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2019

**PUBLICATIONS**
- 78 Journal Papers
- 135 Conference Papers
- 1 Book
- 9 Book Chapters
- 20 Journal Editorships

**INTERNATIONAL PARTNERSHIP**
Dual Degree Program with CQUPT in Chongqing, China

- 4th Year 314 Students
- 26 Students on UAlbany Campus

**FACULTY HONORS**

- IEEE Fellow (3)
- ABET PEV (2)
- Jefferson Science Fellow (1)
- IAPR Fellow (1)
- NSF CAREER Awards (5)

**CONFERENCE LEADERSHIP**
- 38 Conference Leadership Roles
- 50 Presentations

**BEST PAPERS**
- 2
NSF AWARDS: 18
CURRENT AWARDS: 31

— ASTOUNDING —
RESEARCH GROWTH
IN 2018-19 FROM 2017-18

$7.3M NEW AWARDS
 mej 350%

31 NEW AWARDS
 mej 110%

$2.5M RF EXPENDITURES
 mej 292%

$10.3M EXTRAMURAL RESEARCH FUNDING
 mej 36%

ENROLLMENT GROWTH

NEW Programs: 4
Computer Science Undergraduate: 12%
Electrical and Computer Engineering Undergraduate: 25%

PATENTS

9 patents
136 career patents

59 FEDERAL SUBMISSIONS
54% SUCCESS RATE
Globalism, Engineering Education, and Intellectual Security

Kim L. Boyer, Dean of the College of Engineering and Applied Science

President Roosevelt succinctly captures the relationship between economic security and the preservation of personal freedom. Given world events during his presidency, it’s obvious why Mr. Roosevelt made this connection. William L. Shirer’s *The Rise and Fall of the Third Reich* connects the economic insecurity of the Weimar Republic to the rise of the Nazis in chilling detail. Decades later, this point remains valid; we need not look beyond our own hemisphere for an example. But the concern is not just for “other countries.” Risks to a stable democracy borne of economic insecurity could just as readily emerge here at home, in our time.

Economic security, however, is just one of a number of dimensions to what is collectively termed national security. Among them:

- Physical
- Energy + Natural Resources
- Political
- Public Health + Well-Being
- Ecological
- Computer (Cyber)
- Economic
- Infrastructure

To this list I would add one more cross-cutting notion of particular interest to engineers and engineering educators: *Intellectual Security*. While intellectual endeavors and their resulting contributions to our vitality, culture, and economic activity take many forms, here I specifically consider those associated with the engineering sciences. Without the intellectual capacity provided by a broad, deep talent pool of engineers and scientists, economic security, as well as most other forms of national security, could be compromised. In this discussion, I examine intellectual security through the lens of international engineering education.

“True individual freedom cannot exist without economic security and independence. People who are hungry and out of a job are the stuff of which dictatorships are made.”

— Franklin D. Roosevelt
Globalism, of course, is not new to engineering or engineering education. Globalism impacts engineering practice, education, and research in many ways. There has been no time in my career when I didn’t learn from, study with, work with (or for), or teach engineers from around the world. That cosmopolitanism continues to be one of the great joys of my professional life. But that doesn’t mean nothing has changed. Recent events notwithstanding, the world is getting smaller, flatter, and more interconnected, as Thomas Friedman describes in *The World is Flat*. Engineers flatten the world through the technologies we invent. That same flattening affects our creative processes, professional environments, and work-flow. For instance, recent years have witnessed the emergence of multi-continental R&D teams, turning time zones from obstacles into advantages, enabled by nearly ubiquitous high-speed networks.

But globalism in engineering is not just about work-flow, multi-continental teams, and the tools that lace them together. If we consider the Engineering Grand Challenges, and the many other thorny problems confronting society today, it is clear that many (most) of those problems are too large, too complex, and – perhaps most significantly – cross too many political boundaries to be tackled by any one country alone. We need to engage with a wide range of nations in our collective, enlightened self-interest. Parochial viewpoints, xenophobic resistance to changing demographics, or short time horizon perspectives will ultimately prove self-defeating.

International students have long studied engineering in the United States, particularly at the graduate level. In 2015, according to NSF data, 81% of electrical engineering graduate students and 79% in computer science at US universities were international. In most other engineering disciplines, the fraction exceeds 50%. Unfortunately, ill-informed rhetoric and policy decisions in Washington are, to the nation’s detriment, starting to drive these numbers downward; it is a dangerous trend without justification.

Some may suspect a downside to the influx of international students. Do they take seats from domestic students, for instance? There is no evidence of that. Graduate programs typically offer preferential admission to domestic students, who simply opt not to pursue graduate studies in sufficient numbers to fill programs and, upon graduation, meet national needs. According to NAFSA: Association of International Educators, in the 2015-16 academic year more than one million international students injected $32.8 billion into the US economy. Of those, 32% studied engineering, computer science, or mathematics. *Education, particularly graduate education in engineering, is clearly one of America's most successful “exports.”* In fact, in 2017 the export value of educating international students ($42.4 billion) was double that of soybeans, America’s top agricultural export. If one accounts for students’ living expenses, the export value of international education approaches that of pharmaceuticals and automobiles.

Once a country is “developed,” innovation is the only sustainable driver of economic growth. For these economies, including the United States, there is a strong positive correlation between the fraction of scientists and engineers in a population and its *per capita* GNP. Quite simply, relying entirely on domestic students would leave the US with an engineering talent deficit, and threaten our economic health. That is, *risks to our intellectual security threaten our economic security and, with it, other forms of national security*. To see where this cascade of risks could ultimately lead, re-read President Roosevelt’s quotation.

Happily, there is also a far more positive side to this argument.

Many international engineering students remain and build their careers here, adding to our national intellectual capital. Indeed, America’s intellectual security depends heavily on our ability to “import brains” in engineering. They help to sustain healthy graduate programs and the research conducted therein; they contribute their work and talents, both in engineering and entrepreneurism, to American industry; and they take positions in academia, where they educate our *next* generation of engineers and conduct cutting edge research. So, in effect, the “exported” engineering education is often one we get to keep.

Sounds like a deal that’s hard to beat.

Kim L. Boyer, Dean
Tapping Global Talent: Building a World-Class College of Engineering

By Rachel Moody

A World-Class College of Engineering Needs a World-Class Team

According to Jamil Salmi, whose seminal work from 2009 continues to guide institutions seeking to establish and maintain themselves as world-class universities, there are three necessary components to this process: access to financial resources, favorable governance, and having a multicultural and global pool of outstanding students, teaching faculty, and researchers. This last element has been cited as one of the factors that may accelerate a university’s achievement of excellence and global recognition (Altbach and Salmi, 2011).

This is especially relevant to schools of engineering, whose work regularly involves solving real-world problems, whether local, national, or global, through multicultural and multinational teams (Akokanmbi, 2011). Having, therefore, a faculty and student population that reflects the world and a curriculum that promotes international experiences “is essential to giving students the global perspective they’ll need to lead the world toward a more sustainable future” (Accreditation Board for Engineering and Technology, 2015, p. 7).

Recognizing the great importance in tapping global talent to prepare our students to solve many of society’s problems, the University at Albany’s College of Engineering and Applied Sciences has not only sought to recruit and retain a diverse population of undergraduate and graduate students, it has hired an equally diverse and stellar group of faculty from around the world.

We asked six faculty members from the College of Engineering and Applied Sciences the following question: How have you been able to leverage your experiences of living, learning, and/or working outside of the United States in your teaching and research endeavors at UAlbany? Their experiences have had transformative effects on their research, pedagogy, and the social impact of their work.

Linking Theory and Practice

Several faculty members noted the emphasis their education training abroad placed on theory, and how this foundation continues to influence their work. Amirreza Masoumzadeh, assistant professor in the Department of Computer Science, was raised in Iran and graduated from a top university in his country while working part-time as a software engineer. His research interests focus on information security, privacy, and trust in modern computer systems. He shares, “I oftentimes find myself comparing and contrasting my experience and exposure to research and teaching in my home country and in the United States.”

Dr. Masoumzadeh believes that he has been able to “draw from the best from both worlds. While I like the practice-oriented approach to teaching and learning in the United States, I still like to bring more rigorous structure and theoretical foundations into my lectures – a format that I grew up with in the Iranian educational system that has had a lasting impact.”

Amirreza Masoumzadeh
Chinwe Ekenna, an assistant professor in the Department of Computer Science, conveys a similar view about her own experience, noting that “the learning process is very rigorous and theoretical in Nigeria, where I lived, learned, and worked. This gave me a solid background that has aided my research and my teaching.”

Dr. Ekenna’s research centers on intelligent motion planning applied to robotics and proteins.

Mustafa Aksoy, assistant professor in the Department of Electrical and Computer Engineering, echoes his colleagues, emphasizing that research and pedagogy, “though based on accepted scientific norms and methods... are also heavily influenced by local expectations, capabilities, and traditions determined by the society” in which one lives.

“I have been exposed to the organic viewpoint in science, where the emphasis is put on why things happen in nature rather than demonstrating how they happen. During my doctoral and postdoctoral studies in the United States, I have had opportunities to expand my background with the mechanist viewpoint, wherein I put my knowledge into practice to deal with challenging real-world problems.”

Dr. Aksoy, whose research interests are in remote geophysical sensing using microwave and electromagnetic technologies, says that combining these two traditions has prepared him to be “a competent scholar-teacher who can thoroughly study and teach why and how things happen in nature.”

Welcoming and Teaching Diversity in STEM

Professor of Practice Jackson Marques de Carvalho teaches in the Department of Computer Science and specializes in software engineering, multimodal human computer interaction and user modeling, and document processing. He has lived and taught at universities in Brazil, Canada, China, and the United States.

“Teaching in cultures different than one’s own requires recognition of how diverse students from a variety of backgrounds absorb information, but recognizing this is the easy part. The hard part, rather, comes from having to adapt to these differences in learning. These...unique dilemmas...require equally unique solutions and flexibility in order to mitigate them. The flexibility required to reach students, especially when there is a language barrier, I believe has made me a better instructor.”

UAlbany’s College of Engineering and Applied Sciences is fortunate to have so many faculty who have extensive international and multidisciplinary experiences and who desire to leverage lessons learned to train the next generation of world-class engineers.
Md. Aynul Bari, assistant professor in the Department of Environmental and Sustainable Engineering, was born in Bangladesh, where he began his studies. His doctoral and postdoctoral studies were, respectively, in Germany and Canada. Dr. Bari commented on his experience of being a nonnative speaker and on how his background has helped him to be more empathetic to underrepresented students:

“While living in Germany during my graduate studies, I had the opportunity to learn and gain experiences working with students, peers, and faculty members from diverse cultural, ethnic, and linguistic backgrounds. Although foreign language seems to be a barrier to connecting people, the opportunity for learning the basic German language in our international master’s program helped us communicate with people outside campus and cope with daily living.

Being an academic researcher with an international background and experience, I encourage diverse students, including underrepresented groups, to get inspiration and realize that they can also succeed in establishing the academic and professional endeavors they want to pursue. I believe my globalized background, international research, and teaching experience help me meet the need of a diverse student population and establish my research endeavors at the University at Albany.”

