JUNE 2019 - AUGUST 2022

IMPACT REPORT

A TIME OF GROWTH

Center for Information Technology Research
in the Interest of Society and the Banatao Institute
University of California, Merced

CITRIS AND THE BANATAO INSTITUTE

UCMERCED

Future UC Merced students visit from Alpaugh-Allensworth climate change program.

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UNIVERSITY OF CALIFORNIA
MERCED

CONTENTS

a time of growth

WELCOME

from the CITRIS UC Merced Director

Many of our greatest successes have been about developing and using technology to solve the greatest societal challenges in the region, state, and world. The mission of CITRIS and the Banatao Institute is no different: we leverage human ingenuity and insights from technology to address many of the most pressing problems we face as a society. We tackle global climate change, resource sustainability, and human well-being. While tech-forward, our approach is human-centered. It is for this reason that we celebrate and amplify the successes not only of our impact on the development and application of technologies, but also – and more importantly – our impact on people, our communities, and our region. This is “tech for social good.”

As the global COVID-19 pandemic has laid bare, our global village is challenged by many complex and interconnected currents, all needing an informed, collective response. We believe that our approach to problem solving at UC Merced is precisely how best to meet these societal challenges. In the following pages, we document how our faculty, staff and students have responded to pressing problems in our community and region, emphasizing the strength of diverse perspectives in problem solving. We show how we change the face of technology and in so doing make for more a more effective and meaningful tech for social good.

With **NexTech Robotics** and our new drone program dubbed **FLY CITRIS**, UC Merced undergraduate engineering students served 600 San Joaquin Valley students with innovative and fun tech interventions.

With **CITRIS Seed Funds**, we helped fire evacuees escape safely and reduce wildfire risk. With strategic partnerships, forged new ground in the digital transformation of precision food systems, engineering of more sustainable coupled energy-water solutions, and rapid decarbonatization of our regional economy.

As part of the Project 2020 campus buildout, CITRIS and the Banatao Institute at UC Merced has occupied new space in the Sustainability Research and Engineering building. We are excited that post-pandemic, every chair is filled with creative undergraduate student interns and fresh, enterprising staff. We look forward to having you visit us soon to see how we've grown and to meet our team.

As CITRIS as an organization celebrated 25 Years as a UC Institute of Science and Innovation, UC Merced welcomed over 9,000 students, a new record since its opening in 2005. At the same, CITRIS at UC Merced has successfully scaled tech innovation and workforce development for broad regional impact. Thank you for taking the time to learn about CITRIS UC Merced.

Sincerely,

Joshua H. Viers, PhD
Director

Dr. Joshua (Josh) Viers is a Professor of Water Resources Management in the School of Engineering at UC Merced where he also serves as the Associate Dean for Research and campus director of CITRIS. Josh has led UC Merced's efforts to build an Experimental Smart Farm, to develop a joint industry-university consortium on ag-food-tech research, and to convene universities in developing water accounting methods to secure a climate-resilient water future. With Secure Water Future, Josh currently leads a team of over 40 transdisciplinary researchers and stakeholders who are interrogating water management practices to arrive at a climate-resilient future in water-scarce regions of the United States. His decade of service to CITRIS has been marked by millions of dollars of extramural funding and new programs to elevate student experiences.

ADAPTIVE & AGILE RESEARCH

CITRIS Seed Funding

CITRIS Seed Funding has spurred the ingenuity of University of California innovators to respond to emerging research topics and societal issues, including the COVID-19 pandemic. CITRIS UC Merced supports faculty in pursuing these funds by building collaborations, reviewing proposals, and following up with communications support. UC Merced faculty have increased success in accessing this pool through their creative innovations, illustrating UC Merced's research strength. Awards have led to additional extramural funding from NSF, USDA and other state and federal sources. Through interdisciplinary collaborations, seed funds foster growth across the CITRIS campuses and jumpstart society's next tech solution. Seed funds are designed to support the groundwork, data collection and prototyping needed to pursue larger awards that address major unsolved challenges in the IT sector. Prior awardees have attracted significant funding from federal, state, private and philanthropic sources.

COVID 19 Seed Funds spurred innovation and response to pandemic

In March 2020, to respond to COVID-19, CITRIS issued a special call requesting proposals for novel technology research designed to mitigate impacts of the pandemic and rapidly address the pandemic.

"Integrated Quantitative Microbial Risk Assessment and Geospatial Analysis of SARS-CoV-2 in Wastewater for Vulnerable Populations"
Researchers: Colleen Naughton, UC Merced and Maureen Kinyua, UC Davis

The COVID-19 pandemic has fundamentally changed our daily lives and how we assess risk from person-to-person contact and contaminated surfaces. But what about our wastewater? Much of the SARS-CoV-2 related research has focused on aerosols and contaminated surfaces with less risk quantification related to the water and sanitation sector. SARS-CoV-2 has been detected in wastewater across the globe and previous coronaviruses have been found infective in wastewater. Thus, our research will utilize information technology to quantify the associated risk of SARS-CoV-2 infection for wastewater treatment operators and neighboring communities. We will integrate Quantitative Microbial Risk Assessment (QMRA) and geospatial analysis to create a vulnerability map of 38 wastewater treatment plants in the Bay Area. The methods developed in and results from this research will have local and global implications to inform and protect vulnerable populations. Our project utilizes information technology to serve society, aligning with the CITRIS mission and health, sustainable infrastructures, and policy lab interest areas.

In addition to this excellent research program, Dr. Naughton leveraged a COVID-19 wastewater data center, a joint Center of Excellence for testing wastewater, and conducting Healthy Central Valley Together research. NSF-funded Converging COVID-19 Conference: Environment, Health and Equity over 6 weeks online shared important emergent research; CITRIS intern and Psychology student '24 Miriam Saraya Martinez also completed the certificate program from the conference.

"A Multicampus Infrastructure to Advance Telehealth Implementation for Low-Income Californians in Response to COVID-19"
Researchers: Hector Rodriguez, UC Berkeley, Denise Payan, UC Merced, and Lorena Garcia, UC Davis

On March 6, the President signed H.R. 6074, or the Coronavirus Preparedness and Response Supplemental Appropriations Act, 2020. This bill grants $8.3 billion to address COVID-19 and permits the Secretary of Health and Human Services to allow the patient's home to be an originating site of care. COVID-19 and H.R. 6074 provide substantial incentives for Federally qualified health centers (FQHCs), which care for low-income Californians, to transition from face-to-face visits to telehealth encounters for chronic care management. FQHCs, however, have historically lagged in their adoption of telehealth due to technological constraints; innovation is needed to improve the implementation and impact of telehealth for low-income patients. The proposed project builds a multi-campus research data infrastructure for tracking telehealth utilization among California's FQHCs and integrates these data with electronic health record (EHR) data to examine the impact of telehealth implementation on clinical outcomes. The resulting integrated dataset will serve as the foundation for a diverse set of natural experiments examining the impact of COVID-19 and the transition to telehealth utilization on health outcomes for low-income Californians with chronic conditions.

