	Source	Amount	Duration (yrs)	Summary
SLA Printer and 3D Prototypes	Mark Olles		US Army Materiel Command	\$30,000	1.5	Test process parameters of new 3D printer material for the Army.
Environmentally Friendly Additive Manufacturing Technologies	Mark Olles		US Army Materiel Command	\$10,675	1	Develop prototype additive manufacturing technologies to support environmental R&D activities
Advancing RIT's Early Stage Technology Commercialization and Entrepreneurship Eco-System: Integrating Educational and Commercial Outcomes	Richard DeMartino	Denis Cormier	National Science Foundation	\$22,000	2	Scaling of entrepreneurial programs using 3D printing support from the AMPrint Center.

Education and Technology Commercialization Activities

Industry-Oriented Education and Training

AMPrint Center faculty, staff, and students participated in more than 20 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 advising or guidance on additive manufacturing materials, processes, or applications.

A major effort during this reporting period related to the AMPrint Center's 1st Multifunctional 3D Printing Symposium which was held June 12-14, 2019 in Rochester NY. The inaugural event attracted nearly 100 attendees. The majority of attendees were from the NYS industry. The symposium itself provided valuable state-of-the-art knowledge to attendees, and it also featured four pre-symposium hands-on workshops. They focused on (1) inkjet material printing, (2) flexographic printing, (3) printed electronics design using Autodesk EagleCAD, and (4) generative design using Autodesk Fusion 360. Those workshops provided direct workforce development to the attendees.

Commercialization

The AMPrint Center was still relatively new and ramping up during the reporting period, however, the most noteworthy commercialization effort pertained to the AMPrint Center's collaboration with Vader Systems and Xerox to help commercialize the new liquid metal droplet jetting process. Xerox hired two students from the AMPrint Center into full time engineering positions and the work that those former students did within the AMPrint Center is being integrated into the commercial process that Xerox is preparing to release.

Invention Disclosures

Disclosure / Patent name	Inventor	Co-inventor	Licensing Partner	Description
Printed electronics via liquid metal droplet jetting	Denis Cormier	Manoj Meda	Xerox	High performance printed electronic circuit patterns via the jetting of liquid metal droplets.

Start-up Companies Formed

Company Name	City	Product/Service	Sector
N/A			

Licensing Agreements

Project	Inventor	Licensing Partner
1819001	Denis Cormier	Xerox
1819002	Iris Rivero	Xerox

Royalties

Note: The royalties listed below are licensing agreement fees connected to the licensing agreements listed above. In both cases, Xerox used the AMPrint Center's Assigned Project Agreement that allows sponsors to obtain exclusively ownership of IP at the onset of a project for the larger of \$5,000 or 10% of the project amount.

Project	Principle Investigator	Co-Investigator	Company Partner	Royalty Income
1819001	Denis Cormier		Xerox	\$10,000
1819002	Iris Rivero		Xerox	\$5,000

Small Business Assistance Provided

Zero Valent Nanometals: ZVNM is an AMPrint Center startup company that is developing copper nanoparticle inks. The AMPrint Center lab facilities were used to prove out the nanoparticle synthesis technique and to characterize properties of the resulting materials.

Sensor Films Inc: SFI is a Victor NY based startup company developing a new inkjet material deposition machine. The AMPrint Center assisted SFI through fabrication of a small-scale inkjet material jetting testbed used to develop inkjet printing process parameters for inks before they are used in SFI's large scale production machine.

Intrinsiq Materials: Intrinsiq Materials is a Rochester NY based small business that makes copper nanoparticle inks. The AMPrint Center assisted Intrinsiq by developing inkjet printing parameters for its inks and then characterizing the performance of the resulting printed circuit patterns.

Century Mold: Century Mold is a Rochester NY based small manufacturing business. The AMPrint Center helped Century Mold by 3D printing carbon fiber composite prototypes using a new process that Century Mold did not have access to.

BotFactory: BotFactory is an NYC based startup company that makes a machine which prints circuit patterns and places electronic components on the board. The AMPrint Center was one of BotFactory's early supporters/customers. The AMPrint Center has evaluated conductive inks and provided customer feedback to BotFactory to help improve the process for the next-generation machine.

BonBouton: BonBouton is an NYC based startup company that makes shoe insoles with sensors to detect hot spots/ulcers in individuals with diabetes or other high-risk conditions. The AMPrint Center connected with BonBouton at the end of the reporting period for advice on digital printing processes suitable for manufacturing its insoles and a funded research project for the subsequent year was arranged.

R3 Manufacturing: R3 Manufacturing is an NYC based startup company that is looking to make a new high-speed 3D printer. The AMPrint Center connected with R3 Manufacturing at the end of the reporting period for advice on how a key component to its high-speed 3D printing print engine could be fabricated for them in metal. A funded research project for the subsequent year was arranged.

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	\$295,161	\$38,537	\$78,728	\$117,265
Indirect Costs	\$44,274	\$6,555	\$19,682	\$26,237
Equipment	\$1,955	\$0	\$342,363	\$342,363
Materials & Supplies	\$34,391	\$3,179	\$50,541	\$53,720
Tuition	\$0	\$0	\$0	\$0
Travel	\$36,606	\$2,999	\$879	\$3,878
Subcontractors	\$86,360	\$0	\$177,267	\$177,267
Other	\$276,765	\$75,415	\$171,703	\$247,118
Total	\$775,512	\$126,685	\$841,163	\$967,848

Total Federal: \$5,735

Total In-kind: 0

Center for Advanced Technology in Emerging and Innovative Sciences

University of Rochester
Mark Bocko Center Director

Technology Focus: Photonics and Imaging Science Systems

Importance to NYS:

The Center for Emerging and Innovative Sciences (CEIS (hereinafter referred to as the CAT)) at the University of Rochester (UR) is designated in the photonics and imaging science systems technology focus. The CAT will conduct applied research and development in electronic imaging systems that encompass the disciplines of image recording, compression, storage, coding, enhancement, retrieval, printing, and visualization. The CAT will focus on application areas such as imaging for security and surveillance, distributed and networked imaging, human and robotic vision, computer interpretation of images, image display, quantum photonics, photonic sensors, and medical imaging.

Description of Achievements

This CAT report captures the status of 19 projects funded through CEIS Collaborative Integrated Research (CIR) programs with 23 faculty and 14 New York State companies. The projects with Clerio Vision, Envision Solutions, Harris Corporation – Communication Systems Division, and SiMPore are co-funded with the CoE in Data Science. The collaborations with industry partners have allowed 47 students the opportunity to participate in the research. Gustavo Gandara Montano and Bhavan Vasu, students working on the Clerio Vision and Kitware projects respectively, accepted jobs, post-graduation, at these partner companies.

CEIS and RIT co-hosted the 2nd annual AR/VR Initiative Meeting on October 1st. With 100 attendees, this event engaged faculty from both institutions around four facilitated breakout group topics: visual, audio, platform, and applications. Also, in October, our partner Harris Corporation announced their intent to merge with L3 Technologies, Inc. Once completed, the merger will position L3 Harris Technologies, Inc. as the 6th largest U.S. defense company and a top 10 global defense company with customers in over 100 countries. Post-merger announcement, Harris approached several UR faculty members for their expertise in key areas that L3 Harris wishes to pursue and CEIS and the CoE in Data Science have committed to supporting these university-industry collaborations. One of CEIS' start-up company partners, Clerio Vision, Inc. had their own exciting announcement in October – they had treated five First-in-Human subjects with their LIRIC (Laser Induced Refractive Index Change) technology. LIRIC leverages femtosecond laser technology developed at UR (Gerard Mourou and Donna Strickland, were recognized in 2018 with a Nobel Prize) and refined by Wayne Knox as a novel, non-invasive vision correction method. This technology has potential to be a game changer for the more than 2 billion people worldwide in need of some form of vision correction.

In December, CEIS published the latest annual report and distributed it to the research community and company partners along with contacts at specific federal, state and local economic development agencies.

Several CEIS faculty researchers and company partners received recognition during this reporting period. In April, the UR announced that the World Intellectual Property Organization ranked it 4th among U.S. universities for the period 2011-2015 for the percentage of patent holders who are women and highlighted the accomplishments of several faculty, including long-time CEIS partners Krystel Huxlin and Jannick Rolland, in the Newcenter series: [Women of invention: How Rochester faculty find success as patent-holders](#). Their research interests led to collaborations that have resulted in local startups Clerio

Vision, Inc. and LighTopTech respectively. As CEIS strives to foster innovation, it is always on the lookout for entrepreneurs who need a helping hand. Last semester a cohort of undergrads, including 2 CEIS student employees (Nick Drogo BME'19 and Oliver Ostriker Financial Economics '19) formed WetWare BioSystems (<https://www.wetwarebiosystems.com/>) to develop their novel biotechnology, which is designed to preemptively mitigate the effects of TBIs in the defense and civilian sectors. The epitome of home-grown entrepreneurs. WetWare was a finalist in UR's business plan competition in May, which gave them space at NextCorps through 2021 and access to NextCorps resources. They were also selected to participate in RIT's intense Student Accelerator Program this summer. In June, WetWare utilized LSI 2019 to showcase their technology and network with fellow exhibitors and attendees leading to discussions with Pentagon representatives and the CEO of a major helmet company. CEIS resources continue to be available to WetWare as they move forward; there are any parallels with another successful UR student that formed a startup and partnered with CEIS, [Ovitz Corporation](#), the [2019 Luminate NY](#) winner.

Outreach/Networking activities this period include the annual **University Technology Showcase** that was co-hosted with the CoE in Data Science on April 4th. The program consisted of a panel discussion on the challenges and strategies for launching a technology startup with the founders of three exciting technology companies in Rochester. The poster session had over 50 posters representing current research happening at UR and RIT. The winner of the "best poster", as judged by attendees, was "*Image-based biomarker for Cancer Recurrence Prediction Using SHG Imaging*" which represented a project with Harmonigenic Corporation. CEIS also supported a Finger Lakes Workforce Investment Board initiative organized by the Finger Lakes Advanced Manufacturers' Enterprise (FAME) on April 30th. The event, **Regional Apprenticeships – A School to Career Connection**, was held in Rochester at Monroe Community College. Last but not least, CEIS Director Mark Bocko was a part of the planning committee for [Light & Sound Interactive 2019 \(LSI\)](#) held June 25-27th. He organized a very successful Audio and Music track that was held at the Eastman School of Music. CEIS, along with several company partners, exhibited during the daily Demo & Display session in the Sibley Square Building. LSI 2019 brought 700 attendees and 90 presenters to downtown Rochester and generated over \$500,000 in travel, food, lodging, and entertainment as per Visit Rochester. Attendees represented 33 states and 6 countries, 58% were from outside Rochester/Monroe County. Facebook, Amazon and Bose participated and were impressed with the conference and what the region has to offer. Facebook has already committed more than \$5M to fund research in virtual reality at the UR and RIT. Startup Magic Leap, is in discussions with ESD on establishing a workforce development project in Rochester.

Overall, a robust mix of matchmaking, nurturing the entrepreneurial efforts in the area, and strategically identifying additional opportunities for economic development in the Finger Lakes region.

Impacts

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
25	12	\$4,620,662	\$4,809,079	\$33,781,697	\$12,508,000	\$38,439	\$55,757,877

Designations and Recognitions

Awards / Recognition	Date Received	Recognizing Organization	Link
CEIS partner OVITZ Corporation, the 2019 Luminate NY winner	June 28, 2019	Luminate NY	https://www.governor.ny.gov/news/governor-cuomo-announces-round-ii-winners-luminate-ny-accelerator-competition-rochester

Federal or Not-for-Profit Grants Awarded

Project	Principle Investigator	Co-Investigator	Source	Amount	Duration (yrs.)	Summary
"DOD – W81XWH-18-1-0560 “Nanomembrane capture and characterization of cancer-derived exosomes in urine”	James McGrath		DOD	\$611,026	9/1/2018-8/31/2020	Bladder cancer (BC) is the fifth most common solid malignancy in the U.S., is the most expensive to treat over the lifetime of the patient and utilizes more Medicare dollars than any other cancer. The high costs of BC treatment stems from a high rate of recurrence and the fact that both diagnosis and surveillance of BC require invasive cystoscopy and biopsy procedures. Exosomes, small vesicles secreted by uroepithelial carcinoma cells into urine, are promising candidates for detection of BC. Our team has developed a novel nanomembrane based technology for the efficient and rapid capture of exosomes from biofluids with negligible protein contamination.
"RAISE-EQUIP: Integrated Silicon Photonics Platforms for Scalable Quantum Systems”	Marek Osinski (University of New Mexico)	Roman Sobolewski (University of Rochester)	NSF	\$750,000 (\$167,000 to Rochester)	10/1/2018-9/30/2021	The objective of the proposed research is to integrate novel devices for the generation, manipulation, propagation, and detection of single and entangled photons for quantum information processing in a silicon photonics platform that can be used to implement a large-scale quantum communication network.

Education and Technology Commercialization Activities

External Workforce Development

1630C005 Govind Agrawal – Corning, Inc. – The team had multiple face-to-face meetings and periodic on-line conference calls with multiple Corning employees who are customers for the computer code being developing for Corning. These scientists were involved during the entire project period and have benefited from this project.

1430C012 Paul Funkenbusch and 1430C013 Krystel Huxlin – Clerio Vision, Inc. - The team has routine project meetings with Clerio Vision, Inc. several times per week (with different components of the team) to share results obtained and to strategize about technological issues, manufacturing and commercialization goals of this project.

1330C007 Wendi Heinzelman – PI; Cristiano Tapparello – Co-PI – Harris Corporation, Communication Systems Division – The team continued to meet with contacts at Harris on a regular (approximately monthly) basis and presented a summary of the work to Harris employees in mid-June.

1630C016 Kara Maki/David Ross – Bausch+Lomb – The team had two quarterly meetings with the Bausch + Lomb team to present research findings and to collect information and insight from the team.

06330303 Zoran Ninkov – Thermo Fisher Scientific - Numerous visits to Thermo Fisher to train staff on fluorescence phenomena and to test and calibrate test structures in the deep UV.

1630C012 Andreas Savakis/John Kerekes – Kitware - The project PI's, Andreas Savakis and John Kerekes, attended a team meeting with the project sponsors in Washington DC and presented technical updates. The RIT team and Kitware have regular telecon meetings to discuss progress updates and planning for this project.

Internal Workforce Development

1730C005 Diane Dalecki/Denise Hocking – Imaginant, Inc. - Sarah Wayson is a BME graduate student that is serving as a research assistant on this project. The project has provided much opportunity for her to develop new skills and knowledge in high-frequency ultrasound instrumentation and measurements. The project has also provided her with skills in collaborating with industry partners, technical reporting, and understanding ultrasound instrumentation industries and markets.

1430C012 Paul Funkenbusch – Clerio Vision, Inc. - The project team spans PhD and UG levels. At the PhD level, Gustavo Gandara Montano received his PhD during this time period and Dan Yu, Kaitlin Wozniak, Ruiting Huang, Elizabeth Diaz Bueno, and Sara Gearhart are currently pursuing PhDs in Optics, Mechanical Engineering, or Materials Science, topics related to this project. At the UG level, Katherine Donnelly from Optics and Kathryn Colone from Biomedical Engineering have been participating. The team has project meetings with Clerio Vision, Inc. (with different components of our team) to share results obtained and to strategize about technological issues, manufacturing and commercialization goals of this project. Because of the multi-disciplinary nature of the research, the students are well trained in optical systems, instrumentation, and data analysis.

1630C016 Chunlei Guo – AlchLight - Erik Garcell and Billy Lam, PhD students supported by the CAT project, received extensive training in laser materials processing as well as experimental design and specialized testing of processed materials. A number of undergraduate students have participated in the research during this period as well. These students were trained on making different cooling setup and testing of cooling efficiencies of different superwicking materials. They were also trained on data management, data analyses, data presentation, and manuscript writing skills.