Dr. Bari focuses on assessing emerging air-quality strategies in urban and rural areas in order to explore the need for addressing clean-air strategies to achieve sustainable air quality. He was recently featured on National Public Radio’s The Academic Minute.

Mariya Zheleva, assistant professor in the Department of Computer Science, shares her own unique story:

“My research is on next-generation wireless networks and a major part of it focuses on understanding the pitfalls of current wireless technologies in infrastructure-challenged environments such as rural and post-disaster areas and designing new network solutions for such environments. I have lived, studied, and worked in Europe, North America, and Africa, and this global perspective has helped shape my research and teaching at the university. I grew up in Bulgaria, where I also earned BEng and MEng degrees in telecommunications. My passion for wireless networks in infrastructure-challenged environments dates back to 2006, when I worked at an Internet service provider in Bulgaria, which, in part, catered to challenged areas. Building on my academic and industrial experience in Bulgaria, I went on to pursue my PhD at the MOMENT Lab at the University of California, Santa Barbara. As a part of my research, I traveled for fieldwork in Macha, Zambia, to evaluate existing networks, and to design, field-deploy, and study low-cost local cellular networks that use open software and hardware.

My PhD experience informed communication advances in other under-resourced environments. I am currently leading a $1.5M project sponsored by the National Science Foundation’s Smart and Connected Communities program to improve emergency preparedness and response in rural areas. I am also collaborating with Microsoft Research and Essex Farm to study, design, and field-test technology for small-holder farming. These projects are tightly coupled with my teaching and student mentorship. I work with students at all levels, from undergraduate through PhD. If you happen to work with me, you may find yourself tackling a fundamental question in the lab one day and doing fieldwork on a farm or in a mountain town on another.”

Several of the faculty members noted how their international experiences have not only enabled them to address global problems through their work, but how their experiences have created new and unexpected opportunities.
Similarly, Dr. Ekenna remarks on how her background and experience inform her work:

“...thinking about how robots can easily navigate the complex terrain of certain regions in Nigeria, what its usefulness could be and how cheaper, but efficient, robots can be developed to aid in teaching robotics in Nigeria.”

And Dr. Bari speaks, at length, about how his research was molded by his international education:

“For my academic preparation, I gained several international research experiences. I was involved in assessing air-quality problems on the Mediterranean island of Cyprus, working closely with its government. My doctoral research in Germany focused on trying to understand how biomass smoke emissions from wood stoves and fireplaces affected wintertime air quality in rural communities in southern Germany. In parallel, I was involved with two other projects evaluating traffic-related particulate-matter problems at high-traffic sites and assessing clean biomass combustion in residential communities. The experiences I gathered from Germany helped me pursue my postdoctoral studies in Canada.

After moving to Canada, I had the opportunity to work with the federal agency Environment and Climate Change Canada as a visiting fellow. We assessed their regional air-quality model to simulate ambient concentrations of polycyclic aromatic hydrocarbons in southern Canada and the continental United States. However, I received my major research accomplishments while working at the University of Alberta. We collaborated with Health Canada, the government of Alberta, and several industries to assess emerging air-quality issues in Alberta, such as the influence of Alberta oil sands development, urban and rural particulate-matter problems, as well as indoor air-quality exposure.”

Preparing a New Generation of World-Class Engineers

Engineers have to be prepared to engage in lifelong learning and to work collaboratively with team members from various parts of the world (de los Ríos-Carmenado, Rodríguez López, and Pérez García, 2015). This article has sought to highlight how living and working abroad has affected the teaching and research of faculty in the College of Engineering and Applied Sciences. Regardless of where one is born, we know that even short-term faculty abroad experiences can have long-lasting effects on research and pedagogy (Roberts, Rodríguez, Gouldthorpe, Stedman, Harder, and Hartmann, 2016; Gouldthorpe, Harder, Roberts, and Stedman, 2012). The Accreditation Board for Engineering and Technology (2018) emphasizes that “globalized experiences for STEM students, and the resulting diversity on cultural perspectives they gain, are critical to future solutions in sustainability” (p.1). These globalized experiences not only entail studying abroad but also having diverse classrooms and faculty. Diversity, however, is not only cultural. Most of the faculty interviewed for this piece spoke briefly about the frequent use of multidisciplinary and interdisciplinary teams in their work to address societal problems. This emphasis on the practical nature of their work is, according to the faculty, a unique and welcome feature of education in the United States -- a feature that faculty want students to embrace. UAlbany’s College of Engineering and Applied Sciences is fortunate to have so many faculty who have extensive international and multidisciplinary experiences and who desire to leverage lessons learned to train the next generation of world-class engineers.

Rachel Moody is director of International Academic Programs and International Academic Advising at the Center for International Education and Global Strategy

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References:


NSF Career Award

Mariya Zheleva is the latest CEAS faculty member to receive the highly competitive Faculty Early Career Development (CAREER) Award, the National Science Foundation’s most prestigious award in support of early-career faculty who show exceptional promise for a lifetime of leadership in integrating education and research. Zheleva's award, which comes with a grant of $510,494, will be used to develop a long-term, integrated program of research, education and outreach to establish a scientific and technological framework for automated spectrum measurement in support of shared-spectrum access. Her project is titled, “Automating the Measurement and Management of the Radio Spectrum for Future Spectrum-Sharing Applications.”

Zheleva’s research addresses a problem of particular importance to society and can make a significant contribution to expanding wireless technology. A growing number of domains that drive economic growth and the public well-being, including healthcare, emergency management and national defense, hinge on wireless network connectivity. This has created a huge market potential that cannot be realized as existing networks operate at capacity. Only a tiny fraction of radio spectrum is allocated to wireless communication technologies, which creates an artificial scarcity of frequency resources. In response, wireless technologies have begun to incorporate new hardware and software to boost their spectrum efficiency. However, this trajectory of innovation cannot be sustained without a framework for principled spectrum measurement and management.

Zheleva, an assistant professor of computer Science, is one of only 16 faculty SUNY-wide (approx. 35,000 on 64 campuses) to be awarded with this distinction in 2019 as well as the fifth recipient of a CAREER Award at the College. She joins Associate Dean and Professor Won Namgoong (2002), Professor Siwei Lyu (2010), and Associate Professors Jeong-Hyon Hwang (2012) and Feng Chen (2018).

Read more [here](#).
Mohammed Agamy received a total of $184,765 from two agencies to support research that will make advancements for radio frequency heating and improve the resilience of the power grid in an environmentally-friendly way.

**Advanced Power Electronics for Radio Frequency Heating**

Mohammed Agamy is PI on a $66,594 GE Research funded project titled “Modeling and Analysis of Modular Resonant Inverters for Radio Frequency Heating.” Radio frequency (RF) heating promises to be a more efficient replacement for steam based heating methods for underground soil heating for heavy oil extraction. RF heating can double the efficiency of the heating process compared to classical approaches. However, RF heaters require high power high frequency driving circuits in order to deliver the required load power. This poses a series of challenges that need to be resolved so that RF heating methods can be effectively and stably employed.

The purpose of the project is to develop simulation models for the analysis of modular resonant inverters for RF heating applications built by GE Global Research Center. The developed models will result in optimal performance. Based on simulation results, Agamy will provide design recommendations for experimental testing with the expected results. He will also support the testing done by GE Research through test data analysis and comparison to simulation models and provide recommendations for converter performance improvement, as needed.

**Control of Grid Interface Inverters for Distributed Power System Stabilization**

Mohammed Agamy's project titled “Control of Grid Interface Inverters for Distributed Power System Stabilization” is being sponsored by New York State Energy Research & Development Authority (NYSERDA) with funding of $118,171. In this project, Agamy will develop a new control method for grid interface inverters or distributed energy resources. This method combines the features of grid-forming droop control and virtual synchronous machine control concepts. This approach can be deployed on a wide range of inverters. Agamy and collaborating partner Key Capture Energy will evaluate and develop robust inverter control methods to improve the stability of the grid with high penetration of inverter based energy resources as well as assess the economic viability and benefits of deploying the designed control algorithms in existing and new plant deployments.

Higher penetration of inverter based distributed energy resources will present increasing challenges to the stability of the power grid. With more renewable resources replacing traditional generation, there is a reduction of inertia of the power system and with the intermittency of the renewable resources, power fluctuations that impact the system stability can occur if there are non-sufficient spinning reserves. This project will provide a solution to improving the resilience of the power grid in an environmentally-friendly way. The control methods in this project will enable integration of the distributed resources while maintaining a grid stability that is comparable to that of traditional generation with guidelines on defining distributed resource sizing and locations for different regions of the power grid.

Agamy is an associate professor of Electrical and Computer Engineering.
Cyberlearning: Detecting and Predicting Procrastination in Online and Social Learning

Shaghayegh (Sherry) Sahebi (Co-PI) and Reza Feyzi-Behnagh (PI) are collaborating on research designed to detect procrastination in online learners and find ways to improve these learners’ self-regulation. The project, “Cyberlearning: Detecting and Predicting Procrastination in Online and Social Learning” is sponsored by NSF with a grant of $749,766.

As online education becomes increasingly available and trusted by both employers and students, many workers are turning to online courses to advance their education and job prospects. However, online courses demand effective time management skills, as students are required to plan and set goals, manage their time, and work by themselves (or in a group), often with less structure than an in-person course. This increases the risks of procrastination, a key challenge to time management and success in both work and education contexts. To address those risks, this project will use computational algorithms to model students’ procrastination behaviors, identify indicators of likely future procrastination, and detect it early on in both individual and group work. The algorithms will learn to predict procrastination according to learners’ studying behavior captured by a time management application and their performance in courses. The findings of this project can be used to enhance students’ learning by helping them to set goals and plan their work, monitor their progress, and keep track of what they need to do to successfully accomplish their assignments on time.

Sahebi is an assistant professor of Computer Science and Feyzi-Behnagh is an assistant professor of Educational Theory and Practice.

Read more here.

Engineering to Improve Health Care for Patients With Cystic Fibrosis

Gary Saulnier received a subaward of $730,658 from Colorado State University for his project, entitled “Real-Time Assessment of Lung Structure and Function in CF Patients using Electrical Impedance Tomography.” This National Institutes of Health (NIH) sponsored grant is part of a collaboration between research teams at Colorado State University (CSU), the University at Albany (UAlbany), Rensselaer Polytechnic Institute (RPI), and Children’s Hospital of Colorado (CHC). The goal of this research is to determine whether electrical impedance tomography (EIT) can provide sensitive measures of changes in lung structure and function in cystic fibrosis patients of all ages.

Cystic fibrosis (CF) is the most common fatal genetic disease in the United States, and its progression is characterized by a cumulative decline in lung function. Disease management and treatment decisions are currently guided by the results of pulmonary function tests (PFT’s) to assess lung function and CT scans to assess lung structure. However, very young children are unable to perform PFT’s, and CT scans expose patients to ionizing radiation, limiting its frequency of use. Electrical impedance tomography is a non-ionizing real-time imaging technique that has been shown to provide regional pulmonary information and is safe for patients of all ages.