"Developing a mobile, low-cost, scalable, variable output ozone generator for different sanitization applications"
Researcher: Reza Ehsani, UC Merced

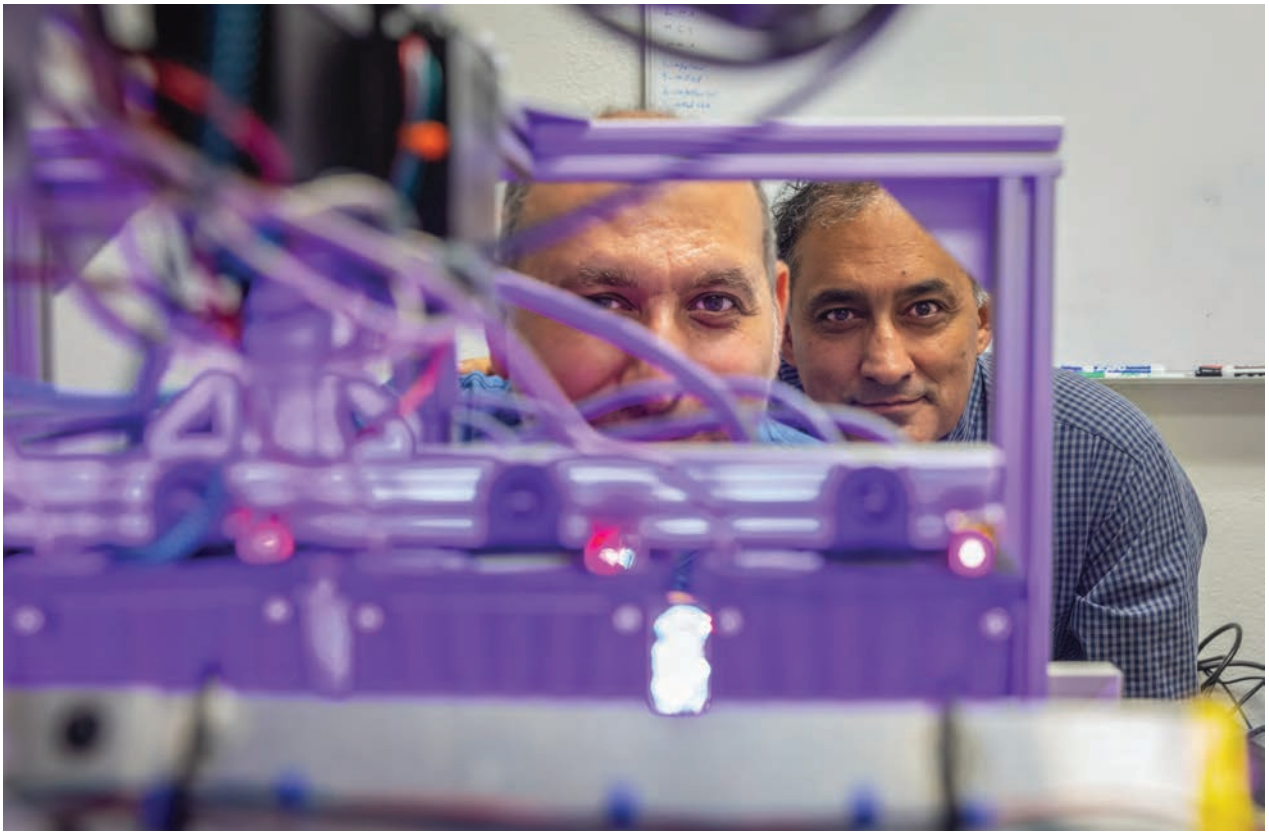
The World Health Organization has declared the novel coronavirus (COVID-19) outbreak a global pandemic. The best method of managing the pandemic is to decrease the rate of infected patients, requiring extreme measures in sanitization. Current sanitization practices

that use chemical sanitizers or UV light have limitations. Ozone is a colorless gas that can be used as a sanitizing agent and has several advantages; however, the commercially available ozone generators are not designed for sanitizing applications. In this project, we will design and fabricate a new, portable, low-cost ozone production system. It will be compact, mobile, scalable, and user-friendly. Unlike conventional ozone generators, this new system will allow the user to adjust the concentration of ozone output, providing more flexibility so that it can be used for sanitizing small or larger indoor areas. It can also be used in agriculture and food production systems. The proposed system can be built in three months and can be mass produced in a small shop using off-the-shelf materials.

"Development of sensor platforms for rapid COVID-19 antibody detection"

Researchers: Wei-Chun Chin, Changqing Li, Jennifer Lu, UC Merced

The most critical question our nation (or almost the whole world) faces now is when we can return to work and resume our normal activities after stay-at-home orders and social distancing. COVID-19 antibody tests have been identified to have the potential to play a role in this complex "reopening" evaluation. Currently there are limited rapid COVID-19 antibody tests available. In this seed project, we aim to build COVID-19 antibody sensor platforms that are based on graphene and carbon nanotubes with very fast response time (within seconds) at very low cost. The proposed sensor is easily scaled up for mass production



and has direct electrical read-outs without complex solution rinsing like in conventional immunological testing kits. We are developing business connections to launch our own start-up. The results from this seed grant will expedite our collaborations with potential business partners to further develop and commercialize our COVID-19 antibody testing platform.

CITRIS Core Seed Funding

The CITRIS Core Seed Funding program supports nascent ideas in information technology led by University of California researchers while fostering collaboration across campuses. Early career and interdisciplinary teams are highly valued. Funding is typically $60,000 for interdisciplinary work that can lead to larger research programs and extramural grant proposals with results within a year.

2019

Automatic building fault detection and diagnostic system using smartphones
Principal Investigators: Alberto Cerpa (UC Merced), Avideh Zakhor (UC Berkeley)

Researchers will build a smartphone app whereby commercial-of-the-shelf (COTS) sensors are added to a mobile phone that can be used by facilities' crews to detect and diagnose problems.

2020

The 2020 Core Seed Fund received 68 proposals and awarded seven teams. Three awards supported UC Merced faculty in the areas of Health, Future of Work and Women in Tech.

"Data-Driven Fall Prevention and Intervention for Older Adults"
PIs: JoAnn Seibles (UC Davis Health), Wan Du (UC Merced), Shijia Pan (UC Merced)

Preventing falls among older adults is an important issue for these individuals, as well as their families and caregivers. Although organizations have started offering fall-prevention programs, participation remains low. For example, over the last 10 years, participation in the Healthy Aging Association's (HAA) Young-At-Heart (YAH) balance training in Stanislaus County, CA, has increased at a lower rate than the increase of its senior population. This project will design, implement, and test a system using Internet of Things (IoT) technology that can assess the fall risk of older adults by passively measuring a set of fall risk factors. The performance of the system will be validated in HAA YAH classes. The research findings are important for improving the well-being of older adults and reduce the social cost of fall treatments.