1430C007 Wendi Heinzelman – PI; Cristiano Tapparello – Co-PI – Harris Corporation, Communication Systems Division - This project has supported two research assistant positions. A fourth year PhD student, Utku Demir, has worked on this project since January 2016, focusing on developing protocols to support and maintain ad hoc network connectivity. A second fourth year PhD student, Nadir Adam, began working on this project in June 2017, focusing on optimizing communication in mixed hierarchical/ad hoc networks. Additionally, four undergraduate students have been working on this project through this reporting period. All of these students have received training in distributed computing, ad hoc networking, Android development, and emulation/simulation software. They all present their work at our meetings with Harris representatives, thereby, receiving valuable presentation and professional development experience.

1430C013 Krystal Huxlin – Clerio Vision, Inc.- The project team spans PhD, and undergraduate levels. Because of the multi-disciplinary nature of the research, the students are well trained in optical systems, instrumentation, and data analysis, but they are also getting a clear glimpse of what is required to take a medical technological product or device through regulatory approval and commercialization. The University-based team regularly works with two research engineers (Len Zheleznyak and Sam Butler), who are both ex-graduate students from the Institute of Optics and MechE, respectively, and who now work full-time for Clerio, based at our company's laboratory in Rochester.

1430C014 Wayne Knox – Clerio Vision, Inc.- Undergraduate students do research in the group and they also give regular updates at Clerio. PhD student Gustavo Gandara-Montano finished his PhD in Optics and joined Clerio. PhD students work closely with several Clerio employees on certain projects directly related to their thesis work. This is an excellent model for interactions with Clerio wherein students can get an education and experience with the corporate ('startup') environment.

1830C001 James McGrath – SiMPore, Inc. - one MS student and one PhD student in a supervisory role worked on this project. Grad student Dan Ahmad is expected to take a job at SiMPore (West Henrietta NY) after graduation.

06330303 Zoran Ninkov – Thermo Fisher Scientific - One graduate student (Ross Robinson) spends substantial time using the testing facility at Thermo Fisher in Syracuse. He has collaborated with staff at Thermo Fisher involved in detector testing. He has also been instrumental in cross calibrating the NIST and Thermo facilities. An undergraduate RIT student, Alex Knowles, from Chemistry has worked on this project as well.

1530C013 Jannick Rolland – LighTopTech Corporation - Amanda Mietus, rising senior student at The Institute of Optics, conducted an internship at the industry sponsor, LighTopTech, from May 2018 to August 2018. Her training included operation of GD-OCM, measurement of various biological and manufactured samples, and numerical processing. Changsik Yoon, PhD student, trained internally on developing the GDOCM/Fluorescence microscopy system and in collaborating with 3 different groups to apply the system on samples. Also, Yue Qi, senior student trained and is working with Changsik on all aspects of the system lab development as well as in identifying applications with experts. Ben Moon was hired to continue work on this project.

Commercialization

1730C004 Steven Feldon, M.D., M.B.A. – Envision Solutions, LLC - Working with Bascom Palmer Eye Institute at the University of Miami and Scheie Eye Institute at the University of Pennsylvania, which will act as the two additional study sites for this study. Also, reached out to other hospitals and clinicians through the North American Neuro-ophthalmology Society by letter and word of mouth to promote this

clinical trial and to recruit additional patients to the study.

1430C012 Paul Funkenbusch and 1430C013 Krystel Huxlin– Clerio Vision, Inc. - Clerio is actively pursuing potential partnerships with several companies at all times during this project. Several partnerships have been established.

1330C014 Zeljko Ignjatovic – Harris Space & Intelligence Systems - During this project period, discussed preliminary results, collaboration and funding opportunities with the following institutions/researches: Dr. Patrick Longhini and Dr. Visarath In with Space and Naval Warfare Systems Command (SPAWAR). Following discussions with SPAWAR personal, there are plans to submit a collaborative proposal to AFRL on the development of Terahertz communication systems. Also, engaged Carestream Health in attempts to commercialize the technology in dental imaging. There is a great promise that the THz imaging may replace traditional X-ray in dental imaging applications thanks to its non-ionizing nature, small form factor and ability to estimate gradient index for topological as well as tomographic imaging.

1530C003 James McGrath – SiMPore, Inc. - The CEO of ProPur Water Filters USA visited SiMPore and the UR McGrath lab where he was given a demo of the computational models.

06330303 Zoran Ninkov – Thermo Fisher Scientific - Collaboration with RIT SMFL, NIST Gaithersburg and NASA Goddard Space Flight Center (use of Carey 5000+UMD). This work involves student Alex Knowles, responsible for ink-jet printing, aerosol jet printing, and quantum dot fabrication. Also, used the facilities of the New York State Center for Advanced Technology in Additive Manufacturing and Functional Printing at RIT. Interaction with Princeton Instruments has been initiated.

1530C013 Jannick Rolland – LighTopTech Corporation - Developed three new collaborations with URMC scientists in applying the methods developed to various sample investigations in relation to corneal imaging, retinal imaging and brain imaging.

1830C003 Geunyoung Yoon – Bausch+Lomb - The PI’s lab is involved in a university-wide initiative for virtual/augmented reality research. The lab has received an internal pilot grant from the University and has been active in various discussions and collaborative research activities. Also, the methodology developed during the project period has potential to provide other funding opportunities from other vision care companies such as Johnson & Johnson and Coopervision. A large 5-year research grant proposal that studies corneal biomechanics with this imaging modality will be submitted to NIH for the October deadline.

Invention Disclosures

Disclosure / Patent Name	Inventor	Co-inventor	Research Sponsor	Description
Modeling Shape Changes in the Cornea	Amy L. Lerner	Paul Funkenbusch Elizabeth Diaz Bueno	Clerio Vision, CEIS	Developing modeling and statistical tools that allow to evaluate the effect of localized stiffness changes in the cornea on the optical behavior.
In Situ Glass Transition and Observation of Microdebris on Silicon	Greg Madejski, James McGrath, Wayne Knox		ParVero, SiMPore, CEIS	

Optical Phased Array for Adaptive Free-Space Optical Imaging	Hui Wu		NSF, Cisco, Harris SIS, CEIS	Related to optical phased array (OPA) design, which may significantly impact large scale OPA systems and related LIDAR and other 3-D imaging applications. The commercial applications in autonomous vehicles and new imaging sensors are projected to reach tens of billions of dollars in market sales annually.
Integrated Silicon Photonics Platforms for Scalable Quantum Systems	Marek Osinski (University of New Mexico)	Roman Sobolewski (University of Rochester)	NSF	The invention relates to integrated silicon photonics platforms and, in particular, to silicon photonics platforms for scalable quantum systems.
Multi-Photon Absorption for Femtosecond Micromachining and Refractive Index Modification of Tissue	Wayne H. Knox, Krystel R. Huxlin, Li Ding		Clerio Vision, CEIS	By adapting femtosecond micromachining approaches developed in hydrogels, Intra-tissue Refractive Index Shaping (IRIS) in biological tissues can be performed.
Method for Modifying the Refractive Index of Ocular Tissues	Wayne H. Knox, Krystel R. Huxlin		Clerio Vision, CEIS	Includes: (a) measuring the degree of vision correction needed by patients and determining location and shape of refractive structures that need to be positioned within the cornea to partially correct a patient's vision; (b) directing and focusing femtosecond laser pulses in the blue spectral region within the cornea at an intensity high enough to change the refractive index of the cornea within a focal region, but not high enough to damage the cornea or to affect cornea tissue outside of the focal region; and (c) scanning laser pulses across a volume of the cornea or lens to provide the focal region with refractive structures in the cornea or the lens.
Optical device and method for modifying the refractive index of an optical material	Wayne H. Knox, Ding; Li, Kunzler; Jay F., Jani; Dharmendra			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. The irradiated regions are characterized by a positive change in refractive index of from 0.01 to 0.06 and exhibit little or no scattering loss.
Refractive Index Shaping Laser Writing Process Control	Knox, Wayne			Refractive index writing system and methods employing a pulsed laser source for providing a pulsed laser output at a first wavelength; an objective lens for focusing the pulsed laser output to a focal spot in an optical material; a scanner for relatively moving the focal spot with respect to the optical material at a relative speed and direction along a scan region for writing one or more traces in the optical material defined by a change in

				refractive index; and a controller for controlling laser exposures along the one or more traces in accordance with a calibration function for the optical material to achieve a desired refractive index profile in the optical material.
Optical Lenses and Methods for Myopia Control	Geunyoung Yoon			Myopia (near-sighted) is one of the leading causes of visual impairment worldwide. Because of high degree myopia being a significant public health concern, it is of crucial importance to find effective treatments to prevent myopic progression in children. This invention is to control myopia progression by reducing peripheral ocular aberrations (both lower and higher orders) via ophthalmic lenses or corneal refractive surgery.

Start-up Companies Formed

Company Name	City	Product/Service	Sector
N/A			

Licensing Agreements

Project	Inventor	Licensing Partner
N/A		

Royalties

Project	Principle Investigator	Co-Investigator	Company Partner	Royalty Income
N/A				

Small Business Assistance Provided

N/A

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	\$573,018	\$500,242	\$0		\$500,242
Indirect Costs	\$58,558	\$66,291	\$0		\$66,291
Equipment	\$14,412	\$40,680	\$0		\$40,680
Materials & Supplies	\$28,280	\$58,864	\$0		\$58,864
Tuition	\$0	\$0	\$0		\$0
Travel	\$1,419	\$62,762	\$0		\$62,762
Subcontractors	\$97,789	\$4,803	\$0		\$4,803
Other	\$25,206	\$25,101	\$0		\$25,101
Total	\$798,682	\$758,743	\$0		\$758,743

Total Federal: \$0

Total In-kind: \$0

Center for Biotechnology

Stony Brook University

Dr. Clinton Rubin

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 will capitalize 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.

With NYSTAR funds and required matching funds, the CfB:

- Invests intellectually and financially in commercially promising bioscience research partnerships with the industry;
- Expands applied research with established New York life science companies to accelerate product development;
- Fosters strategic alliances with New York State companies, the investment community, and medical research foundations to support the discovery and development of commercially promising academic innovations;
- Develops an infrastructure to mentor emerging company CEOs and foster a culture of entrepreneurship;
- Enhances undergraduate and graduate education by integrating bioscience business concepts into the curriculum; and
- Expands workforce-training programs in technology management, biomanufacturing, regulatory affairs, and areas relevant to clinical development and commercialization.

Description of Achievements

The Center for Biotechnology (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, 2018 - June 30, 2019 the Center for Biotechnology's programs contributed to the generation of \$436M in new corporate revenues, \$23M in non-government funds acquired, \$8.8M in federal funds acquired, \$1.7M in cost savings, and \$460K in capital expenditure impacts. Forty-nine new jobs were created and 22 retained.

Significant effort continues to be devoted to leveraging the NIH REACH initiative to build the necessary technology and business development infrastructure in the downstate NY region with the emphasis on new company formation and on supporting the needs of the emerging biotech sector. As reported by RTI, an independent consultant retained by NIH to conduct an impact assessment of all REACH Hubs and National Centers for Accelerated Innovation, the Long Island Bioscience Hub, led by the CfB, had economic impacts on par with the more established centers with larger budgets in Boston, CA and Cleveland. One-hundred-ninety-seven technology development proposals have been reviewed under the LIBH initiative and fifty-eight have been funded. The CfB will invest in four promising Applied Research and Development projects in the next Fiscal Year, 2019-2020.

Three new project collaborations between small New York State companies and Stony Brook University faculty have been launched as of July 1, 2018 (Avery Biomedical, Inc., Biocogent, LLC and Traverse Biosciences, Inc.) and one existing project collaboration has received continued support from the CfB

(ALA Scientific). Roughly \$165,000, was awarded under the CfB's 2018-2019 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.

Over 300 attendees participated in the Life Sciences Summit 2018 held in New York City on October 24-25. One-third of the audience represented investment professionals and individuals representing large pharma and biotechnology companies that could serve as strategic partners for early stage technologies from academia and start-up companies. The "Emerging Company Showcase at the event features presentations by emerging companies that have raised \$15 million or less with pre-clinical to Phase 2A assets. More than forty companies presented over the course of two days, seventeen of which are companies operating in New York State.

Impacts

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
48	72	\$408,319,838	\$1,785,379	\$8,767,608	\$20,355,806	\$460,000	\$439,688,631

Designations and Recognitions

Awards / Recognition	Date Received	Recognizing Organization	Link
Best of Show Award	3/29/2019	CUNA Technology Council	https://news.cuna.org/articles/115819-cuna-technology-council-presents-gac-best-of-show-award-to-glia

Federal or Not-for-Profit Grants Awarded

Project	Principle Investigator	Source	Amount	Duration (yrs)	Summary
Establishing STS-1 as a Novel Target for Treatment of Systemic Candidiasis	Carpino, Nicholas A	NIAID	\$198,904	1	Develop a small molecule drug to be used in combination therapy for the treatment of life-threatening C. albicans infections.
Identify Inhibitors of HIV-1 Budding by Experimental, Computational and Virtual Screening	Carter, Carol	NIAID	\$197,758	1	Goal is to identify small molecules compatible with the interfaces through virtual screening of large commercially available ligand libraries.
MELD: Accelerating MD Modeling of Proteins using Bayesian Inference	Dill, Kenneth A	NIGMS	\$317,007	1	To develop MELD, a computational Bayesian accelerator that "melds" together molecular dynamics simulations with external knowledge.
Novel PET Radiotracers for Imaging Infection	Tonge, Peter	NIBIB	\$350,142	1	Develop radiotracers to be used for non-invasive PET imaging to detect and localize of bacterial pathogens in humans.
Biomechanical Approaches and Technologies for Enhancing TAVR Outcomes	Bluestein, Danny	NIBIB	\$781,199	1	Develop next generation TAVR technology; combining imaging, computational and in vitro tools in a refined biomechanical analysis methodology, an optimization

					approach will guide pre-planning and tailor TAVR procedures for achieving significantly better patient outcomes and reduce complications.
New Antifungals Targeting the Synthesis of Fungal Sphingolipids	Del Poeta, Maurizio	NIAID	\$591,542	1	Assess the therapeutic potential of novel antifungal agents, identified in the laboratory via screening a ChemBridge library that target the synthesis of fungal but not mammalian glucosylceramide (GlcCer).
Molecular Functions of Cilia-Planar Polarity Effectors (CPLANES) in Skin Morphogenesis and Homeostasis	Chen, Jiang	NIH	\$350,900	1	Examine the functions of the CPLANES in skin morphogenesis and homeostasis. Understanding the molecular functions of CPLANES will provide important insight into the molecular mechanisms underlying hair follicle patterning, basal cell carcinoma formation, neural tube defects, and ciliopathies.
Optimizing the Immune Response by Targeting the STS Enzymes	Carpino, Nicholas A	NIAID	\$630,428	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.
Roles of MIR-129 IN Colorectal Cancer	JU, JINGFANG	NCI	\$348,425	1	Test the hypothesis that miR-129 is indeed a tumor suppressor of colorectal cancer and a novel modulator of chemosensitivity to 5-FU based treatment.
Mechanism of Slow onset SNZYME Inhibition and Translation to Time-Dependent Drug Activity	Tonge, Peter	NIGMS	\$326,975	1	Elucidate molecular factors that dictate impact of drug- target residence time on in vivo drug activity. These studies will focus on inhibitors of FabI, an enzyme drug-target from Mycobacterium tuberculosis, and LpxC, an enzyme drug target from Gram negative ESKAPE pathogens.
Field Shaping Scintillator-Coupled High-Gain Avalanche Rushing Photoconductor (SHARP) for Active Matrix Flat Panel Imager (AMFPI): Towards Large-Area, High-Efficiency, and Low-Dose X-Ray Imaging	Goldan, Amirhossein	NIBIB	\$157,008	1	Fabricate and test a prototype high-efficiency flat-panel x-ray imaging detector with avalanche gain. Successful development will lead to clinical-translation ready, practical low-dose x-ray imaging technology, which will be the first large area solid-state detector with stable avalanche gain.
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).

Education and Technology Commercialization Activities

Industry-Oriented Education and Training

Fundamentals of the Bioscience Industry Program (FOBIP)

The Fundamentals of the Bioscience Industry (FOBIP) is an 84-hour seminar and workshop program that is 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. The FOBIP program is offered at Stony Brook's Long Island campus as well as at a satellite Manhattan location and is open to participants from throughout the greater metropolitan area. STLC funding allowed the CfB to introduce a hands-on technology commercialization project into the program that requires students to develop commercialization strategies around real intellectual property. At the completion of the program, the students present the project to a panel of industry representatives and investors.