For this four-year grant, Saulnier will design and build a state-of-the-art EIT instrument, researchers at CSU and RPI will develop new and better algorithms to produce images and measures of lung structure and performance from EIT measurements, and researchers at CHC will collect clinical data from cystic fibrosis patients using the EIT instrument.

Saulnier is professor and chair of the Department of Electrical and Computer Engineering.
**Yard Locomotive Detection System**

**Ming-Ching Chang** received an award from General Electric Global Research of $200,000 to fund his project titled “Yard Locomotive Detection System Development.” Collaborating with GE Research, GE Transportation, and CSX Transportation in a real-world local rail yard setting, Chang is using Artificial Intelligence (AI) and Internet of Things (IoT) to improve rail yard management.

The rail yard is a complex series of railroad tracks for sorting and organizing railroad cars and locomotives. Each rail car has a unique serial number, much like an automotive license plate. Each serial number is located in a different location, depending on the kind of locomotive (e.g., box car, gondola car, hopper cars, etc.).

This sorting operation currently requires humans to visually identify the incoming locomotives, then classify and rearrange them using switchers. The goal of this project is to automate the entire sorting process. This automated switching operation will speed up the rail car sorting and move them out of the station in a shorter time span. The first step towards such automation is to detect, recognize and classify each rail car, and recognize any serial texts/numbers, or logos on each rail car.

To achieve effective site-wide tracking of rail cars, Professor Chang and his team will deploy several cameras at each entrance of the rail yard. Using these cameras, the team will develop algorithms to automatically identify the serial numbers and types of each rail car. Video analytic algorithms will be developed and deployed at IoT edge devices e.g. the NVIDIA Jetson Xavier boards. Recognized rail car information will be transmitted to the control center via message passing. The developed systems and framework will be deployed and evaluated at the CSX Selkirk Yard. Expertise and feedback from the customers (CSX Transportation) will be used to improve algorithm and system design. This video of early results captures the algorithms in action, detecting rail car types, logos, and serial numbers.

**Watch this video.**

Chang is an assistant professor of Computer Science.

Pictured: Early results combining rail car detection and recognition with text detection for serial text recognition captured railcar types (e.g., engine, boxcar, hopper car, etc.), logos (e.g., Norfolk southern), and serial numbers (e.g. 8050).
Mustafa Aksoy (L.) and President Havidán Rodríguez (R.)

ORAU Ralph E. Powe Junior Faculty Enhancement Award

Mustafa Aksoy was honored with the prestigious Oak Ridge Associated Universities’ (ORAU) Ralph E. Powe Junior Faculty Enhancement Award for 2019 for his project “Study of the Greenland Ice Sheet Using Wideband Microwave Radiometry.” ORAU’s competitive research awards provide funding aimed at enriching the research skills and professional growth of junior faculty in science, technology, engineering and mathematics. An ORAU representative wrote in the official notification to Aksoy, the award “represents public recognition by your academic peers of the quality and promise of your research.”

Aksoy will use his award to help fund a student to assist in his research. He said, “I am always looking for good graduate and undergraduate students who are interested in electromagnetic theory, microwave technologies, earth and space sciences.”

Oak Ridge Associated Universities is a consortium of 125 universities that provide innovative scientific and technical solutions for the US Department of Energy and other federal agencies to advance national priorities in science, health, education, and national security.

Only two nominations are allowed per institution. A total of 36 honorees were chosen out of a pool of 167 applicants. UAlbany was one of only two institutions with two awardees. Yunlong Feng, an assistant professor of Mathematics, was the second UAlbany recipient. Both were honored at a reception by UAlbany President Havidán Rodríguez.

Mustafa Aksoy is an assistant professor of Electrical and Computer Engineering.

Read more here.

New Program in Environmental and Sustainable Engineering

CEAS has pioneered a new program in environmental and sustainable engineering. The Bachelor of Science in Environmental and Sustainable Engineering was approved by the New York State Education Department in Spring 2018. It is first-of-its kind to be offered at a public university in the United States.

Environmental and Sustainable Engineering (ESE) is a discipline that builds on knowledge, discovery, and information from math and basic sciences to solve critical environmental problems on national and global scales. Among the many issues that environmental engineers endeavor to resolve are air pollution and prevention, water and wastewater treatment and reuse, water resource management, soil and groundwater clean-up, and hazardous waste remediation.

This new degree program distinguishes itself from conventional environmental engineering by having a serious emphasis, long-term vision, and deep commitment to sustainable solutions. It is designed to educate a new generation of environmental engineers to tackle environmental issues from a sustainable perspective.

The program is consistent with the college view that engineering is “science in service to society.” “In order to serve society better, we must embrace the concept of sustainability,” maintains Dr. Yanna Liang, professor and founding chair.

The B.S. ESE is the fourth degree program established at CEAS in 2018. The Bachelor of Science, Master of Science, and Ph.D. programs in Electrical and Computer Engineering were also inaugurated and highlighted in our 2018 Annual Report (p. 18).

For more, please visit here.
Measuring Antarctic Firn from Space

Mustafa Aksoy received an NSF award of $337,081 to fund his project, titled “Characterization of Antarctic Firn by Multi-Frequency Passive Remote Sensing from Space.” This project will test the hypothesis that physical and thermal properties of Antarctic firn—partially compacted granular snow in an intermediate stage between snow and glacier ice—can be remotely measured from space. Although these properties, such as internal temperature, density, grain size, and layer thickness, are highly relevant to studies of Antarctic climate, ice-sheet dynamics, and mass balance, their measurement currently relies on sparse in-situ surveys under challenging weather conditions. Sensors on polar-orbiting satellites can observe the entire Antarctic every few days during their years-long lifetime.

The approaches developed in this study, when coupled with the advancing technologies of small and low-cost CubeSats (miniature satellites used for research), aim to contribute to Antarctic science and lead to cost-effective, convenient, and accurate long-term analyses of the Antarctic system while reducing the human footprint on the continent. Moreover, the project will be solely based on publicly-available datasets; thus, while contributing to interdisciplinary undergraduate and graduate research and education at UAlbany, the project will also encourage engagement of citizen scientists through its website.

Mustafa Aksoy is an assistant professor of Electrical and Computer Engineering.

Within the GPM constellation, Special Sensor Microwave Imager/Sounder (SSMIS) on Defense Meteorological Satellite Program (DMSP) F17, F18, F19, and F20 satellites (Left, Credit: U.S. Air Force/Lockheed Martin artist’s concept) and Advanced Microwave Scanning Radiometer-2 (AMSR-2) on Global Change Observation Mission - Water 1 (GCOM-W1) satellite (Right, Credit: JAXA) provide radiometric measurements over the Antarctic at frequencies below 100 GHz where the electromagnetic penetration depth varies between tens of meters and a few centimeters. Thus, measurements provided by these two instruments will be used in this project.

The Global Precipitation Measurement (GPM) mission, is an international constellation-based mission designed to combine and improve precipitation measurements from several operational microwave sensors. None of the GPM members were built and launched specifically for the GPM mission. The individual satellites were designed and deployed by their respective space agencies for their own weather programs, but the international community, led by NASA and the Japan Aerospace Exploration Agency (JAXA), decided to incorporate the measurements from these satellites for consistent precipitation products with larger global coverage (Credit: NASA).

A picture of the entire continent of Antarctica seen from space (Credit: NASA/Dave Pape). The Antarctic Ice Sheet is the largest single mass of ice on Earth, thus its characterization will significantly improve our understanding of weather, climate and water cycle on our planet, each of which has important societal impacts.
Accessing and Analyzing Semantically Enriched Data Made Easier

Charalampos Chelmis was awarded an NSF CISE: III grant of $174,596 for his project, “Adding Exploratory Statistical Analysis and Prediction Support to SPARQL,” which will support research to make accessing and analyzing semantically enriched data easier.

Search engines use semantic annotations to provide search results, which remain well hidden behind the familiar search box interface. Beyond web search and recent technologies such as virtual assistants, semantically enriched data appear in a wide spectrum of application domains, including but not limited to, bioinformatics, neuroscience, health care, and social and psychological sciences. Access to semantic data, however, has been restricted to those intimately familiar with Semantic Web Technologies, standards, and protocols, data formats, and query languages. This project aims to substantially reduce the effort and expertise required to access and analyze semantically enriched data, and therefore increase the range of applications that can benefit from such data.

There are two major technical aspects of this project. In the first, Chelmis will develop a general approach to support visual semantic querying by devising algorithms that will automatically construct semantic queries from keywords provided in a search. The second will open up the statistical exploration, analysis, and predictive modeling of semantic data. Specifically, Chelmis will incorporate directly into SPARQL—the query language for retrieving and discovering relationships from semantic data—new primitives based on ideas from statistics and information theory. He will design an ontology that will support alternative statistical operations as well as develop computational methods and algorithms for query answering in this setting. Chelmis will complement these research aims with a comprehensive evaluation plan.

Charalampos Chelmis is an assistant professor of Computer Science.

For more about this project, please click here.

Topology Aware Configuration Spaces

Chinwe Ekenna was awarded an NSF CRII: IIS grant of $174,146 for her project, “Topology Aware Configuration Spaces,” which tackles a major obstacle in the current methods of motion planning in robotics research.

Motion planning is an important concept in robotics with a simple definition: find a path for a robot from its start to a goal position, where the start and goal is determined by the task the robot is expected to perform (e.g., navigate a factory floor, manipulate an arm to pick up an object, etc.). However, this is difficult to model and compute. The existing methods are only suitable to a specific class of problems such as 2D environments or robots with not more than 15 degrees of freedom after which their performance degenerates. Thus, these methods do not scale well for real time planning.

To efficiently plan motions necessitates having complete information about the robot’s environment beforehand, and then building efficient algorithms that produce a trajectory the robot can utilize. In this project, Ekenna will develop algorithms that better approximate the environment information planning space by producing a measure for this approximation using topology and geometric based formulations. This project will give more control to sampling algorithms to help determine what areas in the environment need more attention and representation. Consequently, this will improve the speed with which motion planning is performed.

Chinwe Ekenna is an assistant professor of Computer Science.

For more about this project, please click here.
Siwei Lyu and Hany Farid were awarded a highly competitive 2019 Google Faculty Research Award and seed money of $49,066.00 to support their proposal, “Exploiting Physiological Signals to Expose AI-Generated Fake Videos.”

Lyu and Farid have spent years developing artificial intelligence methods to detect fake videos, which have become increasingly rampant in social media. The advancements of AI technology, in particular, deep generative models, have enabled the creation of fake videos in ways that have not been possible before. Such fake videos are eroding societal trust in the authenticity of digital media and causing serious ethical, legal, social, and financial consequences.

The freely-available DeepFake software, for example, appeared in early 2018 and almost immediately led to the creation of several troubling fake videos (including revenge porn) and illustrated the need to quickly and accurately detect such fake videos (also dubbed “deepfakes”). Fake video production can also be especially problematic around major elections as public opinion, and voting, can be influenced by deepfakes made by or about politicians and other public figures.

This research project addresses the problem by detecting inconsistencies in the fundamental physiological signals expected in authentic videos of people. Lyu and Farid aim to develop new media forensic tools that can expose AI-generated fake face videos.