"Platforms and the Future of Work in Digitized Agriculture"
PIs: Martin Kenney (UC Davis), M. Anne Visser (UC Davis), John Zysman (UC Berkeley), Catherine Keske (UC Merced)

As intelligent tools and systems are adopted in agriculture, California agriculturalists and workers will need to adapt and adjust. Data sharing can be used to create value by increasing transparency, traceability, and productivity. These benefits are predicated upon platform adoption. The conundrum is that, as the intermediary, the platform owner acquires significant power. This research examines five forms of platform organization and their benefits and drawbacks for actors in the agri-food system, farmers. The types discussed are 1) startups, 2) agrifood industry firms, 3) agricultural cooperatives, 4) specially formed consortia of agri-food system actors, and 5) internet companies such as Google. The project will analyze the business models for each, assess likelihood of adoption, and effect on farmers and their practices.

"The Impact of Shared Values and Power on Successful Mentoring for Under-Represented Minorities in STEM"
PIs: Sarah McCullough (UC Davis), Erin Hestir (UC Merced), Anita Balaraman (UC Berkeley)

A chasm often lies between what is taught in the classroom and what students need to be successful. Mentorship provides a vehicle for raising greater expectations by students and gauging whether a student is prepared to be successful in post-graduate academic endeavors or in the world of work.

Unfortunately, mentorship remains a hidden pedagogy in undergraduate and graduate education, and beyond. This project aims to study the characteristics of mentoring programs that benefit historically underrepresented minorities in STEM and increase their retention and continuation in STEM fields. The program will study the impact of a digital mentorship program, enabling mentees to gain professional development skills and garner career advice during COVID-19 given social distancing requirements and across geographic barriers. This work will be presented at the University of New Mexico Mentoring Institute conference in Oct. 2022.

2021

Through the 2021 Seed Fund, **"grand challenges in information technology,"** UC Merced earned 3 of 13 awards focused on prevention of fire in structures, adaptation to fire evacuations, and optimal electrification of farm equipment.

Electric tractors: Identifying paths to clean energy in farming operations
Principal Investigators: Ricardo Pinto de Castro (Lead PI, UC Merced), Reza Ehsani (UC Merced), Stavros Vougioukas (UC Davis)

Almost all agricultural vehicles in current use rely on fossil fuels, one of the main sources of air pollutants. Electrification is a long-term solution

to this problem, but to date, electric tractors have cost more, required more infrastructure, and worked fewer hours per charge than their diesel counterparts. This project will develop a tool to help farm managers determine when to deploy the electric and diesel tractors in their fleets. This decision tool relies on data collected from the farm, such as acreage, crop types, soil, and weather patterns, to compute overall power requirements for the fleet. Optimization techniques will help characterize an ideal balance between technical performance, economic costs, and air pollution. The resulting information can help stakeholders in agriculture develop electrification strategies and ultimately create more sustainable systems.

Developing resilient materials and sensors for improved building performance

Principal Investigators: Lilian Davila (Lead PI, UC Merced), Jeanette Cobian-Iñiguez (UC Merced), Scott Moura (UC Berkeley)

Climate change is increasingly affecting communities around the world through more intense and frequent wildfires, extensive flooding, and other natural disasters. This project will design, fabricate and test new eco-friendly, fire-resistant construction materials, as well as low-cost, integrated environmental sensors to measure their performance. The design process will inform the future development, testing and implementation of similar building materials and monitoring devices while also promoting sustainable materials and reuse of industry waste. If the materials generated by this project prove to be fire-resistant, thermally insulating and structurally robust, they could establish a path away from steel, a key construction component that greatly contributes to carbon dioxide emissions.

Virtual evacuation decision-making under fire threat for personal property and transportation decisions

Principal Investigators: Spencer Castro (Lead PI, UC Merced), Sri Kurniawan (UC Santa Cruz)

Given the devastating breadth of wildfires across 12 states in 2020, and the increasing prevalence of fires in locations with historically lower danger, more people are being exposed to fires at the wildland-urban interface (WUI). Many people in these locations are unaware of the dangers of wildfires and unprepared to evacuate their homes. This project plans to develop a platform for public fire training through immersive virtual environments for greater accessibility and evacuation decision-making under time pressure. The platform will help determine which sensory metrics best predict performance for these types of decisions and accurately represent real-time cognition. This technology will help civilians evacuate their homes more efficiently and, ultimately, help save lives.

INSPIRING

INDUSTRY PARTNERSHIPS

To foster collaborations with innovators in the private sector and inspire the next generation of tech innovators, CITRIS hosts speakers through online and in-person fora. The result is that faculty have stronger research programs and collaborations and that research has entrepreneurial grounding and better serves societal needs.

Frontiers in Technology Speaker Series

In partnership with the Electrical Engineering Graduate Group and CITRIS Frontiers in Technology Distinguished Speaker Series is intended to launch new ideas and collaborations. Featuring visionary technopreneurs addressing space junk and Moore's Law, FIT brings campus and the tech sector together through day-long engagements with faculty and students and inspiring presentations with audience attendance over 100 people. It is an excellent opportunity for computer science students and campus to learn about CITRIS and careers in the tech sector.

2019

Matthew Lange, UC Davis
Food informatics

Associate Director of the UC Davis Initiative for Wireless Health and Wellness, Dr. Lange is leading efforts to build the semantic and ontological underpinnings for the emerging Semantic Web and Internet of Food.

2020

Julie Baker, URSA Space Systems
Unleashing the power of Synthetic Aperture Radar (SAR) for Commercial Applications

Julie holds a master's in computer science from Stanford University. In2014, Julie co-founded Ursa Space Systems to connect information-rich satellite data with critical decision makers around the globe. She is passionate about harnessing the power of satellite data to solve some of the world's hardest problems and to help customers get the answers they need. She has 30 years of experience in the software industry, including 15 years in engineering and technical management.

Baker delivered a technical talk on the formation of her company, Ursa Space Systems, and how it leverages the largest Synthetic Aperture Radar (SAR) satellite network to gather data and directly measure natural and built systems. She will discuss why a virtual constellation of SAR satellites is needed and how the company develops applications.