In 2019, the program was offered at the Stony Brook University location. Fifteen students participated in the 16th offering of the Fundamentals of the Bioscience Industry program. Of those 15 students, there were 5 graduate students pursuing an MS, 8 graduate students pursuing a PhD, 1 postdoctoral associate, and a research scientist also serving as the CSO of a local startup company.

Commercialization Fellowships

CfB has continued its Commercialization Fellowship which aims to provide a select number of Fundamentals 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. By working directly with clients to conduct market assessments and IP due diligence, analyze regulatory pathways, develop financial models, connect entrepreneurs to the CfB network of industry professionals, they help hone the client's investor presentation. They also support the activities of the CfB's BioEntrepreneurs-in-Residence (B-EIRs). The B-EIRs are experienced entrepreneurs whose sole purpose while at the CfB is to start a company, execute a license agreement for a technology and secure professional financing. Fellows are involved in all aspects of the start-up process and work directly under the guidance of the BEIRs. 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 Fundamentals participants and oversee graduate students working on client projects.

Innovation Boot Camp

Each spring, the Center co-organizes the annual Long Island Innovation Boot Camp/Pre-Seed Workshop to support entrepreneurial faculty interested in launching a company based on a technology they developed at Stony Brook University and New York State start-up companies it is working with. The Innovation Boot Camp is an event, which rallies community talent and resources to investigate and transform commercially promising technologies into pre-seed stage companies. The Innovation Boot Camp consists of the following eight idea analysis sessions:

- The Technology: Do you have a proprietary product?
- Technology to Market Map: To whom will you sell?
- Market Need: Where is the pain?
- Competition: Why will you win?
- Business Model: How will you operate?

- Revenue Potential: How big is this opportunity?
- Management Team: You and what army?
- Technology Status: What does the roadmap look like?

Participating teams are led through these eight modules so that they can address key questions and generate a series of slides that constitute the foundation of a presentation that they deliver on the afternoon of the second day before a panel of community experts. Three biomedical entrepreneurs were supported in 2019.

SBIR/STTR Workshops

In January 2019, the Center for Biotechnology hosted its 3rd annual 1.5-day intensive SBIR/STTR workshop led by program experts from BBC Entrepreneurial Training and Consulting. To enhance the offerings for companies who have submitted and received Phase I grants, the Center added a separate training session, coupled with an intensive workshop, focused on preparing for Phase II submissions. The one-on-one assistance program supported four cohorts during the FY18/19. The first consisted of three companies who prepared and submitted applications for the 9/5/18 submission deadline. A second cohort began in mid-October in anticipation of submitting SBIR/STTR proposals on 1/7/19. The third consisted of four companies who prepared and submitted applications for the 4/5/19 submission deadline. A fourth cohort began in late June in anticipation of submitting SBIR/STTR proposals on 9/5/19.

Commercialization

Technology Commercialization in the Life Sciences (MBA 568)

The MBA 568 class continues to be offered through the Stony Brook University College of Business. Students with business and technical backgrounds study topics such as medical technology analysis, competitive advantage analysis, business modeling, regulatory planning, intellectual property, licensing, and financing medical technologies including both dilutive and non-dilutive sources of funding. Importantly, the class also includes two projects using technologies provided by the Office of Technology Licensing and Industry Relations (OTLIR).

BioStrategy Sessions/Technology Commercialization Clinic

The initial interaction between the CfB and client company is usually through a BioStrategy Session. CfB currently has 28 advisors and during the FY18/19, 29 companies joined the list of clients.

The BioStrategy sessions have shown that there remains a significant gap between early-stage, academic technologies and the viability of a start-up company, particularly in regard to how the technology being developed is truly converted into a commercially relevant product that addresses an unmet market need. Often the technologist possesses a limited appreciation for how to develop a business model, identify customers, and project revenues and expenses, though they are very knowledgeable about their technology and its competitive advantages over current products. Moreover, technologists often struggle with a clear description of the intended product their company will commercialize, the mechanism by which sales will be generated and how prospective investors will receive a significant return on their capital.

The CfB continues to work with emerging bioscience companies in an effort to nurture their growth and expansion in New York State. The Technology Commercialization Clinic (TCC) represents one of the tools by which the CfB can support the development of promising biomedical technologies that address unmet and growing market needs. This type of support rarely exists within the academic culture and CfB clients have been able to extract significant value from these activities. Nearly ten years after starting the TCC program at CfB we see clear signs that these activities have started to contribute to the

generation of positive economic impact in New York State. This type of entrepreneurial activity contributes to the growth of an innovation-based economy in New York State and provides further justification for the government investment in programs like the CfB.

Long Island BioMentor Initiative (LIBMI)

The purpose of the Long Island BioMentor Initiative 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. Consideration is based upon stage of development, identified needs of the entrepreneur and the intake assessment conducted by the program's Entrepreneur Liaison, Raymond Farrell and Partner, Carter, DeLuca, Farrell, and Schmidt. The intake assessment includes a personal interview between the entrepreneur, program staff and the Entrepreneur Liaison to discuss the guiding principles of the program, review guidelines for engagement and potential conflict of interest issues, discuss the responsibilities of the entrepreneur, and their commitment to the rigor of the program. If all are in agreement that the initiative is a good fit for the entrepreneur and it is likely that the entrepreneur will benefit from engagement, then the entrepreneur is introduced to the mentor pool through quarterly mentor breakfast meetings.

FY18/19, CfB hosted 3 mentor breakfast meetings, which included 3 new mentors and 5 new entrepreneurs. The mentees 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.

Mentors are identified through the Center for Biotechnology's network and personal referrals. They go through a similar application and vetting process that includes an intake meeting with program staff and the Mentor Liaison, Dr. Saied Tousi. If accepted into the program, the Mentor participates in an orientation that includes guiding principles, the role of mentor and lead mentor, anticipated time commitment, and an in-depth discussion of conflict of interest. New mentors are introduced at the quarterly breakfasts and mentors have an opportunity to self-select whether they would like to join a specific entrepreneur and mentoring team.

The Mentor/Mentee meetings take place approximately every 4-6 weeks at the entrepreneur's request and are limited to 90 minutes. The mentee is required to provide an agenda before the meeting that clearly identifies their priorities for the session, a summary shortly after each consultation summarizing the meeting and any action items. Future meetings are not scheduled until the mentee completes agreed upon action items, or has questions related to execution on the plan. The Lead Mentor is available to the entrepreneur on an ongoing basis to answer questions or provide clarification. However, all written communication is copied to the entire mentor team. There are currently 20 mentors and 17 mentees.

Life Sciences Summit

Through the CfB's role as co-host of the Life Sciences Summit, a global partnering event focused on bridging academic innovators and emerging companies to potential strategic partners and investors, relationships continue to be developed with the global pharmaceutical industry, medical research foundations and the investment community. The Emerging Company Showcase at the Summit brings the Center in touch with dozens of emerging companies from both within New York State and outside of New York State, representing a pool of potential clients or attraction targets. When opportunity presents itself, CfB hosts representatives from Big Pharma to introduce them to researchers and resources at Stony Brook that could be of potential interest.

Over 300 attendees participated in the Life Sciences Summit 2018 held in New York City on October 24-25. One third of the audience represented investment professionals and individuals representing large pharma and biotechnology companies that could serve as strategic partners for early stage technologies from academia and start-up companies. The "Emerging Company Showcase at the event features presentations by emerging companies that have raised \$15 million or less with pre-clinical to Phase 2A assets. More than forty companies presented over the course of two days, seventeen of which are companies operating in New York State.

Invention Disclosures

Disclosure/Patent Name	Inventor	Co-inventor	Licensing Partner	Research Sponsor	Description
N/A					

Start-up Companies Formed

Company Name	City	Product/Service	Sector
N/A			

Licensing Agreements **

Project	Inventor	Licensing Partner
Confidential	Confidential	Nanofiber

**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
Confidential	Confidential	Confidential	Confidential	\$3,510,165.02

Small Business Assistance Provided

N/A

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	\$564,928	\$638,259	\$1,006,524	\$1,644,783
Indirect Costs	\$78,344	\$159,565	\$250,873	\$410,438
Equipment	\$0	\$0	\$6,188	\$6,188
Materials & Supplies	\$54,090	\$66,978	\$195,529	\$262,507
Tuition	\$0	\$7,698	\$18,731	\$26,429
Travel	\$11,628	\$1,093	\$31,405	\$32,498
Subcontractors	\$48,642	\$0	\$215,811	\$215,811
Other	\$22,266	\$34,244	\$79,517	\$113,761
Total	\$779,898	\$907,837	\$1,804,578	\$2,712,415

Total Federal: \$1,675,189

Total In-kind: 0

Sensor CAT

Stony Brook University

Serge Luryi, Ph.D.

Technology Focus: Advanced technologies, including materials, electronics, and designs, for the diagnostic tools and sensor systems.

Importance to NYS:

Sensors and sensor systems are critical components of many manufacturing goods. The Sensor CAT has provided vital R&D and financial support for sensor related NYS manufacturing that faces severe competition from Asia.

Description of Achievements

1. Helped dozens of small manufacturing companies grow and stay in business.
2. Provided industry-based training for hundreds of students at NY universities and colleges.
3. Created material and intellectual resources for R&D support of industry
4. Made NYS a world leader in superconducting electronics and commercial applications of carbon nanomaterials

Impacts

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
15	28	\$402,000	\$785,000	\$3,100,000	\$3,323,000	\$62,000	\$7,672,000

Designations and Recognitions N/A

Awards / Recognition	Date Received	Recognizing Organization	Link
N/A			

Federal or Not-for-Profit Grants Awarded

Project	Principle Investigator	Co-Investigator	Source	Amount	Duration (yrs)	Summary
Development and commercialization of superconducting electronics	Prof. Xu Du	Prof. Dmitry Averin	NSF	\$300,000	2	Development of design tools for quantum computers
Commercialization of mid-IR sensors and sources	Prof. Sergey Suchalkin	Prof. Gregory Belenky	JPL	\$50,000	0.8	VLWIR nBn detectors based on InAsSb
Commercialization of superconducting electronics	Dr. Vasili Semenov	N/A	MIT Lincoln Lab	\$200,000	1	High-density superconducting circuits

Education and Technology Commercialization Activities

Industry-Oriented Education and Training

The CAT continued its support of an extensive program in fostering high school student interest in scientific or engineering careers, while at the same time preparing them to work with and in the industry. This program, led by Prof. Miriam Rafailovich, involves up to 100 high school students and 20 undergrads and leads them into serious research, a substantial part of which is industry related. During the reporting period, the CAT continued to co-sponsor three of Prof. Rafailovich's R&D projects with the

industry, each of those projects incorporated significant participation of students. One part of it is “The Garcia Summer Scholars Program”, a research apprenticeship program that each year mentors more than 50 high school students from diverse ethnic and socio-economic backgrounds. Over the course of the six-to-eight-week program, the students learn to conduct university-level research in Materials Science and Engineering. In many cases, students in the program come from poorly funded school districts.

Two professors from Material Sciences and Chemical Engineering Department began collaboration with Brentwood school district in support of the early involvement of school students in STEM research.

Commercialization

The Sensor CAT supports commercialization of technologies developed at SBU via

1. Jointly sponsored R&D currently includes world-leading technologies of mid-Infrared sources and gas sensors; sensors based on carbon nanomaterials; superconducting electronics; and high-voltage supercapacitors.
2. Faculty-created start-up companies, Sensor CAT Cluster, which currently comprises 9 companies.

Invention Disclosures

Disclosure / Patent Name	Inventor	Co-inventor	Licensing Partner	Research Sponsor	Description
N/A					

Start-up Companies Formed

Company Name	City	Product/Service	Sector
Rolling Motion Industries	North Babylon, NY	Manufacturing a novel energy-saving traction drive	Manufacturing

Licensing Agreements

Project	Inventor	Licensing Partner
N/A		

Royalties

Project	Principle Investigator	Co-Investigator	Company Partner	Royalty Income
N/A				

Small Business Assistance Provided

Practically all Sensor CAT customers are small businesses. In addition to the R&D assistance addressed above, the Sensor CAT provides close guidance to a number of small companies via the Business Development Manager. In one particular case, that guidance was instrumental in creating a new manufacturing company, Rolling Motion Industries (see 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	\$725,113	\$728,235	\$362,360	\$1,090,595
Indirect Costs	\$83,438	\$182,058	\$84,984	\$267,042
Equipment	\$0	\$16,366	\$0	\$16,366
Materials & Supplies	\$57,736	\$17,849	\$1,691	\$19,540
Tuition	\$13,499	\$20,187	\$2,718	\$22,905
Travel	\$2,378	\$14,505	\$2,043	\$16,548
Subcontractors	\$0	\$0	\$0	\$0
Other	\$11,950	\$16,135	\$3,808	\$19,943
Total	\$894,114	\$995,335	\$457,604	\$1,452,939

Total Federal: 0

Total In-kind: 0

New York State Center for Advanced Technology in Nanomaterials and Nanoelectronics

State University of New York Polytechnic Institute (SUNY Poly)

Michael Fancher

Technology Focus: Nanotechnology

Importance to NYS:

The Center for Advanced Technology in Materials and Nanoelectronics (CATN2) located at the State University of New York Polytechnic Institute (SUNY Poly) College of Nanoscale Science and Engineering (CNSE) is designated in the Nanotechnology technology focus with an emphasis on nanomaterials and nanoelectronics. Within the CATN2's nanotechnology focus there are activities in the following areas: information technology (IT) that include cyber security, cloud computing, gaming, data analytics, etc.; quantum sciences; clean energy; artificial intelligence; and nano-biotechnology.

The mission of the New York State Center for Advanced Technology in Nanomaterials and Nanoelectronics (CATN2) at SUNY Polytechnic Institute (SUNY Poly) and its College of Nanoscale Science and Engineering (CNSE) is to serve as a bridge between each phase in the research-to-development-to-deployment (RD&D) commercialization continuum. The Center's objective is to drive systematic progression in technology transitions, workforce skills attainment, market adoption, and entrepreneurial growth by aligning and coordinating an array of capabilities that support innovation with "applied research", transitioning to development with "technology acceleration", and leading to deployment by demonstrating "manufacturing/operational performance". By providing comprehensive support for the RD&D continuum, economic impact outcomes often include formation of: new business ventures that include out-of-state company attraction to New York, technology clusters and workforce pipelines in addition to the traditional outcomes of reduced costs (access/support services), capital expansion (equipment/facility), increased investment (federal/private), and sales growth (direct/indirect).

The CATN2 leverages the multi-discipline SUNY Poly Applied Research Capabilities (SPARC) by working closely with SUNY Poly's faculty to support an innovation pipeline of applied research requiring the demonstration of proof-of-concept for a given scientific solution. Center activities often include assisting in the preparation of proposals for government investment (e.g. NSF, NIH, etc.), and reducing costs by providing access to specialized process and characterization infrastructure.

The CATN2 also leverages the external capabilities of multiple partners to provide deployment services as the final step in the RD&D continuum. SUNY Poly's professional engineering staff, faculty, on-site industry partners, and a network of strategic business partnerships support the development of technology tailored for a market application requiring the demonstration of pilot-prototype fabrication for a given technology solution. Technology acceleration success often requires the formation of manufacturing consortia, joint development and shared access to strategic industry partner capabilities, and formation of start-up companies. Activities often leads to capital expansion, increased investment (angel capital & federal SBIR/STTR grants), cost savings resulting from direct services (business/technology/market), or access to specialized infrastructure (shared-use facilities).

Description of Achievements

The CATN2 continues to leverage multi-user Advanced Manufacturing Performance (AMP) capabilities by working closely with SUNY Poly's industry-compliant manufacturing consortia/alliances to attract supply chain companies. This effort has resulted in the federal and state funded AMP Center that supports the deployment of technology process or systems solutions requiring the demonstration using industry-

compliant test-beds for a given integrated process or system solution. Technology deployment success often requires the combination of multiple technologies that interact to provide real time control of a given operation (factory process, building infrastructure, grid operation, etc.). Activities often include cost savings related to test-bed demonstration of an integrated process (shared-use manufacturing scale-up or system-of-systems (SoS) solutions). The AMP Center’s targeted test-bed areas are: 1) Bench-level Evaluation including methodology design for root cause analysis; 2) Equipment Evaluation (hardware & software); 3) Facility-level Evaluation for SoS (correlations); and 4) Process and Performance Evaluation for manufacturing scale-up demonstration (business performance management). All AMP activities incorporate a workforce development component which is often unique in the industry in that the skills attainment provided by the CATN2’s AMP Center are often only available through on-the-job training.