Siwei Lyu is a professor of Computer Science at the University at Albany. His work in the area of digital media forensics was the main thrust of his NSF CAREER Award (IIS-0953373) and the DARPA Media Forensics (MediFor) Program.

Hany Farid, a UAlbany alumnus who was also Lyu’s Ph.D. advisor at Dartmouth College, is a professor at UC Berkeley with a joint appointment in the School of Information and Department of Electrical Engineering and Computer Sciences.

In 2019 both researchers were tapped as part of a multi-institutional team of experts to work with Facebook to develop new methods to improve detection of deepfake content and misinformation campaigns. Facebook is funding the project to the tune of $10,000,000.

Google Faculty Research Awards can be found here.
2019 Torch Award Outstanding Nominee

Guy Cortesi was honored as a 2019 Torch Award Outstanding Nominee. The award recognizes a faculty member who has had an outstanding positive impact on a graduating senior’s academic and personal success. Computer Engineering senior Bradey Liverio wrote a compelling nomination letter on his behalf, extolling Cortesi’s exemplary teaching and positive influence on his life. Liverio lauded Cortesi for coming up with “some incredible projects,” making all course material “interesting and enjoyable to learn,” and impressing his students to not give up on any of their dreams and passions. Cortesi, said Liverio, provided life lessons “on how to live a wonderful life and to be a successful all-around person.”

Cortesi is a professor of practice in Electrical and Computer Engineering and has three decades of experience in industry and in higher education. Liverio graduated with a BS in Computer Engineering in May 2019 and was hired as an Automation Validation Engineer with Panacea Technologies in June.

Outstanding Achievement in Experiential Education

Jonathan Muckell was recognized with an Experiential Education Impact Award for his exemplary commitment to community engaged and work integrated learning. Sponsored by the University at Albany’s Center for Experiential Education, the award celebrates the outstanding contributions of faculty who augment student success through experiential learning both in and out of the classroom. It also reinforces UAlbany’s commitment to student success, which is a Strategic Plan priority.

Under Muckell’s mentorship, teams of engineering students worked with multiple external partners, including the New York State Industries for the Disabled (NYSID) and the local non-profit Living Resources, to develop technology to promote employment opportunities for individuals with disabilities. In this capstone design experience, there are no step-by-step directions for the students to follow; instead it relies on strong faculty mentorship to guide the students through various stages of the engineering design process.

“Although the students were the ones steering the prototype, Professor Muckell’s guidance and mentorship was paramount to the success of the product,” said Jen Sanderson of Living Resources. “In every meeting that took place with the student engineers, the support agency and Professor Muckell, he always made a great effort to emphasize to the student engineers the importance of truly listening to what the support agency needed from the product... as a result they created a model that was transferable, appropriate, and functional for my clients.”

Brian Bateman of NYSID said Muckell “and his students worked closely with NYSID staff and their agency partner to ensure that what they developed would be most useful to the people using their system.”

Jonathan Muckell is a professor of practice in Electrical and Computer Engineering. He is also the IEEE Student Branch Counselor at UAlbany and has served as the faculty mentor for the World of Engineering and Applied Sciences Living Learning Community since the 2018-19 school year.
Promotions and Tenure

The College of Engineering and Applied Sciences is pleased to announce:

Feng Chen was awarded continuing appointment and promotion from Assistant Professor to Associate Professor of Computer Science.

Siwei Lyu was promoted from the position of Associate Professor to Full Professor of Computer Science.

Outstanding Reviewers

Rixiang Huang, Kyoung-Yeol Kim, and Md. Aynul Bari were recognized for their excellence as reviewers in three academic journals in 2018. Huang was the recipient of the 2018 Editor’s Citation for Excellence as a reviewer for the Journal of Environmental Quality (JEQ) for his particularly noteworthy reviews and edits for the journal. Kim was named Outstanding Reviewer for Environmental Science: Water Research & Technology in 2018 for his significant contribution to the journal, which was based on the number, timeliness and quality of the reports completed over the last year. Bari’s recognition for Outstanding Contribution in Reviewing was an acknowledgment of the contributions he made to the quality of the journal Chemosphere.

It is notable that all three scholars are in the early stages of their careers. Huang, Kim, and Bari are assistant professors of Environmental and Sustainable Engineering.

World Scientific Reference on Innovation: Volume Four: Innovation in Information Security

Pradeep Atrey, an associate professor of Computer Science and cybersecurity expert, co-edited volume 4 of this multi-volume reference that covers a wide range of topics on innovation. The book presents a large body of global evidence on innovation and considers timely and important topics, including cybersecurity, the globalization of R&D, and open innovation. Volume 4 is a comprehensive analysis of cybersecurity. For more information, click here.

Outstanding Presentation

Yanna Liang received the 2019 Outstanding Presentation Award of the American Chemical Society (ACS) Spring 2019 National Meeting ENVR Symposium of Innovative & Practical Approaches for the Treatment of Per- and Polyfluoroalkyl Substances (PFAS). She was lead author and presenter for “Holistic Approaches Designed for Removing PFAS from Contaminated Environment.”

Thousands of chemistry professionals convene at the ACS National Meetings to share ideas and advance scientific and technical knowledge. The 2019 meeting was held from March 31 – April 4 in Orlando, Florida. Co-Authors on the paper were Weilan Zhang and Dongqing Zhang.

For more information, see the abstract here.

Yanna Liang is professor and chair of the Department of Environmental and Sustainable Engineering.

Congratulations to the Newly Minted Dr. Michelle Mora

The faculty and staff of the College of Engineering and Applied Sciences extend our heartiest congratulations to Senior Academic Advisor Michelle Mora, who successfully defended her dissertation in Spring 2019, graduating with a Ph.D. in Educational Policy and Leadership from UAlbany’s School of Education. Her dissertation was titled, “Undergraduate Engineering Students’ Agency in Professional Socialization: Evidence From a Capstone Design Lab.”
Andrew Boggio-Dandry was selected to receive the Institute of Electrical and Electronics Engineers (IEEE) Charles LeGeyt Fortescue Graduate Scholarship for the 2019-20 academic year. On June 22, 2019, the IEEE Educational Activities Board (EAB) voted to recognize Boggio-Dandry’s exceptional achievements by awarding him this prestigious scholarship that comes with a stipend of $20,600.

Established in 1939 as a memorial to Charles LeGeyt in recognition of his valuable contributions to the field of electrical engineering, the Charles LeGeyt Fortescue Scholarship is awarded annually to a beginning graduate student to support one year of full-time graduate work in electrical engineering. The student must be matriculated in a school of recognized standing located in the United States.

Upon receiving news of the award, Boggio-Dandry said “I am deeply honored, grateful, and humbled for IEEE’s choice to select me for this prestigious award. My dream of earning my Ph.D. in Electrical and Computer Engineering in order to start a career in academia is moving forward thanks to generous scholarships such as this.”

The 2019 IEEE EAB Award Presentation Ceremony will take place on Friday, November 22, 2019 during the IEEE Meeting Series in Boston, Massachusetts. Attendees include the IEEE President, members of the IEEE Board of Directors and other IEEE Officers.

Boggio-Dandry, who has a Bachelor of Science in Computer Engineering, is pursuing his Ph.D. in Electrical and Computer Engineering.

A list of prior award winners can be found here.
**First MS Electrical and Computer Engineering Graduate**

In May 2019, **Priti Pachpande** became the first graduate of the Master of Science in Electrical and Computer Engineering program at the University at Albany. Her master’s thesis was titled, “Communication Using Deep Learning Techniques.”

A native of India, Pachpande came to UAlbany with a Bachelor of Engineering (Electronics and Telecommunications) and a Master of Engineering (VLSI and Embedded Systems) from University of Pune. Throughout her graduate studies at UAlbany, she was part of Professor Hany Elgala’s research team at the Signals and Networks (SINE) Lab, where she played a vital role in the team’s investigation of the feasibility of applying ultra-wideband (UWB) technology to public transportation systems. She also engaged in research involving artificial intelligence, neural networks, and deep learning technologies in the communication domain. Pachpande says of her research experience: “Excellent faculty and top-notch labs like SINE Lab at University at Albany’s Electrical and Computer Engineering Department have helped me focus on my research.”

Upon graduation, Pachpande joined Globalfoundries, a leading semiconductor manufacturing company, as a Senior Product Integration Engineer. Her vision for the future: “I see myself leading a team of enthusiastic engineers who will work on developing solutions for problems arising due to Global Warming and Climate Change.”

Pachpande’s passion for research, coupled with her drive to use science to resolve important societal problems, makes Pachpande an example of the kind of graduate our young college can be proud to release into the world.

Read more about the SINE Lab [here](#).

Read more about the UWB project [here](#).

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**Computer Engineering Alumnus Inducted into WACE Hall of Fame**

**David Greenberg ’17,** the first BS in Computer Engineering graduate at UAlbany, was inducted into the WACE Co-op Hall of Fame. WACE is an international professional organization dedicated to developing, expanding, and advocating for cooperative and work-integrated education programs within industry and educational institutions. Typical inductees are usually more advanced in their careers, which makes Greenberg’s recognition all the more impressive.

Greenberg, who interned at IBM in Poughkeepsie, New York while he was a student, accepted a full-time position with IBM immediately upon his graduation. He was promoted to Staff Engineer in Spring 2019. He says, “I completely believe that UAlbany gave me a great underlying framework and set me up for success in my career.”

CEAS Associate Dean for Applied Learning and Cooperative Education Randy Moulic said Greenberg “is a great example of the kind of graduates that UAlbany’s Computer Engineering Program produces.”

For more about WACE, including a list of prior Hall of Famers, click [here](#).
Senior Capstone Design Creating Employment Resources for the Disabled

The 2019 class of Electrical and Computer Engineering seniors followed in the footsteps of the previous year’s class, using the capstone design project to develop innovative technology that would facilitate employment opportunities for individuals with disabilities. This multi-semester project begins in the fall semester when teams of students perform an in-depth evaluation of a problem, engage in background research and brainstorm technical solutions and requirements. The course forces an integration of multiple highly valuable skills, revolving around a real-world project and drawing upon knowledge attained in previous courses. To be successful, the students need to work as a team, apply technical writing or oral presentation skills, all while working on a project that benefits a vulnerable population.

In the 2017-18 academic year, four engineering seniors developed a tool to help persons with disabilities gain employment by providing reminders and streamlining time management. They dubbed their project “Bee Notified,” in recognition of the industrious creatures that, despite their size, are remarkable workers. Their project was supported by the New York State Industries for the Disabled (NYSID) and was completed in collaboration with the local non-profit Living Resources.

NYSID sponsors university projects through their CREATE (Cultivating Resources for Employment with Assistive Technology) program, which incentivizes student engineering projects that promote employment and vocational opportunities for people with disabilities. The project culminates with a symposium and competition consisting of universities across New York State. Despite being a brand-new engineering department and the first-time having the University at Albany represented at the competition, our student team won third place, and a prize of five thousand dollars.