Melba Crawford, Purdue University

Multi-modality Remote Sensing Data Acquisition and Analysis for High Throughput Phenotyping in Agriculture

Dr. Melba Crawford is the Nancy Uridil and Francis Bossu Professor of Civil Engineering at Purdue University. Her research interests focus on advanced methods for image analysis: dimensionality reduction, active learning, deep learning for classification and prediction, and applications of these methods to hyperspectral and LIDAR data for agriculture and natural resource mapping and monitoring. Crawford is a Fellow of the IEEE, Past President of the IEEE Geoscience and Remote Sensing Society, an IEEE GRSS Distinguished Lecturer, and the current Treasurer of the IEEE Technical Activities Board. She was on the NASA Earth System Science and Applications Advisory Committee, Nasa EO-1 Science Validation team, and advisory committee to the NASA SEDAC.

Sensing technologies are rapidly gaining popularity for field-based high throughput phenotyping applications. In addition to direct measurements of traditional phenotypes, these sensors potentially provide surrogate measurements for plant structural characteristics and chemistry. Opportunities and challenges associated with acquisition, processing, and analysis of high resolution RGB, VNIR hyperspectral data, and discrete return LiDAR data acquired from UAVs by Purdue University for row crop mapping and monitoring will be discussed. Results from multi-modality, multi-temporal predictive modeling of complex phenotypes such as biomass using data driven machine learning approaches will be presented. Opportunities and hurdles to generalization of predictive models across geographic areas and time periods were discussed.

Joel Kimmelshue, Land IQ

Agricultural Land Classification and Crop Water Use – The Importance of Ground Truthing for Calibration and Validation

Dr. Kimmelshue is a founding partner and Principal Soil & Agricultural Scientist with Land IQ. He holds a Ph.D. in Soil Science with a concentration in Water Resources from North Carolina State University in addition to his certification as a Professional Soil Scientist (CPSS). He has over 22 years of consulting experience focusing on practical and applied solutions for the development and management of agricultural-based soil/water/plant systems, especially irrigated systems.

With ever-increasing regulatory requirements, the Sustainable Groundwater Management Program (SGMA), and Central Valley Salinity Alternatives for Long-term Sustainability (CV-SALTS) on production agricultural systems, accurate, timely, and comprehensive base layer data are required. Land IQ has developed a statewide land use mapping program for the California Department of Water Resources (DWR) that implements comprehensive ground truthing efforts for calibrating and validating remotely sensed models for the ultimate classification of all agricultural fields in California. Land IQ integrates its agricultural land use mapping, other lines of evidence, and robust ground truthing (i.e., multiple climate stations) to again calibrate and validate remotely sensed crop consumptive use models. The purpose of this presentation is to introduce the importance of comprehensive ground truthing to ensure accuracy for both the remotely sensed agricultural land use mapping and crop consumed water estimates.

2021: Back on Campus and Connected to the CITRIS Research Exchange

Several nominations and faculty from UC Merced have brought fresh perspectives to the CITRIS Research Exchange, a hybrid seminar format that is in-person at Cal and streamed to UC Merced for interactive conversations on campus. Professors and students participated in our on-campus events. All Research Exchanges are online on CITRIS YouTube. In 2021, we covered climate change, health tech and inclusivity.

Dr. Shijia Pan, Assistant Professor, Computer Science and Engineering, UC Merced
"Sense for Less: Physical Informed Cyber-Physical Systems Adaptation for Device-Free Human Monitoring"

Dr. Margaret Burnett, Professor, Electrical Engineering and Computer Science, Oregon State University
"Doing Inclusive Design: From GenderMAG to InclusiveMAG"

Dr. Ahmed Sabbir Arif, Assistant Professor, Computer Science and Engineering, UC Merced
"What if computers could read our lips? Silent Speech as an active mode of interaction with computer systems"

Dr. Laurel Larsen, Delta Lead Scientist, Delta Stewardship Council
"The Drought Cascade: Linking changes in climate extremes to changes in watershed function"

Another fun gathering was a celebration of the Landsat 9 Launch at the Vandenburg Space Force Base with live-streamed commentary by Dr. Erin Hestir who was on-site. The live stream of the NASA broadcast of the first Land-Observing Satellite Launch since 2013 was attended by many graduate and undergraduate students and staff who rely on Landsat data to conduct research on agriculture, water resources, invasive species, wildfire impacts, and biodiversity.

2022

Dr. Murali Annavaram, Professor, University of Southern California
Training Machine Learning models with private data on untrusted hardware.

The presentation covered DarKnight, a framework for large DNN training while protecting input privacy, and computation integrity, ML training challenges in the cloud: namely, stragglers and Byzantine nodes. The conclusion covered thoughts on ML privacy and security going forward.

Dr. Gabe Loh, Senior Fellow, Advanced Micro Devices
The motivation for chiplets & their adoption in AMD Processors

This presentation focused on the industry's shift in response to Moore's Law and chip technologies. Industry is now seeing a trend toward reversing direction on the traditional march toward more integration. Instead, multiple industry and academic groups are advocating that systems on chips (SoCs) be "disintegrated" into multiple smaller "chiplets."

CLIMATE CHANGE RESILIENCY *through*

AGRIFOOD TECHNOLOGY

The greatest challenge of our time is addressing and adapting to climate change, while continuing to produce food. CITRIS Research in Ag Food Tech, also known as CRAFT, began as a day-long event exhibiting new tech innovations and campus research that has grown into one of the campuses greatest strengths. Thanks to the support and innovation of our CRAFT Executive Roundtable, new facilities, infrastructure, and programs have successfully launched to bring together the agricultural lifeblood of the Central Valley and tech of the future to feed 10 billion people in a warming climate.

CITRIS helps build the Farm of the Future: UC Merced Experimental Smart Farm

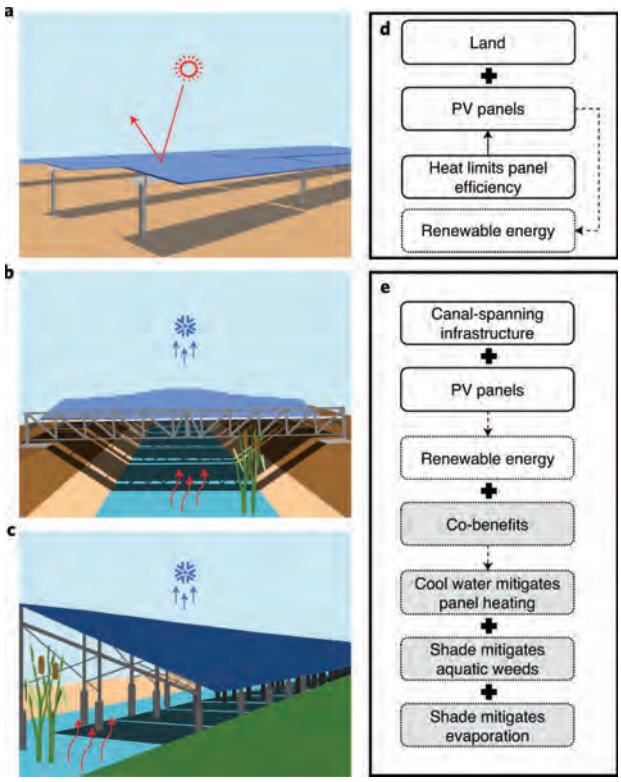
In need of a testbed for agrifood technology research, CITRIS supported the establishment of the UC Merced Experimental Smart Farm. Through scoping and planning with campus partners, the 40 acres on campus will serve as a locus of innovation and collaboration for campus faculty, a core asset in research proposals and a microcosm of agriculture in the Central Valley today and what it could be in the future.