One exciting highlight of this reporting year was the CATN2 and AMP Center coordinated and sponsored campus visit from Dean Kamen, the prolific inventor and founder of FIRST (For Inspiration and Recognition of Science and Technology). Among Mr. Kamen’s many accomplishments are the invention of the Segway, dialysis machines, AutoSyringe, and iBot Wheelchair, but his passion for FIRST was evident when on his tour of SUNY Poly, he met the Tech Valley High School FIRST Robotics team. This visit cemented a relationship between the CATN2 and AMP Center, not just with Mr. Kamen, but also with his private company DEKA Research and Development and the Advanced Regenerative Manufacturing Institute (ARMI), that he founded and is Executive Director and Chairman of the Board. ARMI is one of the fourteen Manufacturing USA manufacturing institutes and has a focus on regenerative manufacturing. During this visit, the Center introduced Mr. Kamen to two companies that the CATN2 has worked with, Glauconix and sxRNA, that have both developed technology that would be critically enabling to ARMI and its member companies. A result of this meeting was the personal invitation from Mr. Kamen to Glauconix, sxRNA, CATN2 and AMP Center to attend and participate in the ARMI spring meeting.

During this reporting period the CATN2 has employed a new project initiation mechanism, the Matching Investment Program (MIP). The MIP was established to provide and encourage faculty and staff to create their own projects with New York state industry partners to serve multiple purposes that include: encouraging faculty/staff entrepreneurship; support NYS industry to achieve NYSTAR’s mission; and improve, enhance, and expand prior investments in core facility capabilities. During its inaugural year, the MIP made 8 awards for industry sponsored projects in areas that range from semiconductor development, packaging and modeling to nanobiotechnology, and genetic sequencing to energy-based advancements.

Impacts

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
25	34	\$318,096	\$3,388,995	\$31,676,149	\$25,004,000	\$0	\$60,387,240

Designations and Recognitions

Awards / Recognition	Date Received	Recognizing Organization	Link
N/A			

Federal or Not-for-Profit Grants Awarded

Project	Principle Investigator	Source	Amount	Duration (yrs)
Design and Development of High Performance Microbolometer using Vox, CNT and Graphene for LWIR Applications	Efstathiadis, Haralabos	Magnolia Optical Technologies Inc. (federal flow through)	\$103,205	2 years
Fabrication of Efficient Reconfigurable Neuromorphic Systems	Cady, Nathaniel	US Air Force Research Laboratory	\$1,768,105	3 years
Fabrication Technologies for Superconducting Optoelectronic Neuromorphic Computing	Papa Rao, Satyavolu	US Air Force Research Laboratory	\$900,000	3 years
Next Generation High Temperature, High Frequency, High Efficiency, High Power Density Traction System	Woongje, Sung	US Department of Energy	\$1,500,000	5 years
Development of Medium Voltage SiC MOSFETs Integrated with SiC Schottky Diodes	Woongje, Sung	US Navy – Office of Naval Research	\$250,000	1 year
A Search for Novel Efficient P-Type Nitride Materials	Shahedipour-Sandvik, Fatemeh	National Science Foundation	\$254,862	3 years
Development of Broadband Nanostructured Antireflection Coatings for Improved Infrared Focal Plane Arrays (IRFPA) Performance	Efstathiadis, Haralabos	Magnolia Optical Technologies Inc. (federal flow through)	\$41,047	0.5 year
SBIR Phase I: Bioengineered Recombinant Anticoagulant Heparin	Sharfstein, Susan	Tega Therapeutics (federal flow through)	\$75,000	1.5 years

Education and Technology Commercialization Activities

Industry-Oriented Education and Training

CATN2 has successfully implemented a comprehensive Engage, Enrich, and Educate (E3) approach to 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.

Student visits to the campus included students from more than 65 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. Education and training efforts have focused on degree and certificate granting programs in: the award of Ph.D., M.S., and B.S. degrees in Nanoscience and Nanoengineering; certificates and badges under the NSF NEATEC program; and collaborative programs with all levels of local, state, and national universities under the federally funded AIM Photonics. Brief summaries of noteworthy E3 activities during the reporting period are listed below.

SEMI High Tech U

In conjunction with the Semiconductor Equipment and Materials International (SEMI) organization, the CATN2 supported SUNY Poly's hosting of the SEMI High Tech U for high school teachers and students from the Capital Region providing them with hands-on exposure to nanofabrication and employment interview experience with industry executives, among many other STEM exposures during a three-day immersion. This year's program had two separate tiers, one for educators that hosted 25 STEM educators and one for students that hosted 35 interested students.

Nano Class at Albany High

A first-of-its-kind initiative developed jointly by SUNY Poly and the City School District of Albany, the groundbreaking “NanoHigh” program has been reimaged as a Nano Class, but continues to impart high-tech knowledge that is critical for the success in New York State’s growing innovation economy to a number of high school students. During this reporting period, 20 Albany high school students took part in the Nano Class and visited the SUNY Poly Albany campus several times throughout the academic year to participate in lectures and laboratory studies.

NEATEC Outreach

In a variety of programming, the CATN2 supported NEATEC program addressed educating, not just elementary and secondary students, but the teachers as well. During this reporting period, several local and regional school districts sent their STEM based educators to SUNY Poly to learn about NEATEC, SUNY Poly and nanotechnology to better prepare themselves and their curriculum to address the needs of local and regional employers. Additionally, over 600 students from local and regional school districts participated in events and activities run by NEATEC to teach about a wide variety of topics relevant to employers in the advanced manufacturing industry, most noticeably, the semiconductor industry.

Advanced Manufacturing Performance Center (AMP)

The Advanced Manufacturing Performance (AMP) Center was initiated by a \$1.25 million award from the U.S. Department of Commerce Economic Development Administration (EDA) for Economic Adjustment Assistance. The total project budget is \$3,221,550, including the aforementioned \$1.25 million from the EDA, a working capital grant from Empire State Development Corporation (ESD) of \$500,000, with industry investment and SUNY Poly in-kind investment. In addition to supporting industry-driven R&D, the AMP Center utilizes the data-driven industry-compliant equipment and facilities located at the SUNY Poly’s Albany campus to support academia-driven hands-on workforce training at SUNY Poly’s Albany and Utica campuses and throughout the Mohawk Valley and the Capital Region.

A major part of the AMP Center’s workforce development program is in skills assessment, career path exploration, curriculum development, and training content delivery. CATN2 has targeted the co-location of NY Wired for Education (NYW), an industry leader in workforce training information technology platform development, with the co-development of the AMP/Metrix Learning Management System (LMS) to streamline, simplify and coordinate the development of a highly skilled workforce matched to the needs of targeted industry sectors. The funding that the CATN2 has secured for its AMP Center is being used to co-develop and deploy an industry leading AMP/Metrix LMS as a unique regional on-line employment matchmaking and training test-bed capable of seamless delivery of integrated on-line and in-classroom education. The AMP/Metrix LMS test-bed will tightly couple the AMP Centers “hardware” and “software” test-beds with foundational on-line content and hands-on learning opportunities delivered at sites located in the Mohawk Valley and Capital Region.

AMP Center staff have initiated and made tremendous progress in the development of AM industry focused training curriculum. One goal of the AMP Center is to deliver curriculum to provide incumbent workers, new workers and those seeking employment as well as existing workers in adjacent industries with the skills ascendancy they need, not just to succeed in AM, but to create a career path so that they can continue to improve their skills and their position. Unlike other training and educational programs in the area of AM, the AMP Center is focused on the positions that support AM facilities for technicians through engineers rather than strictly focused on the process engineers, which are industry specific. This focus will provide the trainees with more career options and a way to chart their own careers because they will have easily transferrable skills. The initial focus of the curriculum has been on abatement systems, related vacuum components, with the complimentary and highly relevant areas of

environmental health and safety, toxic gas monitoring system, and controls. Additional areas of curriculum planned to be developed in subsequent reporting are, ultra-pure water, HVAC, power delivery, and others.

AIM Photonics Academy

A major thrust of the CATN2 supported AIM Photonics program is to prepare the next generation high-tech workforce required to support the burgeoning photonics industry in New York and across the U.S. The AIM Photonics Academy (AIM Academy) is the unified education knowledge, technology and workforce program for the Department of Defense funded photonics institute. With the support of CATN2, AIM Academy continues to create an adaptive portfolio of integrated photonics education and workforce development offerings capable of meeting industry needs to further increase domestic and international competitiveness. AIM Academy activities during the reporting period include:

- One-week intensive curriculum is offered twice annually in the summer and the winter. Scores of participants, largely from industry, participate in the newly developed lecture sessions on integrated photonics design, chip processing, manufacturing constraints, and other manufacturing relevant areas that are taught by expert faculty and industry specialists. Lab demonstrations are also presented with one taking place at the MIT's new Education and Practice factory.
- Bootcamp is designed to complement the lecture focused AIM Academy with a hands-on element to reinforce learning. This bootcamp features concepts and provides the hands-on training necessary to provide a useable base of knowledge to enable individuals to succeed in this newly emerging market. Rather than listen to lectures, as in the AIM Academy, students will solve problems using lab equipment to test passive photonic chips, which will prepare them for the challenges they will face in the workforce. Students will be exposed to and learn: Coupling of fiber to on-chip waveguide - Couple light into an SOI chip using butt coupling and grating coupling; Measurement of integrated photonics devices - Collect data from straight waveguides, spirals, and ring resonators; Basic concepts - TE/TM modes, confinement, evanescence, on-chip guiding; Virtual Lab - Game-based educational simulation to build intuition about on-chip light propagation; Data analysis - Python and/or Matlab to characterize devices based on real data; Lumerical simulations - Principles of design of integrated photonic devices; and Introduction to integrated photonics packaging - Laser die packaging.
- Future Leaders in Integrated Photonics ("FLIP") program, in which 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 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 AM workforce training. These latter components leverage SUNY Poly's NSF NEATEC education center, 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. The technician skills training programs offered by NEATEC are:

Advanced Manufacturing Training for Fort Drum Soldiers

NEATEC provided three Advanced Manufacturing Technician trainings at the Fort Drum Army Base in Watertown. These on-base trainings were provided to 26 soon to be veterans who will be re-entering the private workforce and are seeking the skills needed by regional employers. The 168-hour training workshop series, made up of 24 hours of online training, with 144 hours of hands-on training offers the soon to be veterans the needed skills training in AM practices, pneumatic technology and mechatronics. Throughout the training, the soldiers received 24 presentations from advanced manufacturers from across the State on their maintenance/tool technician job opportunities in an effort to entice the soldiers to apply. These companies included Anaren, Boeing, Danfoss Silicon Power, GlobalFoundries, Pratt&Whitney, Norsk Titanium, Panasonic, and several others. Many of the participating soldiers applied for and secured jobs with the presenting companies as a result of the training.

Pathways in Technology Early College High Schools (P-TECH)

The CATN2's supported NEATEC facilities were leveraged to support the IBM Pathways in Technology Early College High Schools (P –TECH) program. As part of a global effort by IBM encompassing more than 200 P-TECH schools reaching more than 100,000 students in 18 countries, SUNY Poly in collaboration with Fulton Montgomery Community College hosted 10 high school students during a three-day workshop in June. The agenda of the three-day workshop included: a facility tour; intro to a vacuum trainer – assembly and test; measuring pressure in a vacuum system; measuring leaks in a vacuum system; vacuum refrigerators – what happens to the temperature in a vacuum; and making your own neon sign – building a plasma inside a vacuum chamber. A highlight of this particular workshop was a serendipitous visit by Dean Kamen during CATN2 and AMP Center sponsored visit to SUNY Poly.

Center for Global Advanced Manufacturing (CGAM)

Through the support of the CATN2 staff, SUNY has invested \$11M for an Advanced Manufacturing Research and Training Facility called the Center for Global Advanced Manufacturing (CGAM) located at SUNY Poly's Utica campus. This includes advanced materials processing, advanced additive manufacturing prototyping (3D polymer, metal, and ceramic printing facilities), advanced materials characterization and testing, advanced component testing (including power electronics packaging and mixed-signal ICs), and a fully-functional design and design-training center with CAD-based packages for conventional mechanical and electrical systems as well as integrated circuits, micro-electrical mechanical systems and integrated photonics. CGAM was established to provide economic, societal, and global benefits to more than 2,000 small- and medium-sized manufacturing firms across the Hudson and Mohawk Valley regions by providing a wide range of services that include technical, operational, training, educational, and business. Additionally, CGAM supports several SUNY Poly student clubs and organization such as Robotics, 3D Printing, FIRST, Fabrication Club, and Maker's Club making the students that participate to be more attracted to regional manufacturing employers.

Commercialization

The CATN2 supported the establishment of 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; 4) Entrepreneurial Programs; and 5) Participation in Industry and Academic Sponsored Conferences, Meetings, Forums, and Workshops.

(1) 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 that resulted 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. Successful examples of executed and active industry alignment frameworks follow.

(2) RD&D Shared-Use Facilities

The CATN2 is co-located within the SUNY Poly's CNSE Albany campus and provides critical support for its public and private partners by supporting each phase of the technology transitioning continuum, research, development, and deployment (RD&D).

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.

Cyber Physical Systems Test-bed– Zero Energy Net (ZEN) Facility

Since the completion of construction in 2015 of the \$196 million, 356,000 square-foot Zero Energy Net (ZEN) facility, the CATN2 has teamed with EYP and others to utilize it to provide real-world data to analyze the cost, benefits and performance of clean energy (CE) technologies as stand-alone and as integrated system-of-systems (SoS). The ZEN includes the following CE projects that were initiated and are currently managed by the CATN2: more than \$9 million in "active" CE measures provided under a partnership agreement with Japan's New Energy and Industrial Technology Development Organization (NEDO) and its global industry partners; \$3 million invested by the New York State Energy Research and Development Authority's (NYSERDA) to install, operate and analyze multiple CE technologies; and over \$14 million invested by Fuller Road Management Corporation in "passive" energy design measures.

Advanced Manufacturing Research and Training Facility

The RD&D Shared Use Advanced Manufacturing Research and Training Facility, including the Center for Global Advanced Manufacturing (CGAM) is described in more detail above.

(3) Strategic Economic Development Initiative Partnerships

Advanced Regenerative Manufacturing Institute (ARMI)

ARMI is one of the fourteen Manufacturing USA manufacturing institutes and has a focus on regenerative manufacturing.

The National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL)

With the involvement and guidance of the CATN2, SUNY Poly became an academic member of the national Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL). A CATN2 staff member participates on the NIIMBL Workforce Activities Committee and stays involved with relevant projects, events and programs. A SUNY Poly faculty is the Tier 2 academic representative on the NIIMBL Governing Committee.

(4) Entrepreneurial Programs

iClean/Tech Valley Business Incubator & NY Business Plan Competition

One responsibility of the CATN2 is to support nascent innovations and technologies and it has in the past successfully been designated as a clean energy incubator by NYSERDA and as the Tech Valley Business Incubator by Empire State Development. While funding for both incubators has concluded, the CATN2 is continuing its support for entrepreneurial growth by continuing to operate the iClean incubator. During the reporting period, the CATN2 actively worked with a number of SUNY Poly launched start-ups including: Glauconix Biosciences, Lux Semiconductor, Eonix Energy, sxRNA Technologies, and BESS Tech. The CATN2 strongly assisted Eonix Energy with their successful application to the Association of Public and Land-grant Universities (APLU) and the Association of American Universities (AAU) to participate in the 2019 University Innovation and Entrepreneurship (I&E) Showcase in Washington, D.C. on April 10, 2019.