The capstone project learning experience expanded in the 2018-19 academic year with four teams consisting of 12 students engaged in the CREATE competition and working with multiple external stakeholders. These teams worked on a range of problems, including making inventory management and packing systems jobs more accessible to individuals with disabilities, collaborating with a robotics company on an experimental service robot that might one day be able to monitor the health and safety of disabled workers, and extending the Bee Notified project from the previous year. The stakeholder on the last project (Living Resources) has expressed strong interest in commercializing the student-developed product.

The students received media attention both years, and valuable experience they can use as they launch their professional careers. Following are video clips from Spectrum News and CBS 6.

**SPECTRUM: Live at 7:10am and 7:40am**

**CBS 6 Report**
Presidential Award for Undergraduate Research

A record 193 undergrads presented their work at the Undergraduate Conference hosted by the Center for Undergraduate Research and Creative Engagement (CURCE) on Friday, May 3, 2019

Ethan Webster received the Presidential Award for Undergraduate Research at the 16th Annual University at Albany Undergraduate Research Conference for his project titled, “An Unsupervised Channel Selection Method for SSVEP-based Brain Computer Interfaces.” The Presidential Award for Undergraduate Research is a competitive honor established to encourage and recognize undergraduate research and scholarship. Having earned his B.S. in Computer Engineering in May 2019, Webster entered the Electrical and Computer Engineering Master’s program in Fall 2019. His faculty advisor is Tolga Soyata.

TRAVEL AWARD BRIEFS

Imara Nazar received an NSF sponsored Travel Grant to attend and present a paper titled, “A Hierarchical Approach For Timely Cyberbullying Detection,” at the IEEE Data Science Workshop 2019. Nazar is an Electrical and Computer Engineering doctoral student who works with Prof Daphney Zois and her IMAgINE Lab research team.

Yasitha Liyanage received an IEEE Signal Processing Society travel grant to attend GlobalSIP 2018, where two of his research group’s papers were published: 1) “What Matters The Most? Optimal Quick Classification of Urban Issue Reports by Importance” (Authors: Yasitha Liyanage, Mengfan Yao, Christopher Yong, Daphney-Stavroula Zois, Charalampos Chelmis); and 2) “Quickest Freeway Accident Detection Under Unknown Post-Accident Conditions” (Authors: Yasitha Liyanage, Daphney-Stavroula Zois, Charalampos Chelmis).

Jorge Gomez and Maqsood Careem were awarded travel grants to attend IEEE SECON 2019 and present a UAV (unmanned aerial vehicle) prototype platform that can advance wireless communications. Their project was titled, “HiPER-V: A High Precision Radio Frequency Vehicle for Aerial Measurements.” Gomez graduated with a BS in Electrical and Computer Engineering in May 2019 and Careem is an Electrical and Computer Engineering doctoral student.
Students Using Computer Science to Help NYS Agencies

Since the 2018-19 academic year, eleven computer science students have been part of research teams working on two projects that will help New York State agencies create information that better informs policies, programs, decision makers, and the public about important societal issues. Using data science to develop new data management, analytics, and visualization techniques, the students have worked on the Voter Registration Visualization and Pattern Analysis Demonstration Prototype Project and the NYS Data Analytics Prototype Project. For both projects, the students are getting hands-on experience with actual government data sets and applying current state-of-the-industry data management and analytics software.

Voter Registration Visualization and Pattern Analysis Demonstration Prototype Project

An expert team of UAlbany researchers from the Center for Technology in Government (CTG), the College of Engineering and Applied Sciences (CEAS), and College of Emergency Preparedness and Homeland Security (CEHC) are working with the New York State Board of Elections (NYSBOE) to enhance the Board’s ability to identify and address potential threats to the integrity of voter registration data. The goal of the nine-month project is to enhance the Board’s current utility of its data through the development of visualizations and anomaly detection demonstration prototypes. Under the advisement of Associate Professor Feng Chen, four computer science research assistants have contributed to the project: Shu Hu, Adil Alimu, Parth Patwari, and Baojian Zhou. This project is funded by NYSBOE.

NYS Data Analytics Prototype Project

A multi-disciplinary student team from CEAS, CEHC, and Rockefeller College are working with CTG researchers and agency partners to develop a new data analytics system. The project will provide New York State scientists and program managers with improved capabilities to share and analyze relevant environmental data among state and local agencies. Researchers are designing a prototype that will help New York State identify the essential technical capabilities (data management and data analytics software and applications) and data management and governance policies needed for an improved statewide data analytics capability.

Assistant developers on the project include CEAS students Pratik Pratik, Akshay Gujjari, Sughan Richardson Samson Babuji, Pranav Doshi, Shivika Malik, Sunil Joshi, and Saiteja Abbu.
Mariya Zheleva was a recipient of a 2019 President’s Award for Exemplary Public Engagement for her leadership in closing the connectivity gap in rural communities. The President’s Awards for Exemplary Public Engagement recognize individuals and University programs for outstanding achievement in public engagement through a variety of activities, including scholarship, research, and service.

Zheleva has exhibited outstanding leadership and tireless efforts in addressing the problem of limited Internet connectivity in rural areas in the U.S. and abroad. Her scholarly activity over the course of nine years has followed a multi-pronged approach to this challenge, combining fundamental innovations with community engagement, thus offering immediate and sustained benefit for numerous community partners she has engaged in the process. Following are examples of some of these partnerships.

**Cellular Network in Zambia**
During her PhD studies and through long-lasting on-site work, she empowered a rural community in Zambia by deploying a cellular network in a village plagued by no access to commercial broadband. Following its deployment, Zheleva continued working with local partners to ensure there were trained individuals who could maintain the network. This level of thoroughness clearly demonstrates that an important aspect of Zheleva’s public engagement research is to innovate with an outlook of sustained community benefit.

**FarmBeats Project at Essex Farms**
Since 2015, Zheleva has partnered with Microsoft Research and Essex Farms on a project aimed at providing alternative communication capabilities on this smallholder farm in Upstate New York. They found that blanket connectivity, typical to the urban landscape, but scarce in rural regions, was lacking. This has proven to be a challenging obstacle in using technology to increase productivity and sustainability. Monitoring via smart sensors and communicating among their team of farmers is difficult when their overall connectivity is unreliable or fragile in the face of northern climes. Mark Kimball, owner of Essex Farms says, “Dr. Zheleva has been instrumental in evaluating and integrating technologies such as TV white space networks and WiFi to better understand how information and communication technology, when integrated in a farm such as ours, could impact our workflow and productivity.”
Improving Emergency Response in Rural Communities

One of Zheleva’s current projects focuses on improving information dissemination for emergency preparedness and response in rural areas. Working with the leadership and community of the Town of Thurman, New York, and bolstered by a $1.5M NSF grant, Zheleva’s research team is developing technology to improve broadband access in rural areas.

Zheleva’s continued communication with the town board, supervisor, and the department of emergency services prior to the project’s start revealed opportunities to close the connectivity gap by leveraging community networks such as a Television White Space (TVWS) network employed for public residential access. Zheleva realized that the same network can be employed to deliver timely information to first responders and citizens. She and her team are also investigating the capacity of the physical social network among residents to disseminate preparedness information in a peer-to-peer manner.

While conceived in the context of Upstate New York, the framework will be general to ensure broad technology adoption across the U.S. and internationally. The project brings together network, data and political scientists with community members from Thurman.

This year’s recipients of the President’s Award for Exemplary Public Engagement were honored at a reception and awards ceremony on Monday, April 29, 2019 at the University’s Performing Arts Center. Accepting on behalf of Zheleva was Petko Bogdanov, assistant professor of Computer Science and Zheleva’s husband (Zheleva had a prior commitment to present her research at a conference). Also in attendance was Cynthia Hyde, elected supervisor of the Town of Thurman, Warren County, NY, who had provided a letter in support of Zheleva’s nomination.
CELEBRATING WOMEN IN TECHNOLOGY

Electrical and Computer Engineering

Committed to Advancing Women in STEM

After earning her Bachelor of Science in Electrical and Electronic Engineering from American International University-Bangladesh, Farial Nur Maysha taught electrical and electrical engineering courses to undergraduate students for two years. Wishing to pursue graduate studies at the University at Albany, she accepted a research assistantship with Professor Gary Saulnier.

Passionate about modern technology and development, Maysha says she is “committed to working for the advancement of women in computing.” Serving as vice-chair of UAlbany’s chapter of the Association for Computing Machinery- Women (ACM-W) from May 2018-2019, Maysha and her team organized various coding challenges and hackathon events for students and brought in external speakers who were successfully working in the technology field.

Maysha was awarded a Grace Hopper Celebration Student Scholarship to attend the 2019 Grace Hopper Celebration in Orlando, Florida from October 1 – 4, 2019. Produced by AnitaB.org and presented in partnership with the Association for Computing Machinery (ACM), this conference is the world’s largest gathering of women technologists.

Maysha joins a group of deserving female students who have received scholarship support from either GHC or the College in previous years. In September 2018, ECE graduate student Priti Pachpande received a scholarship to attend the 2018 GHC in Houston Texas. In 2017, CEAS registered as a platinum sponsor and sent eight students, two faculty members, and one staff member to that year’s conference.

Maysha joined Globalfoundries as a process engineer in August 2019 after defending her master’s thesis, becoming the second person to graduate with an MS in Electrical and Computer Engineering at UAlbany. Her thesis was titled, “Design and Simulation of a Voltage Controlled Current Source for Electrical Impedance Tomography Applications.” She says, “I am thankful to the ECE department and faculty for all their encouragement and support. I look forward to the new challenges ahead.”
Environmental and Sustainable Engineering

Supporting Her Dream

Sanchita Paul was selected for a Ford Foundation Women in Science Fellowship made available through UAlbany’s Initiatives for Women (IFW). Using individual, corporate, and foundation contributions, IFW provides seed money to support the educational and professional goals of female students, faculty, and staff. The program is run under the auspices of UAlbany’s Office of the Provost.

Award winners are chosen yearly by a committee of volunteers, whose motto is to support her dream. Paul’s proposal was about per- and polyfluoroalkyl substances (PFAS) contamination. There has been growing concern of emerging PFAS in the environment because of their persistent and potentially toxic nature. The objective of Paul’s study is to understand PFAS occurrence, air concentrations, emission sources and deposition pathways in rural and urban communities of New York State. Paul will use her IFW Award to attend the 37th AAAR Annual Conference from October 14-18, 2019 at the Oregon Convention Center in Portland, Oregon, where her paper was accepted for a poster presentation.

Paul, a CEAS doctoral student, has been working with Md. Aynul Bari, an assistant professor of Environmental and Sustainable Engineering. She is a civil engineering graduate with a major in environmental engineering from Bangladesh University of Engineering and Technology (BUET). Paul says, “It has always been my aspiration to work for the promotion of a sustainable environment. Through my energy, intellect and activism, I believe I can contribute to build a more equitable and sustainable world.”

An award ceremony and reception to honor this year’s IFW award recipients was held on Thursday, July 18th in the Campus Center Assembly Hall.

Computer Science

Meet the Women in Robotics

Chinwe Ekenna received an NSF grant to fund her Meet the Women in Robotics Workshop (WiRW) at the 2019 Robotics: Science and Systems Conference (R:SS) on June 23, 2019. Joining her were colleagues Kerstin Haring and Elizabeth Phillips from the U.S. Air Force Academy.