In February 2022, UC Merced undergraduate students broke ground to collect the first soil samples. Under the direction of Dr. Rebecca Ryals, the agroecology students analyzed the current composition and quality of the soil before it is affected by planting of crops and experiments.

At the southwest edge of campus, visible from the Sustainability Research and Engineering building, 40 acres will eventually flourish with crops for research and food for the campus community. CITRIS supported the planning effort with partners at the Sierra Nevada Research Institute. CITRIS conducted faculty and staff focus groups to identify priorities to develop the "UC Merced Experimental Farm Visioning Sessions Synopsis," and CITRIS Aviation supported aerial imaging of the farm.

The new space will serve multiple purposes from undergraduate education to high-tech research to community engagement. In 2022, Danny Royer joined UC Merced as the first farm manager. And a design team is creating visual identity for the farm. The farm would not have been possible without the support of CRAFT Executive Roundtable members, community members, industrial innovators, and cross-campus collaborations.

Ag-Food-Tech Research Programs



The greatest successes in extramural funding and timely research were in the areas of Ag-Food-Tech. Innovative partnerships with world-class universities and agricultural industry as well as community organizations supported growth on campus and in the region. CITRIS supported development, contributed directly, or actively coordinates research and outreach of several ag-related programs, including:

- UC Multicampus Research Program, Labor and Automation in California Agriculture,
- NSF and USDA AgAID: AI Institute for Transforming Workforce & Decision Support,
- USDA NIFA Secure Water Future: Securing a climate resilient water future for agriculture and ecosystems through innovation in measurement, management, and markets,
- California Department of Food and Agriculture "Economic Impacts of the 2021 Drought to California Agriculture" research.

Several UC Merced researchers also contribute to the NSF Engineering Research Center Internet of Things for Agriculture (IoT4Ag.us), a consortium of precision agriculture experts.

At the nexus of food, energy and water research, there is often a role for technology. The need for tech solutions in agriculture grows as the complexity of challenges increases, such as supply

chains, new regulation, and climate change. UC Merced meets this need through interdisciplinary research with surprising results and the unique follow through with decision-makers to ensure the utility of the research.

CITRIS helps to jumpstart new research areas by convening experts and practitioners and gathering data around a topic. Dr. Sarah Kurtz hosted the "What do we do with our biogas workshop" in 2019, spurring collaboration with energy groups and city managers seeking sustainable infrastructure means of turning waste to energy.

In 2021, Dr. Brandi McKuin led a study published in Nature Sustainability titled "Energy and water co-benefits from covering canals with solar panels." In 2022, a partnership with Turlock Irrigation District is leading to the first experiment of its kind to see if the co-locating of energy and water infrastructure leads to savings for both natural resources.

AgBag: A brown bag collaborative seminar and discussion on ag-food-tech

AgAID AI Institute for Transforming Workforce & Decision Support

CRAFT

CITRIS Research on Ag Food Tech (CRAFT) led to a recognition of the need to connect industry partners, faculty from other campuses and UC Merced faculty and research staff around emerging topics in agricultural technology. Through partnerships with the agricultural research organizations on campus, namely the IoT4Ag Engineering Research Center, AgAID and LACA programs, CITRIS hosted online, hybrid, and in-person events to cultivate new research ideas and partnerships. These short informal lectures and discussions were held during the lunch hour and led to research collaborations. Attendees were typically staff and faculty, but undergraduate

and graduate students also participated, as well as colleagues from the home institution or the hosting project. Attendance ranged from 15-60 participants for each session.

2021

Curran Hughes, Renegade Plastics
Eliminating agricultural and industrial plastic waste & Introducing the Ag Airdome, a novel tool for greenhouse research

Curran Hughes is a UC Davis grad and is bringing his new technology for controlled environments and low-cost growing spaces to UC Merced. He shares experiences Danone, Talus and Wonderful Orchards to help us with the design of our UCM Experimental Smart Farm and think about structuring our experiments on campus.

Robbie Weathers, Product Manager at Granular
Emerging questions in data-driven decision-making for agriculture: Crop consultant conversation

As technology expands the capacity of growers to gather data about their management, we must ask questions about what the right kids of data are, who owns the data, and how it is most helpful for the user. Weathers works at the intersection of the field, farmer, and interface for data and in this talk we explored how that information must be balanced to serve the end goals of the grower and sustainability.

Dr. Elia Scudiero, Professor of Environmental Sciences, UC Riverside
Enabling precision agronomy through soil and plan near-ground and remote sensing across scales

Water scarcity and environmental degradation associated with intensive agriculture are threatening the environmental, economic, and social sustainability of food production in water-scarce farmlands in the US Southwest. Improvements to current irrigation practices must be made to help sustain agricultural systems in the long term. Spatio-temporal variability of plant-soil interactions often results in remarkable within-field crop yield variation. This talk will feature research on the use of field measurements, near-ground and remote sensing, and spatiotemporal multi-scale (field to the regional scale) data analysis for i) mapping and monitoring soil and plant properties, ii) understanding soil-plant interactions, and iii) enabling precision agronomic management. Finally, an overview of Dr. Scudiero's USDA-NIFA Sustainable Agricultural System project on Artificial Intelligence for Sustainable Water, Nutrient, Salinity, and Pest Management in the Western U.S. will be provided.

Dr. Martin Kenney, Distinguished Professor & Dr. Anne Visser, Associate Professor, UC Davis
Digitalization and Platformization in Agriculture: The UC Davis LACA Team Agenda

Automation, digitization, and platformization continue to impact and reshape CA agriculture presenting new opportunities and quandaries for the industry and its workers. In our presentation we review our research related to these issues. We will discuss our initial findings across the following four areas: 1) the increasing Digitization of the Combine Harvester and its impact on farming practices and labor processes; 2) Digitization of the Strawberry Value Chain and why strawberry harvesting has been so resistant to automation, 3) COVID- 19s Impact on Labor and Value Chains in the Agrifood Industry, and 4) Challenges of the Digital Agricultural Revolution from an International Perspective. Together these projects speak to major challenges and issues facing business actors, workers, and policymakers engaged in agriculture at the local, state, national and international scale.