(5) Participation in Industry and Academic Sponsored Conferences, Meetings, Forums and Workshops

The CATN2 has sponsored and supported the efforts of SUNY Poly faculty and engineers to present, attend, and participate in numerous industry and academic sponsored conferences, meetings, forums, and workshops including, but not limited to the following list:

Tenth Annual Charles Lieber Satellite Symposium; 2018 ATE National Principal Investigators' Conference; 2018 Hi-Tech Conference; 2018 NYSTAR Annual Meeting & Emerging Technology Showcase; 2018 Yeast Genetics Meeting; 2019 International Conference on Frontiers of Characterization and Metrology for Nanoelectronics (FCMN); 2019 International Symposium on Power Semiconductor Devices; 2019 NICE Workshop; 2019 Northeastern Evolutionary Psychology Society Conference; 235th Electrochemical Society Meeting; 23rd Annual Buffalo DNA Replication and Repair Symposium; 24th Annual Meeting of the RNA Society; 25th Annual Conference of the Society for Redox Biology & Medicine Hilton Palmer House; 37th Annual Microelectronic Engineering Conference; 39th Annual Meeting of American College of Toxicology; 3rd International Aegean Conference on the Long and Short of Non-Coding RNAs; 65th AVS National Symposium; 6th International mRNA Health Conference; 6th Workshop on Wide Bandgap Power Devices and Applications (WiPDA); AACC ATE CO-PI Conference; AFRL-SUNY-Griffiss Institute Quantum Science & Engineering Workshop; 9th Annual Traumatic Brain Injury Conference; Advanced Manufacturing Technician Training Workshop Series; AFWERX Microelectronics Challenge Workshop; AIM Academy at MIT; AIM Academy Summer Event; AIM Photonics Members Meeting; AIM Photonics at Semicon Europa; AIM Photonics Fall Roadmap Meeting; AIM Photonics Members Meeting & Emerging Technologies Showcase; AIM TRB Meeting and Leadership Meeting; American Chemical Society National Meeting; American Physical Society (APS) Meeting; Annual Conference on Innovations in Population Health and Personal Medicine, University of Medicine and Pharmacy; APIdays conference; ARMI Biofab USA Spring Summit; ATMNYC Conference; Critical Materials Conference; DARPA Photonics in the Package for Extreme Scalability (PIPES) Proposers Day; DCD Conference; Defense Manufacturing Conference; Defense Manufacturing Conference; MC Conference and Exhibition; DoD Industry Day; EMGS Conference; ERI Electronics Resurgence Initiative; Fall MRS Conference; FASEB Phosphatase Meeting; Human-Machine Collaboration for National Security Workshop; Graphene For U.S. Conference; Human Behavior and Evolution Society Conference; IEEE Aerospace Conference; IEEE-IRPS 2019; IEEE Photonics Conference; Integrated Photonics Symposium; International Conference on Planarization CMP Technology; and International Integrated Reliability workshop as examples.

Invention Disclosures

Disclosure / Patent Name	Inventor
Group III-Antimonide Based Phase-Change Multilevel Memory	Serge Oktyabrsky, Michael Yakimov, Vadim Tokranov
Gen 2 PRESiCE Technology and know-how	B. Jayant Baliga, Kijeong Han, Woongje Sung
Development of eIF-4E sxRNA Aptamer, sxRNA Point of Care Test, and MS2-sxRNA based technology	Scott Tenenbaum, Frank Doyle
Braille Tiles	Devon Kate Mancini, Daniel Nelson
Method of fabricating a resistive random access memory (ReRAM) when using a bottom electrode material requiring a liner/barrier	Nathaniel Cady, Karsten Beckmann, Joseph Van Nostrand
Method of fabricating a resistive random access memory (ReRAM) which prevents conductive filament formation at the edges of the switching material	Nathaniel Cady, Karsten Beckmann, Joseph Van Nostrand
Device and Method of Producing Tubular Systems for Cell Culture	Matthew Jorgensen and Yubing Xie
Molten liquid nanodroplet vacuum impaction-Additive Manufacturing	Greg Denbeaux
Resist enhancements for sensitivity and resolution	Greg Denbeaux
VISTA LINKS Science Labs	Mojgan Haghanikar
Contamination reduced wafer handling	Gregory Denbeaux
Tetra-nuclear Antimony Clusters for EUV Lithography	Robert Brainard, Michael Murphy
Mono-nuclear EUV Resists Based on Tellurix and Periodic Acids	Robert Brainard, John Welch
Hetero-nuclear Clusters of Tellurium and Iodine as EUV Resists	Robert Brainard
Multinuclear Oxo-clusters with Mixed Oxidation States as EUV Resists	Robert Brainard

Start-up Companies Formed

Company Name	City	Product/Service	Sector
N/A			

Licensing Agreements

Project	Inventor	Licensing Partner
N/A		

Royalties

Project	Principle Investigator	Co-Investigator	Company Partner	Royalty Income
14N2-0004	Yubing Xie	Magnus Bergkvist, Sara Brenner, Susan Sharfstein, Alison Gracias, Karen Torrejon, Ionnis Danias	Glaucnix BioScience	\$6,456.59

Small Business Assistance Provided

None

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

Operating Expenses	Matching Funds			
	NYSTAR Funding	Company Cost Share	Other Sources	Total
Salaries & Fringe	\$323,228	\$117,996	\$24,906	\$142,902
Indirect Costs	\$48,484	\$17,699	\$3,736	\$21,435
Equipment	\$22,620	\$0	\$0	\$0
Materials & Supplies	\$37,425	\$9,598	\$1,544	\$11,142
Tuition	\$0	\$92	\$924	\$1,016
Travel	\$1,430	\$6,553	\$3,459	\$10,012
Subcontractors	\$0	\$0	\$0	\$0
Other	\$15,187	\$520,457	\$0	\$520,457
Total	\$448,374	\$672,395	\$34,569	\$706,964

Total Federal: \$0

Total In-kind: \$0

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

Technology Focus: Information and Telecommunications Technology

Importance to NYS:

The CASE Center for Advanced Technology (hereinafter referred to as the "CAT") at Syracuse University will work 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) and 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 will include the following: 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

The Center for Advanced Systems and Engineering (CASE) at Syracuse University (SU) continued to realize outlined goals, objectives and focusing activities to increase measurable economic impact to position CASE for continued success. CASE continued to be instrumental in delivering on the commitments of the Upstate Revitalization Initiative by providing: support to third round of GeniusNY finalist companies; access to UAVs and FAA licensed pilot for faculty and industry partners; technical support for UAVs and data security activities; assisting CenterState CEO with attraction activities for NSION, Elbit, Sentinent Blue and MPD Partners; 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.

CASE hired Peter Zaehring as its new Deputy Director in October 2018. Zaehring is an economic and business development professional with over 20 years of national and international experience. Most recently, he served as vice president of economic development with the Greater Green Bay Chamber in Green Bay, Wisconsin. Mary Ellen Gilbert, Associate Director of Finance and Administration, became a 65% full-time employee. During the reporting period, our laboratory assistant, Ian Joyce, resigned to join a private industry drone company as drone pilot. However, we quickly hired, Matthew Wood, a recent SU graduate with a BS in Aerospace Engineering to fill the position.

CASE remains an active member of NUAIR, 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 in supporting the Cyber Research Institute. The recent formation of SU's Autonomous Systems Policy Institute (ASPI) will significantly help strengthen partnerships and cluster efforts. CASE also landed an NSF IUCRC on Alternative Sustainable Intelligent Computing.

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. We are also involved in NYSTAR’s newly launched effort to re-engage CAT’s more actively via a newly formed committee facilitated by CICU.

CASE, Fuzehub (in place for CNY TDO) and NYSSTLC and SUNY Upstate’s Biotech Accelerator (CNYBAC) will partner to present our annual NEXT Conference in November 2019. 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 will attend New York State Innovation Summit in Rochester as part of NYSTAR’s annual meeting. In October 2018, in partnership with CNYTDO, NYSSTLC, SyracuseCoE, CNYBAC, and the Tech Garden, CASE co-hosted the annual NYSTAR Partners meeting.

Incubator: CASE’s incubator averaged 70% capacity during the reporting period. It 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 Economic Opportunity (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
27.5	41	\$4,456,422	\$2,022,907	\$22,300,056	\$2,030,740	\$1,479,175	\$32,289,300

Designations and Recognitions –

Awards / Recognition	Date Received	Recognizing Organization	Link
n/a			

Federal or Not-for-Profit Grants Awarded

Project	Principle Investigator	Co-Investigator	Source	Amount	Duration (yrs)	Summary
Variable Rate MIMO for Multi-User Communications Involving Airborne Platforms	Biao Chen	n/a	USAFRL	\$120,000	3 years	High-volume defense wireless communications with broad commercial and defense potential.
SpecEES: Collaborative Research: Energy Efficient Dynamic Spectrum Access in Uncoordinated Networks	Biao Chen	n/a	NSF	\$100,000	3 years	Managing wireless spectrum. Broad defense and commercial applications.
Phase 1 IUCRC Syracuse University: Center for Alternative Sustainable and Intelligent Computing (ASIC)	Qinru Qiu	Pramod Varshney, Yanzhi Wang	NSF	\$150,000	3 years	Large scale data analysis, intelligent computing with potential commercial applications in defense, cybersecurity.
Big Data Enabled Wireless Networking: A Deep Learning Approach: NeTS: Medium: Collaborative Research	Jian Tang	Yanzhi Wang	NSF	\$237,941	3 years	Large scale data analysis, machine learning applications with commercial potential for defense, cybersecurity and communications.

SaTC: CORE: Small: External Obliviousness in Trusted Execution Environments	Yuzhe Tang	n/a	NSF	\$485,999	3 years	Large scale data analysis, machine learning applications with commercial potential for defense, cybersecurity and communications
Graduate Research Fellowship Program - Milcarek	Jeongmin Ahn	Ryan Milcarek	NSF	\$3,833	1 year	Research in energy and electronics with potential commercial applications.
Graduate Research Fellowship Program - Aycock-Rizzo	Mark Glauser	Halley Aycock-Rizzo	NSF	\$46,000	1 year	Research support in aviation electronics leading to potential commercial applications
Micro Environmental Control System	H. Ezzat Khalifa	Edward Bogucz, Donald Carr, Chetna Chianese, Thong Dang, Can Isik, Jianshun Zhang	DoE	\$250,000	4 years	Indoor environmental quality with applications for data centers and defense.
Phase Change in High-Density Confined Liquids for Thermal Management	Shalabh Maroo	n/a	ONR	\$102,471	3 years	Fluid dynamics with applications in aviation, UAVs, defense, energy.
Basic Research in the Sciences-for-Maneuver Campaign towards Reliable Structural Health Characterization and Remaining Service Life Prediction	Volker Weiss	n/a	Dept. of the Army	\$64,868	10 years	Defense and other commercial applications.
Analysis on a Wire	Sara Eftekharijad	Sagnik Basumallik	DoE/B NL	\$24,267	1 year	Broad commercial and defense potential
Machine Learning with Baked-In Knowledge for Forecasting Large Complex Spatiotemporal Neurocomputational Systems with Application to Weather Forecasting	Garrett Katz	n/a	DARPA /U of Maryland	\$42,584	1 year	Broad commercial and defense potential
A Neurocognitive Approach to Robotic Cause-Effect Reasoning During Learning	Garrett Katz	n/a	ONR	\$71,055	1 year	Broad Commercial and defense potential
Adaptable Compressed Jaumann Absorber for Harsh and Dynamic	Jae Oh	Jun Choi	AFOSR	\$123,123	1 year	Broad commercial and defense potential

Electromagnetic Environments						
Intelligent Information Networks: Young Investigator Program: Modeling, Sampling, and Analyzing Adversarial Social Networks	Sucheta Soundarajan	n/a	NSF	\$120,000	1 year	Broad commercial and defense potential
Computational Aircraft Prototype Syntheses (CAPS)	John Dannenhoffer	n/a	USAF	\$180,000	2 years	Broad commercial and defense potential
Design Responding to Engineering Analysis in Support of Manufacturing (DREAM)	John Dannenhoffer	n/a	DARPA	\$55,745	1 year	Broad defense potential
Multi-Stream Near-Wall Turbulence Dynamics	Mark Glauser	Jacques Lewalle	AFOSR	\$229,977	3 years	Broad commercial and defense potential
The Topology of Force Production in Unsteady Flows Around Swept Wings	Melissa Green	n/a	ONR	\$191,808	2 years	Fluid Dynamics research with applications in aviation and UAVs – defense

Education and Technology Commercialization Activities

Industry-Oriented Education and Training

- 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.
- Four NYSTAR entities, CASE, the New York State Science and Technology Law Center (NYSSTLC), FuzeHub (in place of CNYTDO), and SUNY Upstate’s CNYBAC continue to present a joint annual conference, NEXT. The NEXT conference will take place in November 2019, and will feature a keynote by AI expert and Emerj CEO Daniel Faggella. It will also feature a sports-panel discussing innovation in sports with a focus on fan engagement. As usual, the event includes several educational workshops for workforce development and 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.
- The CASE Industry Co-op program continues to be successful in 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, under Program Manager, David DiMaggio, conducts a range of recruiting and promotional activities. During this reporting period, the co-op program placed 75 students with 32 employers.
- CASE continues to work with the NYSSTLC 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.
- CASE’s Laboratory Manager, Ian Joyce, presented the keynote focusing on UAS/drones to more than 2,000 students from 10 counties in CNY at the 2019 CNY Science & Engineering Fair.
- In partnership with CNYTDO, NYSSTLC, SyracuseCoE, CNYBAC, and the Tech Garden, CASE co-hosted the annual 2018 NYSTAR Partners meeting.

Commercialization

- CASE has worked closely with CenterState Economic Opportunity (CEO) and with NUAIR to attract new business to the region. CASE hosted Elbit, Sentinel Blue, MDP Partners, NSION, and several other companies that were brought to the region by CEO.
- CASE leadership works closely with the Associate Dean for Research and the Director of Research Graduate Programs and Corporate Relations for the College of Engineering and Computer Science and key Newhouse faculty and staff to increase and broaden collaboration.
- CASE regularly refers businesses and faculty to the NYSSTLC and receives referrals from them.
- 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. The 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 and works together with CEO, The Technology Garden, CNY TDO, other universities, and range of representatives from the 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.
- CASE meets with leadership at Syracuse COE regularly to identify opportunities for collaboration.
- CASE facilitated meetings between a number of local small businesses and potential partners on campus and within larger corporations.