The workshop is designed to raise the visibility of women in robotics, strengthen the community of female roboticists by bringing together women from various disciplines and subfields in robotics, provide opportunities for networking, and connect junior female robotics researchers to senior mentors in the field.

Robots are anticipated to be an integral part of meeting societal needs in domains like healthcare, space exploration, and education. Ekenna’s work in mentoring women in the burgeoning field of robotics is important because to meet the growing demand for robotics technologies in these domains, the pool of capable roboticists will need to grow in kind. However, the number of female roboticists entering the field continues to notably lag behind male counterparts. This gender disparity presents a significant hurdle for adequately meeting the demand for experienced robot scientists. Accordingly, WiRW is focused on reducing the gender gap in the robotics domain by providing an opportunity to feature the work of prominent female roboticists.

Chinwe Ekenna is an assistant professor of Computer Science and an advisor for UAlbany’s student chapter of ACM-W.
Environmental and Sustainable Engineering is a discipline that builds on knowledge, discovery, and information from math and basic sciences to solve the critical environmental issues of today. For the ESE faculty at the College of Engineering and Applied Sciences, this requires building a strong research portfolio aimed at addressing problems both locally and globally.

Led by Professor and Chair Yanna Liang, the recently launched Department of Environmental and Sustainable Engineering includes a team of researchers studying issues such as air pollution and prevention, water and wastewater treatment and reuse, water resource management, soil and groundwater clean-up, and hazardous waste remediation.

“As we face climate change, resource depletion, and increased frequency of natural disasters, we need environmental engineers more than ever before,” said Liang. “The need is both local and global: while the world grapples with the long-term impact of climate change on distressed communities, New York continues to contend with high wastewater treatment costs and numerous Superfund sites that require substantial cleanup of polluted soil and groundwater by either well-known or emerging contaminants.”

Liang’s faculty researchers include Assistant Professors Md. Aynul Bari, Rixiang Huang, Kyoung-Yeol Kim and Yaoze Liu. They are collaborating on research aimed at providing long-term solutions that are both economical and sustainable.

The Fight for Clean Water

Professor Yanna Liang has made it a top priority of her research lab to find green and innovative technologies and approaches for removing emerging contaminants from the environment. Among her top targets are Poly- and perfluorooalkyl substances (PFAS), a group of synthetic chemicals widely used in manufacturing since the 1950s.

Because they are found in everything from food packaged in PFAS-containing materials, household cleaning products, drinking water and
in living organisms such as fish or other wildlife, most Americans have been exposed to PFAS. The potential harm of this exposure includes many adverse health effects for humans and wildlife, such as cancer, obesity, immunotoxicity, and thyroid disease. By some estimates, as many as 43 U.S. states have locations, including drinking water sites, that are contaminated with PFAS, with possibly 19 million Americans facing unhealthy exposure levels.

In her lab, they have been investigating different approaches, such as sorption, nanophotocatalysts and plant-microbe interactions for removing PFAS from contaminated environment.

In terms of their third approach, they have demonstrated that plants do uptake and accumulate perfluoroalkyl acids (PFAAs) in shoots and roots,” said Liang. “Interestingly and surprisingly, we have also observed anaerobic PFAA degraders on agar plates.”

**Assistant Professor Yaoze Liu’s lab** is also at work addressing water quality issues, including some that pose particular health and safety risks in New York State.

Harmful Algal Blooms (HABs), which are overgrowths of algae that produce toxins and severely impact human and aquatic ecosystems, are a major environmental problem in New York, as well as other parts of the U.S. HABs usually occur in nutrient-rich (nitrogen and phosphorus) slow-moving waters with high temperature. Nutrients in water bodies released by human activities -- in both agricultural and urban areas -- cause more severe and frequent blooms.

The records of the New York State Department of Environmental Conservation show that HABs occurred in a large number of waterbodies in New York State during the past 7 years. New Yorkers may also face a greater risk for exposure to HABs due to current water treatment infrastructure.

Liu and his team are working to develop optimization-based decision support systems to obtain cost-effective strategies to address HABs and other water quality problems. This is done by analyzing places where agricultural and urban best management practices (BMPs) have been implemented, then using the decision support systems to see where additional practices should be applied to obtain the greatest positive impacts with the lowest costs.

“We’ve found that the initial implementation of BMPs with low expenditures greatly reduced pollutant loadings; however, beyond certain levels of pollutant reductions, additional expenditures resulted in less significant reductions in pollutant loadings,” said Liu. “Compared to optimization for the entire watershed, optimization in critical areas can greatly reduce computational time and obtain similar optimization results for initial reductions in pollutant loadings; however, for higher levels of reductions in pollutant loadings, only focusing on critical areas creates less cost-effective BMP implementation strategies compared to optimization in the entire watershed.”

Liu’s research holds the potential to positively impact local and regional communities throughout New York that are currently at risk from harmful algal blooms and other water quality problems.

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**Air Quality in Urban and Rural Communities**

While air quality concerns -- particularly in urban environments -- have been raised for decades, there has been substantially less attention paid by government and regulatory agencies to indoor air quality.

**Assistant Professor Md. Aynul Bari** has been involved in assessing emerging air quality issues in urban and rural areas in order to explore the need for addressing clean air strategies to support the initiatives of environmental sustainability. He has undertaken long-term air quality trend analysis, multivariate receptor modeling, and used a variety of advanced statistical approaches for interpreting and understanding characteristics and sources of air pollutants at numerous locations across Alberta, Canada and in Europe (Germany, Cyprus) over the past ten years.

His research group is currently carrying out an in-depth investigation into the sources of volatile organic compounds (VOCs) in the Albany area. “Understanding sources of pollution -- as well as the associated risk to public health -- can aid us in developing appropriate management strategies to
minimize the release of pollutants into the urban environment,” said Bari.

According to preliminary results, his team was able to determine ten sources in the region where secondary organic aerosol and diesel vehicles/global background were the largest contributors to VOCs. But Bari’s work doesn’t stop at outdoor (ambient) air quality.

“While government agencies have done much to tackle urban air pollution, little attention has been paid to assess the quality of air we breathe inside of our homes,” said Bari. “From studies of time-activity patterns, we know that American adults typically spend an average of 69 percent of their time in indoor residential environments. Different daily activities and sources within the home may contribute considerably to our exposure to air pollutants such as particles and VOCs”.

Concentrations of organic air pollutants tend to be as much as 10 times higher indoors than outdoors, regardless of whether the homes are located in rural or highly industrial areas. To address this issue, Bari’s group is also planning to initiate indoor air quality monitoring in Albany and surrounding communities to determine pollutants concentrations and identify different sources within home settings.

“Once we know the important sources of specific air pollutants in our homes, we can take necessary steps to change our daily activities and minimize our exposure to sources, and improve the quality of indoor air and our health,” said Bari.

To aid in their research, Bari’s team is exploring the use of internet of things (IoT)-driven air pollution sensors, which may provide a low-cost solution compared to the often time consuming and labor intensive nature involved in conventional measurements of air pollutants.

His group is asking the question, ‘how we can leverage recent advances in IoT-driven sensors for outdoor, indoor and personal exposure monitoring?’ Several challenges exist in low-cost air pollution sensor measurements including sensitivity, selectivity, stability and response time as well as interference with meteorological factors such as temperature and relative humidity. But the implementation of IoT-based air pollution and greenhouse gas (GHG) sensors has the potential to transform the ability of communities, cities to understand and tackle air pollution issues and challenges. The potential deployment of IoT air pollution and GHG sensors within dense networks offers an opportunity to complement conventional sparse air quality monitoring system to improve our understanding of air pollution exposure, identifying source impacts in order to raise awareness among the community about air quality problems.

“Air pollution has no local, regional, and continental boundaries,” said Bari. “Some air pollutants can remain in the atmosphere for several days to weeks, can travel hundreds or thousands of miles and influence local and regional communities. At UAlbany, Bari and his team will continue their efforts to tackle local and global air pollution problems, in collaboration with national and international researchers to develop sustainable air quality models.

“We are open for potential collaboration opportunities with government, industry, community and environmental stakeholders to improve air quality in our communities,” said Bari.

The Biowaste Problem
The human population of Earth stood at about 7.3 billion people as of 2016, according to the U.S Census Bureau, a jump of about 1.3 billion people since the year 2000.

And with that massive, ever-growing population comes tremendous amounts of waste – much of it in the form of biological substances.

In the lab of Assistant Professor Rixiang Huang, the goal is to find sustainable solutions to the biowaste problem, with a particular focus on the U.S. “Significant amounts of solid organic wastes are generated annually from various human activities, such as agriculture, food processing and consumption, and wastewater treatment,” said Huang. “These wastes are important pools of critical elements such as carbon, nitrogen, and phosphorus, thus play important role in their global cycles.”
“Significant amounts of solid organic wastes are generated annually from various human activities, such as agriculture, food processing and consumption, and wastewater treatment,” said Huang. “These wastes are important pools of critical elements such as carbon, nitrogen, and phosphorus, thus play important role in their global cycles.”

Huang understands that the management of these wastes is closely related to the food-energy-water nexus and has significant environmental and socio-economic impacts.

In addition to laboratory studies, his team is also collaborating with local municipalities, the waste industry, and farmers to study and solve problems that occur in the field.

“One example is how we deal with biowaste in the Capital Region,” said Huang. “Because bio-solids were processed differently in different wastewater treatment plants, it is important to understand how different treatments affect bio-solid quality and behaviors in soil.”

For food waste, because more and more states are starting to ban food waste landfilling (New York recently stepped in), other treatment and disposal options are urgently needed. This is why Huang and his team are also working to study anaerobic co-digestion of food waste, focusing on solving the issues originated from co-digestion.

A Better Way to Manage Resources
Whether it is biowaste or wastewater, the ESE researchers at the College of Engineering and Applied Sciences are focused on finding ways to reclaim and reuse the energy that is otherwise lost during the process of cleaning these products of human consumption.

While Huang’s team looks at the solid waste problem, Assistant Professor Kyoung-Yeol Kim is exploring how to recycle the energy found in wastewater, developing better wastewater treatment approaches, and improving methods for removing contaminants from water.

“As population increases, the amount of wastewater from human activities increases as well and accessibility to the clean water is getting limited,” said Kim.

He notes that with nearly 20 million people living in New York, the state operates 616 municipal wastewater treatment plants (WWTPs) which are responsible for cleaning about 3.2 billion gallons of wastewater per day. With the energy cost to treat a million gallons around 1,480 kilowatt hours (kWh), the energy cost of treating wastewater in New York is substantial - more than 4.7 million kWh per day.

“The largest portion of the energy cost is due to the aeration -- which accounts for 67 percent of total electrical energy consumption in the treatment plants,” continued Kim.

Aeration is required for a biological treatment process such as activated sludge that has been widely employed in treatment plants to remove organic matter and solids from the wastewater using aerobic microbes.

“There is a potential to further reduce energy cost in WWTPs by developing new less-energy intensive treatment processes to replace conventional treatment processes like activated sludge,” said Kim. “Also, instead of just ‘destroying’ organic matter, solids, and nutrients in the wastewater, there are ways that we can recover valuable products from the wastewater.”