2022

Luca Brillante, Bronco Wine Co. Chair & Professor, Fresno State University
Precision and digital viticulture at Fresno State

This talk is an overview of past and current activity in precision and digital viticulture, organized in two parts: i) spatial variability of grapevine physiology and the effect of the environment, ii) development of sensing and modeling approaches to monitor and predict grapevine status in space and time. The first part will discuss grapevine physiology and grape composition variability at the field scale and the primary environmental drivers. The second part will describe methods to characterize grapevine variability, including imaging and quantifying grapevine water absorption through geophysical means, the use of machine-learning models to predict grapevine water status, and current projects on using hyperspectral imaging to assess grapevine health.

David Zilberman, Professor of Agriculture and Resource Economics, UC Berkeley
Innovation and Supply Chains in Agriculture

This seminar highlights the importance of studying technological change within the context of multi-stage supply chains, relying on findings from economics, engineering, and other disciplines. It emphasizes that markets, firms, and products are the endogenous outcomes of innovation and product supply chains. Government regulations of markets must balance the incentive for innovation with the consequences of excessive market power. We argue that more attention to supply chain design and function will improve efforts to mitigate climate change and address food security and health challenges.

Down on the Farm podcasts

Listen to what's new or old in agriculture with farmer emeritus T.D. Willey in the Down on the Farm podcasts featuring two of UC Merced's agriculture aficionados.

APRIL 3: REBECCA RYALS, AND MARIN CARBON PROJECT

Surpassing 1850's scientific understanding, poet Walt Whitman heralded soil's transformation of sickness and death into health and new life. Catching up with the bard, UC Merced ecosystem scientist Rebecca Ryals pioneers turning every sort of organic waste into black gold. Novel research with the Marin Carbon Project.

MAY 7: WATERSHED SCIENTIST JOSHUA VIERS

As our San Joaquin Valley confronts its first drought under Sustainable Groundwater Management Act rules, just pulling harder on deep wells isn't an option anymore. UC Merced watershed scientist Joshua Viers encores on "Down on the Farm" to critique proposed infrastructure techno-fixes vs. reimagining an agriculture that will reap more value from less production. Several collaborative stakeholders grapple with action plans but could consensus ever emerge?

ROBOTICS AND COMPUTER SCIENCE

TECH INSPIRATION:

Hands-on outreach to ignite the next generation of tech innovators

NexTech Robotics

CITRIS engages with middle school students throughout our region by placing near-peer UC Merced students into classrooms to build and code robots. Using a STEM based curriculum, our team has inspired over 3000 students since 2016.

Started by and led by UC Merced engineering undergraduates, NexTech Robotics delivers high quality and hands-on programming to Merced area middle school students. The flagship outreach program persisted through the pandemic, serving students online and providing students with kits to take home when they weren't on a middle school campus. In 2021, full in-person engagement returned to Hoover Middle School. CITRIS NexTech Educator interns went above and beyond to customize the programming to students advancing their skills in tech, introducing 3D visualization and design of objects, and introducing a versatile computer language, empowering students through Python.

In 2022, the NexTech educators built a whole new program called FLY CITRIS, focusing on drones. Check out the Aviation section to learn more. With support from CITRIS, Siemens and AgAID: AI Institute for Transforming Workforce & Decision Support, NexTech reached more young people to explore technology and STEM careers with new computers, new kits, and more range in travel.

NexTech and FLY engaged incoming first-year and transfer students at the 2022 Bobcat Day event on campus!

Watch NexTech Robotics in action: **https://www.youtube.com/watch?v=7Y_GBjRHZ6E**

NSF Computer Science for All: START UP SJV

Teacher development in computer science can affect thousands of students compared to direct student engagement. That's why CITRIS UC Merced supported Dr. Angelo Kyrilov, computer science and engineering faculty, and Dr. Chelsea Arnold, Director of the CalTeach teacher prep program, to earn NSF funding for START UP SJV: STEM Teachers Alliance for Regional Tech thinking through Underrepresented Professional development in the San Joaquin Valley. The goal of the proposed project is to create a self-sustaining and scalable professional development program to support pre-service and in-service high school teachers in Merced and environs who teach Computer Science. The START UP SJV program aims to help teachers improve their own computer programming and computational thinking skills, so that they can better teach their students. Access to Computer Science education is severely limited, with only 3 of the 9 local high schools offering AP Computer Science classes; student success rates on the AP exams remain low. The START UP SJV project relies on an online and supported educational and engagement platform called Compass, built by Dr. Kyrilov, to leverage existing tools and curriculum from campus, and set up the materials with accompanying exercises on our online Compass educational platform. To provide real-time support on the system, advanced Computer Science Engineering undergraduate students from UC Merced who earn course credit, answer participant's questions, and provide overall guidance and support.






Pilot Program: Tech for Social Good

In Spring 2020 we partnered with **Merced County Food Bank** to harness the creativity and coding skills of UC Merced and Merced College students for social good. Student teams aimed to organize data around food storage and delivery, moving from a manager with a pencil to a forklift with integrated data systems. One team completed the challenge and presented at Innovate to Grow and executive director of the Food Bank. Interrupted by the pandemic, CITRIS is offering tech training and design programs in future TSG events. Tech for Social Good is run as a machine learning education program called TensorFlow for Social Good Fall 2022, led by UC Merced students for their peers from all majors.

Learn more: citris.ucmerced.edu/tsg

CITRIS AVIATION & REMOTE SENSING

BioSCape: NASA's First Biodiversity Field Campaign

Through cross-disciplinary research, the US National Aeronautics and Space Administration (NASA) is conducting its first biodiversity field campaign by assembling airborne imaging spectroscopy, lidar, and field observations of a critical and highly diverse area of the world, the South African Greater Cape Floristic Region's coastal and marine environments. Dr. Erin Hestir co-directs the program that is designed to engage scholars from South Africa and to improve understanding of the distribution and abundance of biodiversity, the role of biodiversity in ecosystem function, and the impacts of biodiversity change on ecosystem services.

Learn more: https://www.bioscape.io/

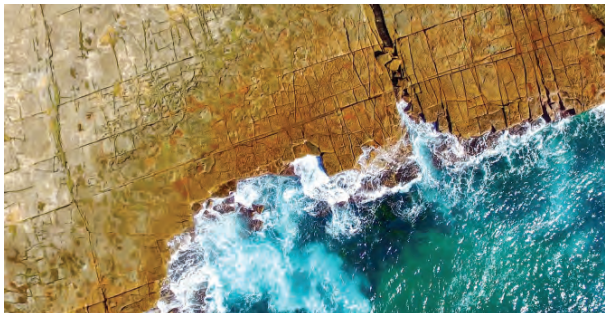
NASA Kelp Fire program tracks wildfire impacts to coasts and trains diverse students

Over four years a team of geospatial experts at Nasa Jet Propulsion Laboratory, Woods Hole Oceanographic Institute, UCLA and led by Dr. Erin Hestir and colleagues at UC Merced will train the next generation of diverse NASA innovators and advance understanding and forecasting of wildfire on the California coast. Funded by NASA MUREP "Minority University Research and Education Project," the program studies how coastal wildfires delivers sediments and carbon into the ocean ecosystems, including National Marine Sanctuaries and the unique kelp-based ecosystems. For UC Merced students conducting remote sensing research this is a once-in-a-lifetime opportunity to intern with JPL and build their science career.