Invention Disclosures

Disclosure/ Patent Name	Inventor	Co-inventor	Research Sponsor	Description
Triple Shape Memory Composite Foams	Patrick Mather	Hossein Birjandi Nejad, Richard M. Baker		https://patents.google.com/patent/US10125233B2/en?q=10%2c125%2c233
Peptide Coagonists of the Glucagon-like Peptide 1 Receptor and Neuropeptide Y-2 Receptor	Robert Doyle	Ron Bonaccorso		https://patents.google.com/patent/US10111932B2/en?q=10%2c111%2c932
Conformable Reversible Adhesives with Shape Memory Assisted Delamination	Patrick Mather	Jaimee Robertson		https://patents.google.com/patent/US10081746B2/en?q=10%2c081%2c746
Reversible Shape Memory Polymers Exhibiting Ambient Actuation Triggering	Patrick Mather	n/a		https://patents.google.com/patent/US10040909B2/en?q=10%2c040%2c909
Furnace with an Integrated Flame Assisted Fuel Cell for	Jeongmin Ahn	H. Ezzat Khalifa		This technology has residential, commercial and industrial applications for providing

Combined Heating and Power				electricity during power interruptions. There is a market for this technology.
Self-Replenishing Boundary Lubrication in Hydrogels Using Zwitterionic Polymers	Michelle Blum	Patrick Mather, Allen Osaheni		This technology is a hydrogel with improved wear properties through a lubricating boundary layer. There are biomaterials market applications for this technology.
Diversity Combining of Non-Coherently Modulated LDPC Codes in Wireless Communications	Biao Chen	Kapil Borle, Yu Zhao, Fangfang Zhu		This technology has the potential to improve performance in existing digital communication systems. There is a well-developed commercial application for this invention.
Heat-Curling Polymeric Needle for Safe Disposal	Patrick Mather	Pine Yang		This technology reduces the hazards associated with needle disposal. This technology has a medical disposal market application.
An Electricity and Syngas Co-Generation System Using Porous Solid Oxide Fuel Cells	Jeongmin Ahn	Ryan Milcarek, Pingying Zeng, Kang Wang		This technology produces electricity from fuel and air at industrial sites. There is an existing commercial market for this technology.
Improved Piezoelectric Sensors and Quartz Crystal Monitors	Fritz Schlereth	James Spencer		This technology monitors the dew point or condensation point of gases. There is a market for highly accurate dew point detectors.
Automatic Fall Detection by a Wearable Camera	Senem Velipasalar	Mauricio Casares, Akhan Almagambetov		This technology has the ability to monitor the wearer's movements throughout many environments and has the added benefit of assisting first responders in locating a wearer who may have collapsed. There is a commercial application for this technology.
Universal DNA Profiling	Michael Marciano	Molly Cadle-Davidson		Permits DNA based geolocation based upon the DNA profile of the contributors.
Trackable Reasoning and Analysis for Crowdsourcing and Evaluation (TRACE)	Jennifer Stromer-Galley	Nancy McCracken, Brian McKernan	Office of the Director of National Intelligence	Software that provides a structure for users to create and document analytical reasoning while reducing cognitive bias.
Chemical Inhibition of Horizontal Gene Transfer by Bacteria that Prevent Drug Resistance Development	Yan-Yeung Luk		NSF	Chemical innovation that prevents and inhibits bacteria from passing the gene materials from one to the other. Patentability assessment and corresponding commercialization assessment to be evaluated after test data becomes available.
Intent-Oriented Browsing System	Yang Wang	Nata Barbosa	DHHS, NIDILRR	Internet browsing system that identifies target web pages based upon inputted user intent to aid in website navigation

				regardless of the site's structure. The invention has commercial potential.
Pose Estimation Method for Autonomous UAVs in GPS-Denied 3D Environments	Senem Velipasalar	Burak Kakillioglu	NSF	This technology enables UAVs to navigate in spaces where GPS is unavailable. There is a current market for this technology.
Method for Estimating the State of Charge in a Heat Thermal Storage Device	H. Ezzat Khalifa		DoE	Method for moderating the heating/cooling cycles of a microenvironment heating/cooling system. Further testing is required before commercialization potential can be realized.
Detection of Single Proteins and Protein-Protein Interactions in Mammalian Serum	Liviu Movileanu	Avinash Thakur	NIH	Technology to detect proteins in blood samples and development of assay for drug discovery. This is a very early stage discovery.
Degradable Wound Healing Gels	Mary Beth Monroe			Technology can be used in wound dressing. There is a current market for the invention.
Quantum Transducer Booster	Matthew LaHaye	Britton Plourde		Quantum computing is a developing area, so there is no current commercial market for this technology.
Residential Air Handling Unit	Mehmet Nasir Sarimurat	Thong Dang	DoE	Invention can be used to reduce size and energy usage in residential HVAC systems.
Phase Separation Innovation	Carlos Castaneda			Technology, with more development may be used to study neurodegenerative diseases. Additional research is required before the technology can be patented.
Programming via Printing for Shape Memory Polymers	James Henderson	Pranav Soman, Kathleen Pieri		Process supports 3D printing of shape memory products.
Processing of Waveguide Array Encapsulants	Ian Dean Hossein	Saeid Biria		Invention can be incorporated into conventional solar cells to increase output and improve efficiency.
Synthesis of Acids and Esters	Viktor John Cybulskis			The acids and esters synthesized by this process are used in the formation of flavors, fragrances and cosmetics.
Demeter – Data Set Management Software	Yatish Hegde	Jennifer Stromer-Galley, Brian McKernan		Software tool to be used by researchers to manage and analyze data across a variety of formats.
Motion Detection System	Biao Chen	Yang Liu, Tiexing Wang		Invention can detect movement and has applications in home security systems and drones.
Privacy Mirror	Yang Wang	Corey Jackson, Jr.		Mobile device interface to monitor applications in association with user's privacy settings.

Start-up Companies Formed

Company Name	City	Product/Service	Sector
n/a			

Licensing Agreements

Licensing agreements have been established with Pelitex; Cooper Atkins; Sensgard LLC; Canusia-I; Symphony Video; Life Unit; USPLM; and NicheVision. All agreements are confidential.

Royalties

Royalty Income received was about \$78,000 from confidential agreements

Small Business Assistance Provided

- CASE has worked closely with CenterState Economic Opportunity (CEO) and with NUAIR to attract new business to the region. CASE hosted Elbit, Sentinent Blue, MDP Partners, NSION, and several other companies brought to the region by CEO.
- CASE actively supports SU's newly established Autonomous Systems Policy Institute (ASPI) and partnered with ASPI to become a partner in SU's Diamond Sponsorship of NUAIR's annual symposium.
- CASE is a member of NUAIR, which has a waiver for Class C airspace, including parts of the Syracuse University campus. The 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 meets with leadership at Syracuse COE regularly to identify opportunities for collaboration.
- CASE facilitated meetings between a number of local small businesses and potential partners on campus and within larger corporations.

Level of Matching Funds Provided and uses

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

Operating Expenses	NYSTAR Funding	Matching Funds		
		Company Cost Share	Other Sources	Total
Salaries & Fringe	\$619,958	\$961,168	\$177,272	\$1,138,440
Indirect Costs	\$68,801	\$74,513	\$26,428	\$100,941
Equipment	\$0	\$953	\$11,880	\$12,833
Materials & Supplies	\$5,247	\$51,929	\$326	\$52,255
Tuition	\$0	\$3,898	\$18,708	\$22,606
Travel	\$1,089	\$13,618	\$6,152	\$19,770
Subcontractors	\$0	\$0	\$0	\$0
Other	\$141,156	\$44,632	-\$6	\$44,626
Total	\$836,251	\$1,150,711	\$240,760	\$1,391,471

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 (UB) Center for Advanced Technology in Big Data and Health Sciences (Center) 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 Center's Co-Directors 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, and attraction/relocation of outside firms.

Description of Achievements

The UB Center for Advanced Technology in Big Data and Health Sciences (UB CAT) is currently in its third year under the new technology focus of big data at the intersection of medicine and health. During the reporting period, 15 company projects were funded. Thus far, 9 projects are completed and 6 are in a no cost extension.

The program is uniquely positioned to enable life science companies with projects requiring experts and technology in big data and data analytics, through its alignment with and proximity to the NYS Center of Excellence in Bioinformatics and Life Sciences (CBLS), Buffalo Institute for Genomics and Data Analytics (BIG), and Center for Computational Research (CCR). The synergies between these programs, and others under UB's Business and Entrepreneur Partnerships (BEP), enable the UB CAT to serve and support a larger portfolio of companies and offer comprehensive support packages based on their needs.

Company engagement with the UB CAT provides access as well as the advantage of an experienced life science focused business development team that works to provide the right combination of project funding, faculty expertise, equipment, mentorship, and entrepreneur services. The expanded UB CAT business development and marketing teams have worked to coordinate and enhance outreach connection with new UB faculty and companies locally and across the state.

Highlights from the 2018-19 fiscal year include a new web-based marketing initiative for the CAT and a strong STEM outreach in the Buffalo City School District.

The following are some examples of company highlights:

- Tactiva Therapeutics secured a \$35 million Series A financing led by Panacea Healthcare Partners and included Vi Ventures and Efung Capital. This is among the largest private capital raised and secured by a Buffalo-based biotech startup company and will catalyze the clinical development of Tactiva's lead candidates.
- Ithaca based Rheonix has continued the development and testing of its microfluidics platform paired with its new product focused on Next Generation Sequencing (NGS) in collaboration with

sequencing technology leader Illumina. The current project enabled Rheonix to finalize a fully integrated and automated DNA library preparation using the DNA Flex library preparation reagents supplied by Illumina to develop and optimize the NGS OnePrep™ solution.

- KSL Biomedical is seeking New York State Department of Health approval of a new test for the BCR-ABL gene rearrangement which is the cause of Chronic Myelogenous Leukemia. The quantitative test will be useful to identify early stage exit from remission in patients and allow modification of medications and improved patient longevity.
- Circuit Clinical has further enhanced its' TrialScout™ platform, a web-based application that enables patients to find, participate and rate their experience in clinical research. Three major enhancements were made to the TrialScout™ platform under this year's project: The Health System and Advocacy Brand Deployment System; CincialTrials.gov merge process; and a patient engagement module.

For the current reporting period, the program yielded \$65.3 million dollars in non-job impacts and 114 new jobs across New York State

Impacts

New Jobs	Retained Jobs	Increased Revenue	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
111	78	\$22,070,200	\$3,052,317	\$2,835,294	\$32,992,353	\$1,010,000	\$61,960,164

Designations and Recognitions

Awards / Recognition	Date Received	Recognizing Organization	Link
N/A			

Federal or Not-for-Profit Grants Awarded

Project	Principle Investigator	Co-Investigator	Source	Amount	Duration (yrs)	Summary
N/A						

Education and Technology Commercialization Activities

Industry-Oriented Education and Training

Workforce Development: UB CAT offers a multitude of workforce development opportunities for a variety of ages and education levels. Sandra Small, Ph.D., the Science Education Manager, leads these initiatives. 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), managing the CBLS and CMI Career Experience Programs, and interfacing with new and growing companies to help fulfill their workforce needs.

- **Buffalo Public School STEM Experience:** UB CAT has a strong relationship with the Buffalo Public Schools (BPS), the City of Buffalo and SUNY to promote Science, Technology, Engineering and Math (STEM) awareness through the "BPS STEM Experience" Program. The year 2019, was the 5th annual Buffalo Public School STEM Experience. The UB CAT was heavily involved in the following affiliated events:

- **Genome Day:** Four hundred, eighth-grade BPS students and over 50 student, faculty and staff volunteers participated in this annual event. Students visited the UB Jacob's School of Medicine and Biomedical Sciences building to learn about DNA and genetics. They had the opportunity to interact with UB scientists, ask questions and learn what it is like to work in science. Students also participated in an activity to extract and visualize DNA from their cheek cells and take it home in a keepsake necklace. All UB CAT and CBLS staff members participated in this event.
- **Science Exploration Day:** Science Exploration Day (SED) is an annual science conference for area high school students. Students spend a day on UB's North Campus and choose to attend science and engineering talks and activities for three concurrent sessions. Dr. Small facilitated UB funding to allow BPS students to attend SED and led one of the sessions offered for students to attend.
- **School Relationships:** UB CAT has developed relationships with many area schools, including Buffalo Public Schools, BOCES, Sweet Home School District, Hamburg High School, and West Seneca High Schools. UB CAT continues to grow this list of partnerships with visits to classrooms, hosting students at CBLS and teacher training.
 - **Health Sciences Symposium:** 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. This event was hosted in the Jacobs School of Medicine and Biomedical Sciences building in conjunction with the Department of Surgery. Session partners included Roswell Park Comprehensive Cancer Center, Hauptman Woodward Institute, Kaleida Health, and Ivoclar Vivadent. This event was a success and schools expressed interest in holding it annually.
- **Science Education Partnership Award (SEPA):** UB Faculty member Steve Koury has been awarded the Science Education Partnership Award by the National Institutes of Health to support professional development for teachers and more experiential learning for students in bioinformatics. Dr. Nowak, UB CAT PI, is Co-investigator on the award. As part of SEPA, Drs. Nowak and Small participate in many related activities and programs, including teacher training, student visits and capstone events. Drs. Nowak and Small are key personnel on a new NIH SEPA grant submission to expand upon the bioinformatics education, which is already being implemented with high schools in Western New York.
- **CBLS Tours:** The CBLS and Center for Computational Research (CCR) host facility tours for middle and high school students, teachers, community leaders, and industry groups. The tours highlight the core facilities and the variety of careers that exist in the building.
- **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 about genomics and the microbiome and the environment's effect 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. Dr. Nowak is a co-director of GEM.

- **Research Laboratory Program in Bioinformatics and Life Sciences:** UB CAT has supported, from the beginning, the creation of a new high school in the Buffalo Public School District, the Research Laboratory Program in Bioinformatics and Life Sciences (RLP). The creation of which was inspired by Genome Day. Dr. Small is a member of the steering committee for the school.
 - **After School Program:** Following successful after school science programs during the 2017 spring semester and 2017-2018 academic year, CBLS was again selected to provide an after school program for the 2018-2019 academic year. An average of 20 students regularly attended this program. All of the lessons, activities and field trips supported what was being taught in the school’s science classes.
 - **Summer Youth Employment Program:** Through the Erie County “Summer Youth Employment Program,” The Buffalo Urban League and Dr. Small’s relationship with RLP students, two students were placed in UB research labs to work in paid positions for the summer. The young women are entering their junior year in September 2019.
- **Buffalo Niagara Medical Campus BNMC Summer STEM Program**
 - Dr. Small led a committee with representatives from Buffalo Manufacturing Works, The Jacob’s Institute and The Buffalo Niagara Medical Campus in planning and implementing the third annual BNMC Summer Workshop, summerSTEM, for students entering the Research Laboratory or Math, Science, Technology Preparatory High Schools. The committee was awarded a grant from The Cullen Foundation to fund the 2018 program. Students spent two weeks on the Buffalo Niagara Medical Campus visiting different institutions and participating in hands-on activities to apply their knowledge of biological sciences. They were exposed to a variety of careers and future camps, programs and internships.
 - Dr. Small continued her role leading a committee of representatives from The Buffalo Niagara Medical Campus (BNMC), Buffalo Manufacturing Works (BMW) and The Jacobs Institute to organize the 2019 summerSTEM Program, which was held from July 22 – 26.
- **BNMC Open House:** The Buffalo Niagara Medical Campus (BNMC) annually hosts an open house for area middle and high school students and parents. This year’s event was held on April 13, 2019. Participants visited various buildings on the campus and participated in hands-on learning activities. Visitors to UB CAT and CBLS were able to make their own bio-art drawings using yeast and petri dishes. The young bio-artists were able to take their masterpieces home and watch the drawing appear as the yeast grew.

Commercialization

- **NYS Center of Excellence in Bioinformatics and Life Sciences (CBLS)**
The NYS Center of Excellence in Bioinformatics and Life Sciences (CBLS) is a hub for life sciences innovation, big data and technology-based economic development driving scientific discovery and facilitating collaboration among academia, industry and the public sector. The CBLS is located in the heart of the Buffalo Niagara Medical Campus (BNMC)—a world-class medical campus for clinical care, research, education, and entrepreneurship. This “coatless campus” allows easy travel to key research partners on the BNMC, which include Roswell Park Cancer Institute, Hauptman-Woodward Institute, Buffalo General Hospital, and UB’s Clinical and Translational Research Center (CTRC).

The CBLS with its 19,000 square feet of office space, 4,600 square feet of meeting space and 25,000 square feet of BSL2 designated lab space is home to multidisciplinary faculty and start-up companies. It is also home to the UB Center for Advanced Technology in Big Data & Health Sciences (UB CAT). Additionally, the CBLS houses three core facilities that offer services and expertise in high performance computing, genomics, massively parallel sequencing, proteomics, bioanalysis, and bioinformatics. The CBLS is unique in that the cornerstone technologies necessary for omics technologies are housed in a single physical location.

Of the nineteen companies located within the CBLS during the reporting period, nine of them previously or currently benefit from UB CAT matching grants to support applied research projects with UB faculty.

The list of companies is below:

- Athenex, Inc. (formerly Kinex Pharmaceuticals)
- CH3 Biosystems
- Efferent Labs, Inc.
- Enhanced Pharmacodynamics, LLC
- Neurovascular Diagnostics, Inc.
- Patient Pattern, LLC
- Tactiva Therapeutics, LLC
- Veronomics, Inc.
- Zeptomatrix

- **Omics Core Facilities at the CBLS**

- **UB's Genomics & Bioinformatics Core (GBC)** offers a comprehensive suite of genomic services that utilizes advanced Next Generation Sequencing (NGS) platforms, single cell technology and gene expression analysis platforms. Platform technologies include: Illumina NovaSeq sequencers for whole genome; exome and transcriptome sequencing; Illumina NextSeq sequencer for RNA-seq and ChIP-seq; Illumina MiSeq for microbiome sequencing; 10X Genomics Chromium for single cell and long read genomic solutions; Qiagen Pyrosequencer for DNA methylation; SNP and microbial identification; and QX200 Droplet Digital PCR System to detect low copy number transcripts and viral load.
- **The UB Proteomics & Bioanalysis Core (PBC)** under the direction of Dr. Jun Qu, who specializes in proteomics, LC/MS (liquid chromatography–mass spectrometry) and bioinformatics. The core houses three mass spectrometers: high-resolution Thermo Lumos ETD; Thermo Quantiva triple-quad; Thermo Altis; eight liquid chromatography systems; high flow fractionation systems; and micro-flow LC and nano-LC ultra-high-pressure systems.