For example, energy potentials of organic matter in domestic and animal wastewaters in the U.S. are estimated at 17 gigawatts. Currently, the U.S. only
produces biogas (methane) through anaerobic digestion (AD), and the AD process is not appropriate to directly treat municipal wastewater.

For Kim’s team, the goal is to find other processes that can recover the energy available in wastewater, and thereby reduce the cost of its treatment.

One potential avenue would be a microbial fuel cell (MFC), a novel technology that can produce electrical energy from organic matter in wastewater using exoelectrogens.

“Exoelectrogens” can uptake organic matter as their substrate and transfer obtained electrons to the anode surface through mediators or electrical nanowires.

“MFCs have shown great potential to be an alternative treatment process to activated sludge by lab-scale tests. Less energy is required for MFCs compared to activated sludge since aeration isn’t required. However, as a power generation system, the power densities of MFCs are still low. Kim’s team is exploring how these microbial fuel cells can be further improved to supply power to other facilities in WWTPs.

Coalbed methane, a form of natural gas extracted from coal beds, is becoming an increasingly important source of energy in the U.S. Liang and her team are at work developing methods to convert coalbeds to methane, which would reduce or eliminate the need to disturb the surrounding environment, and thereby reducing the cost for extracting the energy.

“In the U.S., among six trillion tons of estimated coal resources, 90 percent is currently unmineable,” said Liang. “But if the coal is surrounded by suitable microorganisms, it can certainly be converted to methane.”

This process of coal “biogasification” has been reported in many different parts of the world. But, in underground coal seams where nutrients (nitrogen, phosphorus, etc.) are notoriously deficient, biogenic methane formation can be a slow process.

To enhance methane release from coal, two processes are generally employed: bioaugmentation and biostimulation. Bioaugmentation is generally not necessary since most indigenous microbes are capable of gasifying coal.

Biostimulation, meanwhile, has been practiced in coal-bed methane wells. This approach involves supplementing suitable nutrient solutions to the in situ microbial communities to improve methane production rate.

Liang and her team are working to identify the best nutrient recipes (low cost, highly efficient) for different basins. This process involves sequencing the microbial communities in different basins and studying the different nutrient recipes that have shown high stimulating effects on methane production.

“As a result, we have developed recipes that are less than 10 percent of the initial cost, but enhanced methane production 200-500 fold,” said Liang. “Currently, we are investigating the stimulating effects of these nutrient solutions at on-site conditions.”
Over 14 million Americans are unemployed. Now, imagine you wake up one morning and you realize you’re one of them. Your savings are gone. You have lost your house. You have nothing to eat. What would you do? Can’t picture it? There is a simulation game called Spent (available to play at http://playspent.org/html/). It’s about surviving a month with your last $1,000. Dr. Chelmis has already taken up the challenge thinking that “it didn’t sound like a big challenge. Well, I made it through the month with about $200 to spare. Success, right? Well, the rent for the next month was due and I ended up being jobless. So, I guess I failed. It was actually a dark and grim experience! Can’t imagine living it in real life!”

Most individuals would turn to family or friends in an effort to find solutions when facing tough realities. Some may scavenge the Web for pointers. Others may reach out to their congregation. But what if you have no access to the Web? What if you never visited a church? What if you are socioeconomically disadvantaged? What if you no longer have adequate skills in our ever-progressive society to get a decently compensated job? And then there is a twist: You have a child to support, and you have a preexisting medical condition. How would you survive during such a non-stop stressful experience?

Research has shown that in a crisis most people do not have the patience to shop around for services [17,9, 5]. Even if they did, seeking services can be daunting, if not intimidating, particularly for those being socioeconomically marginalized and/or those experiencing challenges with technology. Where would one start to look for service providers? What if an emergency occurs after business hours? Without a comprehensive resource to guide service seekers through the process of finding service providers, service seekers need to comprehend complex terms and eligibility criteria, resulting in little or slow progress [6]. Often there is no good solution to an issue at hand. Alternatively, a “solution” may be complex, requiring multiple steps to be taken from the service seeker, as well as coordination of services to address. For some, the mere fact that they have to repeat their story multiple times, or that a potential solution may need time to materialize, might raise their level of frustration. This is where innovations in AI, Machine Learning, Signal Processing and Big Data can make a difference.

A Compass to Navigate Among the Complexities. Assistant Professors Zois and Chelmis of CEAS have partnered with Assistant Professor Lee in the School of Social Welfare and non-profit organizations in the Capital Region to develop technology that will make a difference in assisting people struck with poverty, hunger and homelessness in an effort to address their everyday struggles. “We envision Human Services 2.0, the next generation of human services,” said Dr. Zois, “in which information about service providers is openly accessible and easy to find, search and filter through.” At the same time, “delivery of services should be digital, seamless, efficient, and traceable, maximizing positive outcomes both for service seekers and service providers alike,” she added. Their inspiration stems from Web 2.0, a “set of economic, social, and technology trends that collectively form the basis for the next generation of the Internet, a more mature, distinctive medium characterized by user participation, and openness” [18].

When interviewed, approximately 86% of human service providers in the New York Capital Region showed interest in technology that would enable them to communicate with and serve their clients digitally, facilitating seamless and end-to-end service request and delivery via a user-friendly mobile app. At the same time, our surveying of 94 service seekers has identified the need for technology that would (i) provide accurate and up-to-date information (e.g., current programs and services, and eligibility criteria) about human service providers, and (ii) enable them to submit and manage service requests electronically (e.g., semi-automatic intake form completion).

Making this grand vision a reality however, is far from trivial. Currently, service providers employ a mix of electronic and paper and pencil systems, limiting their ability to have a positive impact on
issues and communities. Differences in technical infrastructure, privacy and confidentiality concerns, policies and regulations, and mistrust as well as competition among service providers results in a heterogeneous, hostile environment for integration [10,12,11,8]. On the other hand, service seekers have to physically visit a service provider, call, or search the Web even for a simple inquiry. However, service seekers may be unable to use such methods due to reasons including restricted mobility or personal preferences (e.g., someone may prefer the anonymity of a mobile app to search for options).

“With limited resources, human service providers need to make technology investments and understand that data, both qualitative and quantitative, are essential for them to better meet their clients’ needs,” Dr. Chelmis underscored. Naturally, human service providers may often be staffed by people not inclined to seek out data, and even opposed to adoption of new technologies. “The fact that we still have those long-standing problems that human service providers are set up to address means there still is work to do, and big data might well be a lever to creating change.”

As part of their National Science Foundation funded project, COMPASS1, Dr. Zois and Dr. Chelmis are developing technology to (i) simplify the discoverability and use of human services by offering service seekers a universal, searchable, and dynamically updated resource guide of human service providers in a locale [7], (ii) improve service providers’ intake rate of new clients and processing of documentation [19,16], and (iii) assist stakeholders in assessing and promoting the wellbeing of their communities [15,14].

For service seekers the new technology manifests as an easy to use mobile app that allows them to find, search and filter through service providers in an area, or expand on any provider to obtain more information, including directions and contact details, hours of operation, programs and services provided, and eligibility criteria if applicable. Filtering and search capabilities, and the ability to bookmark organizations enable users to easily navigate among a potentially large number of service providers in a locale, whereas requesting for services is one click away. Tracking the status of service requests is simplified, whereas notifications can be set (some automatically by the app) to notify the user of changes in any of her requests (e.g., need for additional documentation). Dr Zois recently presented a working prototype of the technology at two collocated events, namely the Smart Cities Connect Conference and Expo2, and the US Ignite Application Summit3 (see Figure 1). Both venues are geared towards empowering smart cities at all stages of growth by accelerating the adoption of smart technology solutions, and advancing technology research for the betterment of cities, communities, and their citizens. Key technological challenges and their unique proposed approach have also been recently presented at the Data Science for Social Good workshop4, which was collocated with the Web Conference5 (formerly known as WWW conference), that began in 1994 at CERN6 and serves as the premier forum for discussion and debate about the evolution of the Web, the standardization of its associated technologies, and the impact of those technologies on society and culture.

What is very exciting is that the proposed technology can also help service providers collect the data and analytics necessary to understand the needs of their clients now, and over time. The impact of this can be huge, since it can help dynamically shift the activities of service providers to better provision for services and tremendously facilitate strategic decision-making. It can also break down silos and “open up” collaboration opportunities between service providers to ensure continuity of care for the clients.

To enable fast processing of service requests that can be implemented in low-cost mobile phones, Drs. Zois and Chelmis have designed low-complexity machine learning algorithms to extract the most useful information from a client’s request and identify the appropriate service providers to address the client’s need in real-time [19,16]. They have conducted extensive evaluations on real service requests data to show the feasibility of the proposed algorithms illustrating significant gains both in...
accuracy and time-to-decision with respect to the state–of–the–art. They have also designed AI methods to automatically identify which types of service requests a community considers important [15]. They believe that such methods form the basis of AI-driven equitable decisions to reallocate available resources on the fly that have the potential to assist stakeholders in assessing and improving the well–being of their communities. Their work has been featured in major signal processing conferences, including the 44th International Conference on Acoustics, Speech, and Signal Processing (ICASSP), the world’s largest and most comprehensive technical conference focused on signal processing and its applications. Currently, they are working towards integrating their algorithms with their working COMPASS mobile app prototype, hoping to have community representatives test and provide feedback on the proposed technology soon.

Dr. Zois and Dr. Chelmis are piloting their technology in the Capital District of the New York State. Combined with the close-by cities of Schenectady and Troy, this metropolitan region is the 4th largest in New York State and the 45th largest in the United States. Albany is a multiracial and multi-ethnic city (on average 52% White, 29% Black or African American, 9% Hispanic or Latino, 6% Asian, and growing refugee populations) with a mixture of income–level and neighborhood types and a high concentration of human service providers and service organizations related to government, health care, and education [13].

Engaging the Community in Research and Development.
Disruptive innovation starts with a vision. Being responsible, open and receptive is really important, however, when engaging the public in research, designing and development, testing, and early adoption of new technologies. Drs. Zois and Chelmis take the “pulse of the community” at every step in their project (see Figure 2). Thus far, they have partnered with key non–profit organizations in the Capital District, including the United Way of the Greater Capital Region [4], the Food Pantries of the Capital District [3], the Capital Region Coalition to End Homelessness [2], as well as grassroot initiatives such as ServeAlbany [1], which focuses on promoting volunteering activities in Albany.

Concluding Remarks.
Connecting those in need with those being able to help demands an integrated, interdisciplinary approach. For some this means getting easy access to relevant resources. To others this translates to improving the interoperability and collaboration among service providers, and actively engaging citizens in improving their lives and the lives of those in need. We argue that technological innovations designed towards socially responsible cities should transform the culture of community members from individually tackling a problem to collectively looking after one another so as to make their communities quantifiably more responsive to the needs of their citizens.
References:


Footnotes:


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Brief Background: The architectures of CHRONOS is based on Cloud Radio Access Networks or C-RAN that has been adopted in 5G and future wireless networks (figure 1). The project is funded by the National Science Foundation (NSF) to investigate novel network algorithms and signal processing techniques to substantially improve the performance of future wireless networks. As demand for mobile data increases [1], it is important to develop new architecture and protocols to cater to that need. The unique feature of this testbed is the ability to synchronously transmit and receive wireless signals using relatively low complexity remote radio nodes while the signals are processed and generated at a centrally located cloud infrastructure.