Learn more: citris.ucmerced.edu/kelpfire

The related research of wildfire impacts on reservoirs was featured in an original comic by Psychology major and artist, Miriam Martinez, featuring Brittany Lopez Barreto and Dr. Erin Hestir in "The Adventures of CITRIS Scientists: Superpowered scientists and satellites show California wildfire and water impacts."

AquaWatch California



UC Merced and UC Davis are teaming up with CSIRO Australia to join an international constellation of space and ground sensor systems integrated into a near-real time space – based IoT system to delivery timely water information to those that need it most. The quality of freshwater resources is a concern shared by humanity across the world, vital to preserving agriculture, landscapes, and our communities. Using California as a key pilot site for development, UC Merced is leading research that will inform sensor development and data integration from ground-based sensors, spaced based sensors, advanced analytics, and predictive modeling to delivery decision ready information to end-users.

UC Merced Extension: Bringing UC expertise to train professionals

Dr. Erin Hestir and PhD candidate Christiana Ade offered upskill training to ten water management professionals with the Delta Stewardship Council. The two-day program covered Google Earth Engine, Geographical Information Systems, image processing and spatial analysis. The program started in 2019 generated revenue for the faculty educator and campus.

Starting in 2018, CITRIS Aviation offered training in Unmanned Aerial Vehicles (UAV or drone) Safety, mission planning and data analysis. In 2019, through an 8-hour course, participants were prepared for passing their 107 flight exam and pursuing commercial drone pilot certification.

FLY CITRIS:
Drone Education Program

The human desire to release from the earth and soar through the skies is universal. Drones offer that lightness while serving as a gateway technology.

FLY CITRIS inspires students to take flight, bringing UC Merced engineering undergraduates to campuses and community events in the Central Valley. The near-peer mentors show participants that they can be pilots and continue in higher education. Children of all ages (even preschoolers) can manually fly the drones through an obstacle course or program the drones to do tricks in a sequence with Python code and a bluetooth connection.

Teamwork, spatial and three-dimensional thinking, mission planning, production of images and video, and solving engineering puzzles are all part of the activities for kids to pursue with the Tello drone kits and DJI minis. CITRIS UC Merced drove the UC Merced Mobi or Mobile Maker Lab in Spring 2022 and were able to buy equipment thanks to Siemens donating to our program.

By offering take home activities, including safe drone flight training, participants can continue their aviation journey and eventually may make their way to UC Merced's labs that use drones for research. Since its start in 2022, CITRIS undergraduate engineering students have served 600 young aviators with drone education programming, and through the CalTeach Bobcat Summer STEM academy on campus, 21 students were able to get a week's worth of high-flying fun.

AgAID
AI Institute for Transforming Workforce & Decision Support

SIEMENS
Ingenuity for life

Associate Director's Letter:

EDGE IN TECH INITIATIVE
UNIVERSITY OF CALIFORNIA™

STRENGTH IN DIVERSITY

Technology has a diversity problem. We know from years of disclosures from the largest corporations in the tech sector and comprehensive reports from the National Academies of Science, Engineering and Medicine that women, black, and Hispanic students and graduates are underrepresented in technology fields. And this has consequences for us all. We need game-changing technologies to address humanity's most pressing problems – climate change, social, health and economic disparities - and inclusive innovation is what will get us there, by delivering more creative solutions with greater utility for even larger and more varied users. Inclusive innovation begins with tech developers who share the varied and diverse lived experiences of humanity. Institutions of higher education play a critical role in transforming the face of technology to better reflect the population at large.

As UC Merced students train to enter and to change the tech sector workforce, we've been able to provide crucial support to our diverse student population. For three years, I'm proud of the work we've done with through **¡Valle! Get Your Start in Tech** because I'm proud of ¡Valle! Students! I regularly hear from our ¡Valle! Alumni, sharing their experience in Ph.D. programs, or their internship with Canon, or their new job at Oracle. Some have told me they wouldn't have even applied without the confidence and skills they gained through ¡Valle! And we couldn't have achieved these successes without funding from Google Research and our partners Merced College and California State University, Stanislaus.

A growing body of data indicate the importance of mentoring for students

of color, a challenge to accomplish during COVID remote learning and increasingly remote workplaces. Our **EDGE in STEM Mentoring program** used an innovative digital platform and mentor training to help students connect with and form deep and effective mentoring relationships based on shared values. Our program illustrates how shared values, and the removal of a power structure can lead to stronger sense-of-belonging in STEM. Bringing undergraduate and graduate students together creates a stronger bridge to continuing education and mentorship for all.

We have been doing a lot to support our students and community, but I know we can do more as we foster relationships with tech training in the community, continue collaborations with Merced College, and grow as a region with the Fresno-Merced Future of Food “just transition” programs for better tech jobs. I look forward to the coming years as these visions become reality and our research and outreach programming helps students change the face of technology!

Erin Hestir, PhD is Associate Professor of Geomatics in the Department of Civil and Environmental Engineering at UC Merced. Since 2021, she has served as CITRIS UC Merced Associate Director, bringing expertise in aviation and drones, biodiversity and water resources remote sensing research, and diversity in STEM programming. Dr. Hestir is co-lead of NASA’s first biodiversity campaign, BioSCape.

EXPANDING
Diversity and Gender Equity in Tech

In the wake of social and political upheaval, CITRIS made conscientious decisions in its efforts to address inequities in tech and research. In 2021, the rebranding of the former Women in Tech Initiative transformed our focus to be more inclusive. The Expanding Diversity and Gender Equity in Tech Initiative better reflected the solutions UC Merced offers the campus and community. While our programming is aligned with the EDGE in Tech Center at Berkeley Engineering, UC Merced has a distinct focus.

STEM Mentoring Program

At a time when pandemic-related isolation was at its peak, a novel mentorship program centered on a digital platform, called Epixego, that engaged historically underrepresented students and maybe saved their careers in science. Funded through a Women in Tech CITRIS Seed Fund, a team of faculty and researchers at UC Davis, UC Merced, and UC Berkeley, with the former two having the distinction of being Hispanic-Serving Institutions, delivered a near-peer mentoring model program and evaluated its impacts on the 100 students who participated through a pre- and post-survey with 75% response rate.