The Core provides collaborative services in:

- Quantitative proteomics and biomarker discovery (quantification of >5000 proteins in clinical or pharmaceutical samples)
- Large-scale protein or proteome identification
- Identification and localization of post-translation modifications on proteins
- High-throughput quantification of specific protein markers in large-scale analysis
- LC/MS-based biological and pharmaceutical analysis (regulated or unregulated)

- **CBLS Core Facilities** continue to foster industry collaboration. During the reporting period, the below CAT projects leveraged the GBC and PBC to accomplish their respective R & D goals –
 - Neurovascular Diagnostics (UB spin-off)
 - ASDDR LLC (UB spin-off)

- **UB Biorepository**
 The CBLS has partnered with the Buffalo Institute of Genomics & Data Analytics (BIG) and UB’s five health sciences schools (Jacobs School of Medicine & Biomedical Sciences, School of Public Health & Health Professions, School of Dental Medicine, School of Nursing, and the School of Pharmacy & Pharmaceutical Sciences) to create a unique bio-medical resource for research institutions and the industry throughout New York State and across the country. UB’s Biorepository Program will provide high-quality biomaterials to support science and clinical research through centralized and standardized services for the collection, processing, management, and distribution of biological assets. It will enable critical clinical science research and diagnostic development as well as the advancement of precision medicine through deep annotation and “big data” integration. It will be distinguished from other biorepositories by its accreditations through the College of American Pathologist (CAP), Good Laboratory Practice (GLP) and Good Clinical Practice (GCP) certification and will be 21 CFR part 11 compliant to manage bio-samples suitable for use in any downstream applications with academic, pharmaceutical and biotechnology partners. The facility currently services NeuroVascular Diagnostics and Circuit Clinical.

- **Buffalo Institute for Genomics & Data Analytics**
 The Buffalo Institute for Genomics & Data Analytics (BIG) is dedicated to accelerating the growth of companies at the intersection of life sciences and big data by providing them with access to expertise and equipment, such as: Biorepository; Center for Computational Research; Genomics and Bioinformatics Core; Institute for Healthcare Informatics; and Proteomics & Bioanalysis Core.

- **Center for Computational Research (CCR)**
 The Center for Computational Research (CCR) is a leading academic supercomputing facility that maintains a high-performance computing (HPC) environment, high-end visualization laboratories, corresponding support staff with expertise in advanced computing, modeling and simulation, and data analytics. Together these resources support CCR’s core mission of enabling research in Western New York, providing hi-tech workforce training and fostering economic development, and job creation within Western New York and New York State. The Center’s computing resources include a Linux cluster with more than 13,000 processor cores connected via a high-speed QDR Infiniband network and a 3,000 core Linux cluster that is dedicated to support economic development through outreach to the industry. In addition to providing access to state-of-the-art computing resources, CCR’s staff of computational scientists and software engineers provide researchers and industrial partners with support for modeling and simulation, software development, bioinformatics, and data analytics.

- **Innovation Hub**
 In April 2018, Governor Cuomo announced that \$32 million dollars will be made available through Empire State Development as part of the Buffalo Billion Phase II. In May 2019, the Innovation Hub (HUB) was launched to provide comprehensive seamless support to accelerate growth of life science and technology startups leveraging the extensive resources on the Buffalo

Niagara Medical Campus and partner organizations, CBLS, Roswell Park, Kaleida Health, and 43North.

In addition to the HUB housing life sciences and technology startups and new and existing resources like the UB CAT, it will also offer expert support and mentoring to move startups from idea formation through development to acceleration.

The \$32 million in funding, spread over five years, includes:

- \$13.5 million for an early stage technology commercialization fund administered by UB that will help the startups prove their concept and offer early seed funding. Investments could range from as little as \$25,000 for the earliest stage startups to as much as \$1 million in follow-on funding for startups that have made more extensive progress in developing their product and business and raising private investment.
- \$11.5 million for support programs and services for entrepreneurs as well as funding for the personnel and administrative services needed to run the hub.
- \$7 million to design and build new incubator space at the Center for Bioinformatics and Life Sciences on Ellicott Street. That space is expected to open by the end of 2019.

To support commercialization, the \$13.5 million Buffalo Innovation Fund is a continuum of early stage gap funding. A portion of these funds is allocated to the Buffalo Fund accelerator to facilitate the development and commercialization of technology-driven innovations that will lead to the formation of a start-up business or license to an existing company. Grants from the fund can be used for a variety of activities that advance innovations from laboratory to marketplace. Earlier in 2018, the fund began accepting applications and of the following seven awardees of the first round announced on May 2019, six were from the University at Buffalo (UB) and one was from Roswell Park Comprehensive Cancer Center (RPCCC):

Variable Stiffness Robotic Gripper (Dr. Eshan Esfahani, UB). The award will help further refine the novel, variable stiffness robotic gripper, which can detect unwanted collisions and adjust to protect humans and robot payload.

Better Batteries (Dr. Mark Swihart, UB). The award will further refine a form of nano-silicon that overcomes many limitations of current silicon anode solutions. Moreover, this solution promises a low-cost manufacturing process.

Non-Opioid Therapeutics (Dr. Arin Bhattacharjee, UB). The award will refine a local non-opioid analgesic with promises to long-lasting post-surgical pain control while reducing the need for opioids.

Innovative Therapeutics for Respiratory Failure (Dr. Bora Baysal, RPCCC). The award will further refine a therapeutic drug to increase survival and reduce patients' dependency on supplemental oxygen.

New Type 2 Diabetes Therapeutics (Dr. Qing Li, UB). The award will further refine a new therapeutic for type 2 diabetes. This new drug promises to simultaneously reduce blood sugar and weight.

Energy Harvesting for Leadless Pacemakers (Dr. Amin Karami, UB). The award will further a novel energy harvesting device, which captures vibrational energy from a beating heart and can fully power a leadless pacemaker.

Superior Synthetic, Nano, Bone-grafting Materials (Dr. Rosemary Dziak, UB). The award will refine a novel class of synthetic, nano, bone-grafting materials with superior strength and usability characteristics.

- **NSF I-Corps**

The I-Corps Site program is an NSF initiative that assists researchers by evaluating their technology's market fit and provides resources to individuals and teams in the form of seed funding, entrepreneurial mentoring, curriculum, or other assets needed to transition ideas and technology into the marketplace. Teams work with mentors and subject matter experts to learn how to conduct customer discovery, evaluate technology and gain alignment with what the NSF typically funds as part of its mission. Each I-Corps team cohort attends three scheduled sessions, works on assignments between sessions and obtains more than 25 customer interviews over a seven-week period.

Select I-Corps participants may be eligible to apply to the national NSF I-Corps program to advance the scientific discoveries. The national program provides \$50,000 of non-dilutive funding for the production of prototypes, perform validation testing and evaluate market potential, and the development of technologies, products and processes needed for successful commercialization.

From January 1, 2019 – June 30, 2019, I-Corps hosted two Cohorts which included six sessions and a total of 55 individuals participated from 23 teams.

- **SUNY Technology Transfer**

UB CAT co-director Jeff Dunbar refers startups from the UB Technology Transfer program. Three of the UB CAT projects funded July 1, 2018 – June 30, 2019, are UB technology companies: ASDDR; Garwood Medical Devices; and Neurovascular Diagnostics. Four of the CAT Projects to be funded July 1, 2019 – June 30, 2020, are UB technology companies: Cytocybernetics; For-Robin; Neurovascular Diagnostics; and POP Biotechnologies. Mr. Dunbar also seeks referrals from the other six SUNY Tech Transfer offices (Stony Brook, Binghamton, Albany, Upstate Medical, Downstate Medical, and RF Central), which may have startups that can benefit from UB CAT and CBLs services. Concarlo Holdings, a 2019 UB CAT award recipient, is a SUNY Upstate Medical startup.

- **Western New York Incubator Network (WIN) UNY**

The UB CAT is an active collaborator in the NYSTAR-funded WNY Incubator Network (WIN), a consortium led by UB's Business and Entrepreneur Partnerships, which includes the CBLs, 43North, BNMC Innovation Center, Launch NY, Fredonia Technology Incubator, Harrison Place, Incubator Works, UB Technology Incubator, TReC by NGTI, Olean Business Incubator, and Z80 Labs. In total, the consortium represents nearly 200 incubator companies.

Managed by University at Buffalo Business & Entrepreneur Partnerships, WIN connects startups to UB's vast resources, including student talent, faculty expertise, entrepreneurial support programs, and world class facilities. Additionally, WIN offers a subsidized consulting program, a package of prescreened vendors offering attractive rates, a Pitch Prep series for companies

seeking their first round of investment, and several programs designed to build companies at the “pre-incubation” stage.

- **Launch NY**

The CBLS and UB CAT collaborate with this venture development organization in providing entrepreneurial support and engagement. Business development staff regularly refer clients to Launch NY for no-cost entrepreneur-in-residence support to selected startup ventures. In return, Launch NY frequently refers companies to CBLS and UB CAT for funding, co-location and programming.

- **MedTech**

MedTech is an advocacy association for New York State’s Bio/Med industry focused on collaboration, education and advocacy. The UB CAT works collaboratively with MedTech and in May, it hosted FuzeHub’s Solutions Forum for NYS Manufacturers in partnership with MedTech that focused on medical device manufacturers and suppliers. Thirty-four New York State companies attended, and the CAT team were able to facilitate interactions between 8 companies at the event. In addition, CBLS/UB CAT Business Development Associate Benjamin Paluch is on a planning committee for the 15th Annual MedTech Meeting planned for October 2019 in Rochester, NY. The theme of the conference will focus on employing innovation to drive New York’s bio/med economy.

- **43North**

This global business plan competition was funded by the Buffalo Billion Initiative in 2014. Contestants stand to gain \$5 million worth of investment awards, access to mentorship, free incubator space, a built-in network of partners, and no state taxes for 10 years.

The UB CAT team works with 43North life sciences companies to assist with their integration into the region’s ecosystem including awareness of facilities, assets and programs that will help them grow. This includes, not just UB CAT funding, but business development support and assistance navigating other BEP programs such as Start-Up NY, the Career Experience Program and CBLS facilities.

The UB CAT Principal Investigator and CBLS Executive Director, Norma Nowak, and UB’s Associate Vice President for Economic Development, Christina Orsi, are both active members of the 43North Board of Directors.

- **New York BIO**

NewYorkBIO supports the development and growth of New York State's life science industry and serves its members and the life science community by providing a network for public policy, industry advocacy and community development. Being members of New York BIO has provided significant benefits for the business development team in terms of professional development and deal flow with potential companies for UB CAT and networking opportunities.

Conference Attendance

The business development team attended: VBP Forward Inaugural Meeting (February 20th - 21st Buffalo, NY); Medtech Meetup at Cornell (February 26th-27th, Ithaca, NY); Bio-IT World Conference & Expo 2019 (April 16th-18th, Boston, MA); NewYorkBIO 2019 Annual Meeting (May 14th New York City, NY); BIO International Convention (June 3rd - 6th Philadelphia, PA); and MD&M East (June 11th - 13th (New York City, NY) in 2019. At BIO, the business development team had over 40 one-on-one partnering meetings

and met with 100+ companies over the course of the convention spanning biotech, pharma, digital health, medical device, and R&D services.

Other conferences included: VBP Forward; Medtech Meetup at Cornell; Bio-IT World Conference & Expo 2019; NewYorkBIO Annual Meeting; Medical Design & Manufacturing East; and BIO International Convention.

Invention Disclosures

Disclosure / Patent Name	Inventor	Co-inventor	Research Sponsor	Description
Cancer Immune Therapy Using Molecules that Block Immune Suppressive Exosomes	Richard Bankert, Ph.D.	Sathy Balu-Iyer, Terry Connell, Raymond Kelleher, Christopher Greene, Gautum Shenoy, Malausri Bhatta	National Institutes of Health	Tumor-associated immune suppressive exosomes represent a novel therapeutic target for the treatment of ovarian, melanoma and possibly other types of cancer. The discovery that HLT B-pentamers block exosome arrest of T-cell function provides a novel and cost-effective cancer therapeutic molecule.
Method for monitoring and reformulation of food during infant bottle feeding	Albert Titus	Kail Ling Kong, Poornima Dharmavaram, Leonard Epstein, Stephanie Anzman Frasca	N/A	Enables modification of formula or breast milk during feeding via a smart infant feeding bottle. This device can monitor sucking and enable mixing of additional food components (flavoring, nutrients, water, additional breast milk, or other liquid to change consistency) stored in the bottle.
PET-MRI calibration phantom	Ferdinand Schweser, Marc Alessi, Robert Gross, Louis Pollenz	N/A	N/A	The docket discusses an object useful as a calibration reference when aligning separate PET and MRI images taken at the same time.
Early detection and prediction of opioid induced respiratory depression	Carla R. Jungquist, Manoj Mammen, Lora Cavuoto, Varun Chandola	N/A	N/A	Disclosed here is an algorithm (i.e. a software-based method) for early detection/prediction of opioid-induced respiratory depression through the use of a trained machine learning model.
Candidate Neuroprotective Drugs and Analogs	David Poulsen	N/A	Neurotrauma Sciences	Discloses three chemical entities of known structure with previously unknown neuroprotective properties against physical brain traumas.
Separation of Biophysical Contrast Mechanisms in Biomedical	Ferdinand Schweser, Thomas Jochmann	N/A	N/A	MRI images involve a mix of information from biological samples. By applying artificial neural networks, the artifacts can be corrected resulting in a better image.
Projection Tomography Image Reconstruction	Ferdinand Schweser	N/A	N/A	MRI images involve a mix of information from the biological samples. By applying artificial neural networks, the artifacts can be corrected resulting in a better image.

Start-up Companies Formed

Company Name	City	Product/Service	Sector
N/A			

Licensing Agreements

Project	Inventor	Licensing Partner
N/A		

Royalties

Project	Principle Investigator	Co-Investigator	Company Partner	Royalty Income
2014-LIC-YOUF	Robert Baier	Anne Meyer, Lindsay Frances Rodgers Springer	You First Services, Inc.	\$1,547.58
2016-LIC-CYTOC	Glenna Bett, PhD	Randall Rasmusson, PhD	Cytocybernetics, Inc.	\$175.00
2016-LIC-ENER	Mark Ehrensberger, PhD; Anthony Campagnari, PhD	Esther Takeuchi, PhD; Nicole Luke-Marshall, PhD	Garwood Medical Devices, LLC	\$10,000.00

Small Business Assistance Provided

N/A

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

Operating Expenses	NYSTAR Funding	Matching Funds		
		Company Cost Share	Other Sources	Total
Salaries & Fringe	\$364,378	\$120,861	\$124,355	\$245,216
Indirect Costs	\$54,657	\$14,674	\$13,861	\$28,535
Equipment	\$99,877	\$27,467	0	\$27,467
Materials & Supplies	\$76,696	\$110,276	\$2,512	\$112,788
Tuition	\$8,567	\$20,161	\$0	\$20,161
Travel	\$2,955	\$2,843	\$1,539	\$4,382
Subcontractors	\$5,500	\$0	\$0	\$0
Other	\$277,476	\$289,329	\$49,085	\$338,414
Total	\$890,106	\$585,611	\$191,352	\$776,963

Total Federal: none**Total In-kind:** \$191,352

Center for Advanced Technology in Energy Storage

Stony Brook University
Benjamin Hsiao, Center Director

Technology Focus: Advanced Energy Systems

Importance to NYS:

The Center for Integrated Electric Energy Systems (CIEES) at Stony Brook University is designated in the energy systems technology focus. The Center aims to capitalize upon the intellectual and physical resources of Stony Brook University to accelerate the progress of renewable energy as one of the mainstream resources displacing fossil fuel-based electric power worldwide by facilitating the integration of renewable sources into the electric grid.