Since CHRONOS was funded in Fall 2018, the team has been focused on finalizing the specifications of the various hardware and software components for the testbed with a long-term research agenda in mind. The cloud server, shown in figure 2, is responsible for signal processing related to the wireless waveform. The unit is a high-performance hybrid processing unit containing two 12-core CPUs and 8 Field Programmable Gate Array (FPGA) cards. Two of these servers will interface 8 Heterogeneous Edge Node (HNE), as shown in figure 1. The HNEs comprise a Xilinx RF System on Chip (RFSoC) with 8 radio channels that can be used to communicate either using microwave, millimeter wave or Terahertz (optical) frequencies. The cloud server and the edge nodes will communicate using the Common Public Radio Interface (CPRI [2]) protocol over high speed multimode optical fiber.

Preliminary Testbed at UAlbany
We have demonstrated a preliminary testbed with four Software Defined Radio (SDR) nodes, as shown in Figures 3a and 3b. Each SDR is a USRP N210 [3] that is set to operate at 2.484 GHz (not used by Wi-Fi) as a Heterogeneous Mobile Terminal (HMT in Figure 1 above). Another USRP N210 is used to transmit wireless packets using the visible light spectrum. Two USRP B210s SDRs [4], synchronized by the Octoclock-G [5] are used as HNEs, with each having an RF and optical detector to receive from the two transmitters. The Heterogeneous Baseband Processor (HBP in figure 1) is a Quad i7 laptop connecting to the HNEs over gigabit Ethernet. The baseband signals are synthesized in MATLAB/Simulink and transmitted or received using the USRPs. Both the HNEs are operated by the same PPS signal from Octoclock-G, thus receiving synchronized complex baseband samples.
The optical front end is based on a laser kit and photo-detector modules from Thorlabs. The kit consists of current and temperature controllers attached to a mount for standard lasers (Figure 3c). The mount includes a bias-tee for RF modulation of the laser current with 200 mW maximum power, and up to 600 MHz bandwidth, which is modulated by the signal from the N210 transmitter. The photo-detector modules with and without a focusing lens (mounted using a lens tube) are also shown in Figure 3c. The detectors capture and convert the emitted optical signal, and amplify the electrical signal using a transimpedance-amplifier (TIA). The output of the photo-detector module is connected to the receiver chain of the N210. The current setup uses a red-laser to emit a baseband signal around a 50MHz carrier frequency. The optical link is used to transmit a Reverse Polarity Optical Orthogonal Frequency Division Multiplexing (RPO-OFDM) signal. This combines the fast OFDM communication signal with a relatively slow Pulse Width Modulation (PWM) dimming signal. The PWM signal is set to have a duty cycle of 50% and the OFDM signal is superimposed on it. The RF link transmits the same OFDM signal without the PWM superimposition. Figures 4a and 4b show the received waveforms in both RF and VLC links. During this process, existing students of the PIs gained extensive experience working on the platform, which will help them to kick start the CHRONOS testbed development.

Research Opportunities
CHRONOS utilizes channel diversity and flexible architecture to enable next generation wireless connectivity to facilitate research in many directions. It will enable the conduction of cutting-edge broadband wireless communication and networking research, (a) to cope with the exponential increase of traffic demands in congested networks through broadband offloading of cellular mobile traffic indoors, (b) to integrate different wireless technologies for acceleration of Internet-of-Things (IoT) deployments, (c) to simultaneously incorporate wireless sensing, and (d) to virtualize the physical layer and provide radio as a service.

Joint RF-VLC Communication: Although C-RAN has been studied in sub-6GHz domain, CHRONOS will enable for the first time the coordination between hybrid small-cells/network-edges. A directional high-speed Visible Light Communication (VLC) link relies on a strong line-of-sight links to maintain a high-quality signal at the receiver, thus is susceptible to total blockage/shadowing or deep flat-fading. To overcome these limitations, a joint hybrid RF-VLC transmission based on various schemes is a promising solution to exploit diversity. We will actively pursue research in diversity mechanisms (e.g. temporal, spatial or coding diversity) by data transmission of two separate bit streams over the RF and VLC links.

Synchronous Hybrid MIMO: The distributed antenna geometry in C-RAN is significantly different compared to conventional Multi Input Multi Output (MIMO) setup, which is used not only for increasing throughput, but also for multi-user detection algorithms, Time-of-Arrival (ToA) and Angle-of-Arrival (AoA) calculations used for localization. It not only reduces inter-carrier interference (ICI) and inter-symbol interference (ISI), but also ensures precise timing in wide bandwidth communication, where symbol duration gets shorter. Much needed research is enabled by CHRONOS in the RF-optical combination of MIMO techniques.

Localization: We will leverage the C-RAN deployment to pinpoint locations of devices by jointly analyzing the received signals from multiple antennas. We aim to precisely locate a target by aggregating and analyzing various signals it transmits in different frequencies to different heterogeneous networks that it is associated with. Our gain is substantial as we
can leverage the diversity in signal quality, in space, time and frequency due to distributed antenna geometry and capability of centralized signal processing in C-RAN. It has to be noted that gesture recognition and localization algorithms developed for multi-antenna single access point cannot be extended for the C-RAN scenario due to the distributed nature of the antenna elements.

**Reconfigurable Baseband using Dataflow Graphs:**
In order to utilize the available resources in the HBP, the FPGAs consist of a network of Processing Elements (PE) that are enclosed in specialized IP containers, similar to Linux Containers to support partial reconfiguration. This Network on Chip (NoC) fabric is static for a particular instantiation but can be reconfigured with different resources for a different physical layer implementation. Once dynamic instantiation of Dataflow Graphs is implemented, CHRONOS will enable Radio-as-a-Service (RaaS) and allow for multi-tenant C-RAN much like as seen in contemporary cloud infrastructure.

**Concluding Remarks:**
CHRONOS is the first testbed to be built for research and experimentation on heterogeneous C-RAN architecture. Once completed, the testbed will be made available to the broader research community in academia and industry to test and deploy novel algorithms for future wireless networks.

More importantly, it will create a tremendous opportunity for the students of the College of Engineering and Applied Sciences to participate in cutting edge research and obtain hands-on experience in building large complex systems. The interdisciplinary nature of this testbed will attract students from various backgrounds such as, wireless communication, cloud computing, reconfigurable hardware design and wireless networking. We have already hosted our first group of undergraduates[6] in Summer 2019 under the NSF sponsored Research Experience for Undergraduates (NSF-REU) program to work on extending the preliminary testbed and proof-of-concept for the research problems mentioned above. This is a one of a kind infrastructure and we are all excited and proud to have it at the University at Albany.

Dola Saha, Aveek Dutta, and Hany Elgala are assistant professors in Electrical and Computer Engineering.

More information about this project can be found [here](#).

1. CISCO Visual Networking Index
2. CPRI
3. ETTUS Research USRP N210 SDR
4. ETTUS Research USRP B210 SDR
5. Octoclock-G Synchronizer
6. Undergraduate researchers Nimra Faheem, Travis Cooper, Shalin Alfred, and Ryan Abuasi worked on this NSF sponsored project during Summer 2019.

![Figures 4a and 4b: RF and VLC Waveforms](#)
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Professor and Chair  
Utah State University  
Research Interests: Microbial ecology in engineered and natural systems; fate and transport of engineered nanoparticles and emerging contaminants in aqueous and soil environments; microbial electrochemical cells for CO2 reduction; biochemical conversion of lignocellulosic feedstocks to biofuels: pretreatment, hydrolysis and fermentation; thermochemical conversion of renewable feedstocks to biofuels and bioproducts; proper utilization of industrial and agricultural wastes or by-products for producing value-added commodities through holistic approaches; water reuse and wastewater treatment; bioremediation and biodegradation of organic contaminants in subsurface and groundwater

Yaoze Liu  
Assistant Professor  
Purdue University  
Research Interests: Water resources, hydrology, water quality, green infrastructure, best management practices, land use change, climate change, optimization

Paul Millard  
Professor of Practice  
University of Maryland, College Park  
Research Interests: Biosensor design, fluorescence technology, immune response to infectious disease
Research Facilities

University
Research Center

Light Enabled Systems and Applications NSF ERC
Hany Elgala

This NSF Engineering Research Center is an interdisciplinary, multi-university center developing “Smart Lighting Systems that See and Think.”

Test Bed

CHRONOS: A Cloud based Hybrid RF-Optical Network Over Synchronous Links

College Research Labs

Air Quality Lab
Md Aynul Bari

Albany Lab for Privacy and Security (ALPS)
Pradeep Atrey, Amirreza Masoumzadeh

Breakthrough Interactive Thinking Systems (BITS) Laboratories
Tolga Soyota

Computer Vision and Machine Learning (CVML) Lab
Siwei Lyu, Ming-Ching Chang

Data Management Systems (DMS) Lab
Jeong-Hyon Hwang

Data Mining and Management (DMM) Lab
Petko Bogdanov

decision Making for Ambient INtelligence Environments (IMAgINE) Lab
Daphney-Stavroula Zois

Environmental Process Chemistry Lab
Rixiang Huang

Hydrology and Water Quality Lab
Yaoze Liu

Intelligent Big Data Analytics, Applications, and Systems (IDIAS) Lab
Charalampos Chelmis

Kim’s Research Group
Kyoung-Yeol Kim

Microwave Remote Sensing Lab
Mustafa Aksoy

Mobile Emerging Systems and Application (MESA) Lab
Aveek Dutta, Dola Saha

Robotics Manipulation Lab
Weifu Wang

Robotics, Algorithm and Computable Systems (RACS) Laboratory
Chinwe Ekenna

Sahebi’s Lab
Shaghayegh Sahebi

Signals and Networks (SINE) Lab
Hany Elgala

Software Engineering Research Lab
Mei-Hwa Chen

Sustainable Design Lab
Yanna Liang

Ubiquitous Networking Laboratory (UbiNET)
Mariya Zheleva
In case you missed it

Selected Media Highlights

WATCH

Siwei Lyu on Full Measure News with Sharyl Attkisson leads us down a fascinating and frightening look into the world of Deepfakes. Video and Transcript.

Daphney-Stavroula Zois and Charalampos Chelmis discuss Instagram’s plan to use AI to detect cyberbullying. Watch on WNYT Channel 13.

READ

Hany Elgala on Ask the Experts, City and State New York How should the MTA update its signal technology?

Siwei Lyu in The Conversation Detection and Protection against DeepFakes

LISTEN

Engineering Faculty Line-up on WAMC’s The Academic Minute

Pradeep Atrey on Battling Fake News on Social Media

Md. Aynul Bari on Air Pollution in the Home

Siwei Lyu on Detecting DeepFake Videos

Mariya Zheleva discusses whether or not the radio spectrum is a finite resource

Tolga Soyata discusses better communication for those who can't speak or type.
Acknowledgments

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