The Center has been conducting collaborative applied research within the industry leading to technology transfer and economic impact, conducting industry-oriented education and training, and facilitating outreach and networking. Recently, the Center has further expanded its mission to develop advanced technologies to enhance the nexus of food-energy-water systems (FEWS) through the core competency of energy storage.

The Center will facilitate New York companies' access to economic development programs that support company growth including but not limited to the Long Island Regional Economic Development Council, Long Island High Tech Incubator (LIHTI), other NYSTAR-designated centers, Small Business Development Centers, Strategic Partnership for Industrial Resurgence, and other local and state economic development programs. The Center will continue expanding its partnership with Brookhaven National Laboratory and enhancing its infrastructure to proactively support the energy industry sector. The Center will additionally explore mechanisms to provide small companies with access to relevant technologies from the intellectual property portfolios of New York State's research institutions.

Description of Achievements

In the first half of 2019, the Center for Integrated Electric Energy Systems (CIEES) continued to advance its goal of promoting job creation and workforce development in the Eastern Long Island area and downstate NY. The Center is reaching out to a wider sector of energy related FEWS businesses and is more actively engaging young Stony Brook faculty. Over the reporting period, the Center's industrial clients created 18 new NY jobs, retained one job, and generated \$1.664 M of economic impact, all directly related to the CAT assistance.

In the past year, the Center installed a second large energy storage system at the facility in the Advanced Energy Center (the first one is the molten salt battery bank). This system, developed and marketed by StorEn Technology, is a vanadium redox flow battery, engineered to fit inside a small, compact enclosure. The system setup involved the safe transfer of approximately 1 ton of electrolyte and the setup of a power and battery management system. The CIEES team of engineers and students finished the task on time and on budget and delivered a unique and compact vanadium sulfate flow battery for testing and evaluation. The CIEES team installed the necessary infrastructure, supervised all steps of the system setup, including the transfer of over a 1 ton of vanadium sulfate electrolyte. The system is undergoing a thorough testing, which includes multiple charge-discharge cycles.

Workforce development played a prominent role in last year's activities. Our industrial projects employed 14 graduate and undergraduate students and two post-doctoral fellows. The students obtained invaluable hands-on experience in water purification technologies, power electronics and

battery management, narrow band semiconductors, and other high-tech areas. The Center also continued strengthening the collaboration with Brookhaven National Lab. On April 25 2019, CIEES co-hosted the Industrial Additive Manufacturing Workshop on Metals and Ceramics on BNL campus <https://www.bnl.gov/iam2019/index.php>. The event attracted over 20 local business leaders, who learned about analytical and synthesis capabilities at the BNL and SBU campuses.

CIEES continued to expand into areas where SBU faculty possesses world-class expertise, such as narrow-band semiconductors, water purification and thermodynamic modeling. In a way, CIEES has successfully expanded its scope to advance new technologies to improve the innovative nexus of food, energy and water systems (INFEWS).

Strength of SBU faculty - energy efficient water filtration, water quality and marine biology is being leveraged in projects with AquaVectors, SWF technologies and an upcoming project with Manna Fish Farms. Water quality and its effect on aquaculture are considerable concerns on Long Island, where water pollution by nitrogen runoffs and other products degrade quality of coastal waters. Stony Brook Department of Chemistry, Dr. Ben Hsiao, has been developing energy efficient water filtration solutions that use renewable materials. Another project, in collaboration with the School for Atmospheric Sciences and Marine Biology will target development of sustainable aquaculture by implementing a network of advanced sensors powered by a robust energy harvesting and storage system.

In the second half of 2019, the Center made significant progress in advancing its primary mission of promoting economic growth and job creation in the Long Island area and downstate NY. In specific, the Center executed three new projects with local small business, Chem Cubed LLC, Bren-Tronics LLC and Flower Turbines LLC. The new projects coincide with three thrust areas of the Center, energy materials, energy generation and energy storage. In addition, the Center has made solid stride towards ongoing projects with existing partners involving Power2Gas (P2G), SWF Technologies, StorEn Technologies, BAH Holdings LLC, Aqua Vectors, Inc., Island Pyrochemical Industries (IPI), Unique Technical Services (UTS), ThermoLift, Inc., National Grid, and Green Power LLC. Two notable new accomplishments made during this period are as follows.

We assisted traditionally defense-oriented business of Long Island with diversification and re-designing defense-oriented products for the civilian markets. This activity is directed towards making the Long Island businesses more competitive and resilient to federal funding cycles. One of the clients, Bren-Tronics (featured in the success story), 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.

The Center completed one of critical project, the evaluation of a large-scale battery for StorEn LLC. The battery stayed in an outside enclosure for 15 months. During this time, the CIEES team conducted hundreds of full and partial charge-discharge cycles under variable loads, different weather conditions and cycle frequencies. The tests confirmed that the battery is suitable for medium-scale storage applications, additionally the team developed recommendations for product improvement. The Center also continued work on existing projects with long-term clients, such as Unique Technical Services, Island Pyrochemicals and others.

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 the 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 a 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.

Impacts

New Jobs	Retained Jobs	Increased Revenues	Cost Savings	Govt Funds	Non-Govt Funds	Capital Improvements	Total Impacts
18	1	\$540,000	\$269,200	\$90,500	\$760,000	\$205,000	\$1,864,700

Designations and Recognitions

Awards / Recognition	Date Received	Recognizing Organization	Link
Innovation of the year award, StorEn technology for work performed with CIEES team	March 20 2019	Innovate LI	https://www.innovateli.com/2019-innovator-of-the-year-awards/
Esther Takeuchi, received an honorary degree from Notre Dame University	March 26 2019	Notre Dame University	https://news.nd.edu/news/notre-dame-to-confer-six-honorary-degrees-at-commencement-3/
Dr. Esther Takeuchi received the Sigma Xi Walston Chubb Award for Innovation in Battery Field	November 18 2019	Xi Walston Chubb Award	https://www.americanscientist.org/article/first-person-esther-takeuchi
Dr. Benjamin S. Hsiao, Elected Member, University of Connecticut, Academy of Distinguished Engineers	May 2019	University of Connecticut	https://news.engr.uconn.edu/2019-uconn-academy-of-distinguished-engineers-inductees-speak-about-road-blocks-adversity.php#

Federal or Not-for-Profit Grants Awarded

Project	Principle Investigator	Co-Investigator	Source	Amount	Duration (yrs)	Summary
Center for Mesoscale Transport Properties (m2m) renewal	Dr. Esther Takeuchi	Dr. Amy Marschilok	US Department of Energy	\$12,000,000	4	Improvement of charge transfer in battery materials
<u>SnappyXO</u> , a robotics platform	Dr. Anurag Purwar		National Science Foundation	\$225,000	2	Development of next generation robotic platforms
Institute of Gas Innovation of Technology (I-GIT)	Dr. Devinder Mahajan		National Grid	\$100/year		Novel natural and biogas technologies

Education and Technology Commercialization Activities

Industry-Oriented Education and Training

Department of Chemistry graduate students, Hui Chen, Qinyi Fu, Nisha Verma, Xiangyu Huang, Mengying Yang, Grenalynn Ilacas, Ritika Joshi, Madani Khan, Chengbo Zhan, and Marc Nolan have taken an active part in the AquaVectors and SWF projects. Both projects are related to water purification. The students performed tests of separation media, water composition and data analysis and prepared reports to submit to the industrial sponsor.

CIEES employed Mr. Kabilan Ramkumar, an SBU student, who is currently working on evaluation of BAH laser technology. The student is measuring optical absorption of Ethane and Methane using both 2nd and 6th harmonic lasers.

In 2018, 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 active RF-ID applications. CIEES identified a candidate, Dr. Shuang Song, who led the effort in the evaluation of jet printed composites. Dr. Song worked with ChemCubed on the development of the composite test prototype.

The UTS battery storage project currently employs two undergraduate students from Stony Brook University, Bryan Moy and Hannah Kim. The students are actively participating in the design and assembly of the molten salt battery testing unit, developing the LabView code for the energy storage control and data acquisition.

In 2019, 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.

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

CIEES supported the program Next Generation Engineering Laboratories (NGELs). The program is administered by The Department of Electrical & Computer Engineering at Stony Brook University (SBU). During the past year, the program offered two components, one targeting students and the other one 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.

Regional Impact

During 2019, about 30 schools brought a total of 800 students from grades 6-12 to Stony Brook to participate in Design and Build/Create Labs. The majority of these students (73%) attended high need schools in Long Island and New York City. Students attended with their classroom teachers, so the activities also served as professional opportunities for science teachers, who were encouraged to incorporate additional engineering principles in their traditional science instruction. The summer camps were offered to 70 middle school students coming from different regional schools.

In 2019, CIEES started collaboration 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 the 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 \$10 to \$20K grants to selected student teams (pre-startups) dedicated to take the idea to the startup level. CIEES staff will connect the pre-startups with strategic partners from the business network of the Center's clients. The program will also provide the necessary training for developing the successful funding strategy, using both federal (for example, NSF SBIR) and private funding sources.

Commercialization

June 25 – 27, 2019, CIEES hosted a booth presented by potential client, CloudVisit Inc., at the Light and Sound Conference event. The event also connected CIEES client, BAH holdings LLC, with manufacturers of mid-IR equipment.

On April 25, 2019, CIEES co-hosted, The Industrial Additive Manufacturing Workshop on Metals and Ceramics, on the BNL campus <https://www.bnl.gov/iam2019/index.php>. The event attracted over 20 local business leaders, who learned about the analytical and synthesis capabilities at the BNL and SBU campuses. Currently, CIEES is negotiating with industrial clients, Optisys LLC, Kitty Hawk Technologies and Obsidian LLC, that were interested in working with CIEES.

June 11-12, 2019, CIEES participated in the 1st Annual Scientific Summit on Dairy Methane Management Research in Davis, CA. The workshop prepared the CIEES-SBU team for the upcoming methane management initiative in NY. The team visited several dairy farms in California's Central Valley and inspected the generation facilities powered by bio-methane.

CIEES continues to work jointly with the Green Technology Accelerator Center, NYSP2 at Rochester Institute of Technology on the flow battery demonstration project. The project is already underway and the subcontractor submitted the first invoice to NYSP2.

Invention Disclosures

Disclosure / Patent Name	Inventor	Co-inventor	Description
Method and apparatus for sulfur removal	Devinder Mahajan	Saurabh U. PATEL	Removing hydrogen sulfide from a gas stream, includes contacting the gas stream with a reactor that is configured to remove the hydrogen sulfide.
Flower-like multiwalled carbon nanotube composite structures for battery applications	Esther S. Takeuchi	Stanislaus Wong, Lei Wang, Coray McBean, Amy C. Marschilok, Kenneth Takeuchi	Fabricating nanocomposite anode material embodying a lithium titanite multi-walled carbon nanotube composite intended for use in a lithium-ion battery includes providing multi-walled carbon nanotube.
Synthetic methods for crystallite size control of bimetallic polyanionic battery compositions	Esther S. Takeuchi	Amy C. Marschilok	Bimetallic polyanionic materials are promising cathode materials for Li batteries due in part to their large capacity and high current capability.
Device and method for fast charge of batteries	Esther S. Takeuchi	Amy C. Marschilok, Kenneth Takeuchi, David C. Bock	An anode configured for fast charging a lithium-ion battery.
Nitrogen removal and nitrogen salts recovery using carboxylate cellulose extracted by nitro-oxidation	Benjamin S. Hsiao	Priyanka Sharma, Sunil K. Sharma, Ken Johnson	N/A

Removal of negatively charged impurities using metal-cellulose fiber composite	Benjamin S. Hsiao	Priyanka Sharma, Sunil K. Sharma, Ken Johnson	N/A
Nanocomposite scaffolds containing cellulose substrate and metal oxide nanocrystals as adsorbents for removal of toxic impurities	Benjamin S. Hsiao	Sunil K. Sharma and Priyanka Sharma	N/A
Composite superhydrophobic membrane for membrane distillation from hydrophilic lignocellulosic materials	Benjamin S. Hsiao	Ritika Joshi and Tom Lindstrom	N/A
A compartmental hollow fiber membrane distillation system	Dufei Feng	Benjamin S. Hsiao	N/A
Cellulose nanofiber apparatus and method	Benjamin S. Hsiao	N/A	N/A
Methods for printing conductive inks and substrates	Daniel Slep	N/A	Methods for printing conductive ink on a substrate.

Start-up Companies Formed

Company Name	City	Product/Service	Sector
CP Water Tech	East Setauket, NY	Wastewater processing	Wastewater treatment
SWF TECHNOLOGY LLC	Commack, NY	Water Purification Nanomaterials	Clean Technology

Licensing Agreements:

Project	Inventor	Licensing Partner
N/A		

Royalties

Project	Principle Investigator	Co-Investigator	Company Partner	Royalty Income
N/A				

Small Business Assistance Provided

Company Profile: StorEn Technologies LLC (StorEn), located in Stony Brook, NY, currently employing 4 people.

Situation: Vanadium sulfate flow batteries have long been known as a scalable and inexpensive energy storage solution. However, a typical flow battery installation is comprised of multiple tanks and pumps, which need to be plumbed on-site. StorEn developed a flow battery with complex seal which can be dropped on a customer site and operated immediately. StorEn needed a third-party validation of the technology and a test site where the battery solution can be presented to potential customers and investors. It is critical to demonstrate that the flow battery has the distinct advantage over more entrenched technologies, such as Li-ion. The operation of a flow battery is more involved because battery operation consumes energy to run circulation pumps. The energy consumed by the pumps and auxiliary electronics needs to be taken into account when calculating the total efficiency. Due to a unique combination of environmental, power and expertise requirements, StorEn could not elsewhere locate a suitable facility that would perform the tests in the short timescale.

CAT Deliverables: CIEES team coordinated the safe delivery of 1 ton of Vanadium Sulfate electrolyte, safely filled the flow battery container, installed the high-current wiring and the battery management system. The battery is undergoing tests and the first results are very encouraging, the battery demonstrated >90% roundtrip efficiency and over 95% charge retention.

Results: The CIEES team successfully completed its tasks, safely installed the battery and provided power wiring and the interfacial electronics. The successful test results were the critical factor in securing \$360,000 in private funding, which will fund development of a pre-production prototype.

Company Profile: Bren-Tronics (BT), located in Commack, NY, currently employing 200 people.

Situation: BT is a New York based (Commack, Long Island) small business that has been operating continually since 1973. For over 30 years, BT has always been the Department of Defense’s go to partner for their power and energy needs. Over 95% of BT shipments is in supporting the warfighter. Over the last 47 years, BT developed an array of energy storage products for the US Army, Special Forces and NAVY. BT derives over 95% of its revenue from DoD deliveries. It recognizes that relying on a sole customer might be a risky business position, considering that the level of DoD funding depends on the administration.

CAT Deliverables: 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, 48 V battery, currently offered by Bren-Tronics to DoD customers under brand name Brenergy 480. CIEES team identified markets and regulations needed to promote the BT battery storage system for civilian applications.

Results: 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 community to deal with any energy crisis after natural disasters.

Level of Matching Funds Provided and uses

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

Operating Expenses	Matching Funds			
	NYSTAR Funding	Company Cost Share	Other Sources	Total
Salaries & Fringe	\$569,074	\$159,204	\$193,337	\$352,541
Indirect Costs	\$71,050	\$39,801	\$48,334	\$88,135
Equipment	\$34,937	\$0	\$0	\$0
Materials & Supplies	\$103,930	\$7,168	\$0	\$7,168
Tuition	\$0	\$1,712	\$0	\$1,712
Travel	\$9,300	\$1,258	\$0	\$1,258
Subcontractors	\$34,338	\$6,482	\$0	\$6,482
Other	\$86,212	\$3,281	\$0	\$3,281
Total	\$908,841	\$218,906	\$241,671	\$460,577

As required by Public Authorities Law section 3102-b, subparagraph 3.a.iii, matching funds received from businesses with no more than one hundred employees is counted as double the actual dollar amount toward the center's overall match requirement.

Total Federal: \$0

Total In-kind: \$0

Please note: Stony Brook University acknowledges its shortfall in reported matching costs through the period ending 12/31/2019. To address this, Stony Brook University will retroactively report matching expenditures when we complete the fiscal report through the end of June.