Evaluation of the program indicates that access to social capital via mentoring is critical for historically excluded students' sense of belonging, self-efficacy, and retention. The measures corresponding to a mentor or mentee's past mentoring experience showed that shared values between mentor and near-peer mentee increased by 27%, and the mentee's STEM self-efficacy (measured via occupational identity & social capital) improved by 23% and 35% respectively. Short-term interventions like this can have a tremendous impact on the lives of participants, forming a broader network (across the UC system) and building a stronger identity in STEM and a sense of belonging in STEM.

Presented in October 2022 at the University of New Mexico Mentorship Conference.

¡Valle! Get Your Start in Tech

Technology's diversity problem can be addressed in part by talented students from UC Merced and the Central Valley gaining access to tech careers. Our ¡Valle! program is named for our location, our region, our community in the great Central Valley of California, a place where people drive technological solutions in the interest of society.

¡Valle! is a program to support undergraduate STEM students to get their start in tech-related fields. The program is focused on individuals building a sense of belonging, confidence, application materials, and creating a network of students, alumni, mentors, and sponsors. This program builds tech career pathways, enables students to explore graduate school, research careers and tech careers in a safe cohort environment. Research shows that students who study in groups, have peer mentors, engage in research, and have alumni networks graduate and have greater success accessing careers in tech and of their dreams.

One of the last things CITRIS did in-person in 2020 before the COVID-19 pandemic changed the world was host the first ¡Valle de Exploracíon! Workshop where 30 students from around the Central Valley and interested in tech came to UC Merced for a seminar and three days of networking, mentoring,

skill building, and confidence lifting. The students from 2021 participate in Valle entirely through zoom, but the team from UC Merced and Merced College sent care packages, books to help with burnout, and supported participation in hackathons. In 2022, Valle went hybrid, with four sessions engaging long-distance expert mentors and on-campus workshops, fun, engineering problem-solving, coding, and creativity.

¡Valle! was a wonderful opportunity of growth for me. From developing soft skills, like developing my elevator pitch and updating resume, to learning technical skills, like utilizing TensorFlow and Google Earth Engine, I was able to find more confidence in myself when applying for internships and eliminate my imposter syndrome.

–Peter Sou, Computer Science and Engineering, UC Merced '22

Valle gave me that push to believe in myself that I can have a career in tech. It gave me the opportunity to meet a diverse group of individuals that are driven to reach the same goals as me. I was able to step out of my comfort zone, learn new things, and build relationships along the way. The experience really opened my eyes to the fact that tech is a broad field that I could apply myself to as an environmental engineer.

–Megan Pinkus, Environmental Engineering, UC Merced '21

After three years, ¡Valle! served over 90 students and assembled mentors from across the valley to sustain long-term networks. CITRIS supported two interns with additional funding from Google Research, both of whom were Valle alum with one earning a research internship and the other tech career after graduating. Soft skills have become essential skills; students need projects and examples to show employers; and most importantly they need each other to build confidence with.

Findings from Valle Program Evaluation and Research

In order to ensure CITRIS is meeting the goals of programming and best supporting students, evaluations were conducted for the initial program in 2020, online program in 2021, and hybrid online and in-person program in 2022 using a multi-modal system of three instruments: 1) survey employed by the funder (Google Research exploreCSR) for pre- and post-participation testing intersectional capital, imposter syndrome, research skills and program evaluation; 2) qualitative internal post-survey of the intervention; and 3) retrospective follow-up survey for where alumni worked, attended graduate school or interned.

The ¡Valle! program intervention resulted in three core findings. The survey responses were based on a 5-point Likert scale of 1=Strongly disagree and 5= Strongly agree.

First, students thrive in a near-peer environment and are most-likely to overcome networking challenges through repeated engagement with peers, near-peer mentors, and supportive community members (Fig. 1).

Secondly, mean responses from student surveys on sense of belonging in STEM and imposter syndrome improved more after hybrid format with in-person workshop (2022) than on zoom (2021) (Fig. 2).

Finally, students reported greater likelihood of speaking up and applying to internships and graduate school and internships after the intervention based on qualitative responses.

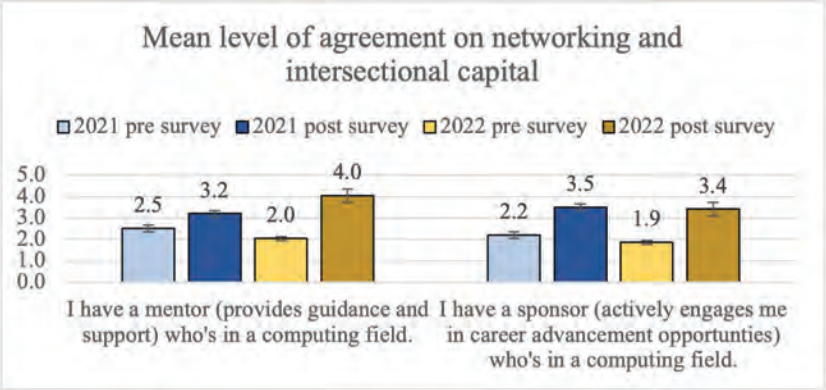


FIGURE 1: Perceived network relationships, a component of intersectional capital, improve after the intervention, with participants more likely to somewhat or strongly agree that they have a mentor or a sponsor in computing.

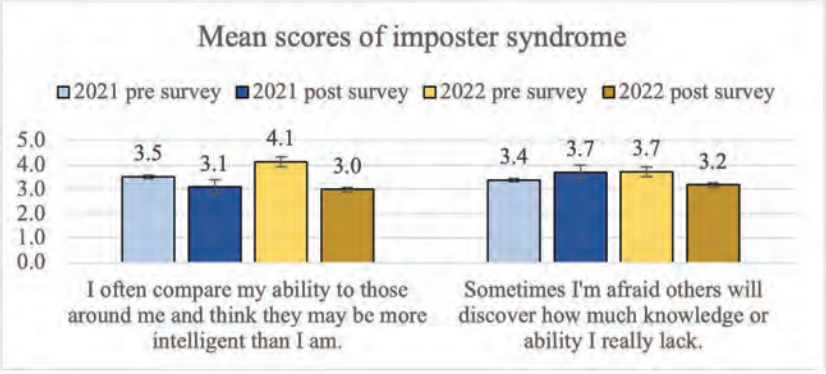


FIGURE 2: A decrease in the mean scores of imposter syndrome after intervention illustrates increased growth mindset, which was greater after in-person intervention than zoom.

Presented in October 2022 at the University of New Mexico Mentorship Conference.

Women in Tech and Diversity in Tech Symposia

CITRIS UCM contributes to the theme, recruitment, and content of the premiere online symposia of diversity in tech. In addition to inviting speakers and sending students and colleagues, CITRIS UCM has organized two food-focused panels that bring to light the capacity of technology in improving equity and access to food, especially under climate change.

2021 Panel Discussion: Human-Computer Interaction and Food: Feeding 10 billion people: perspectives on humans, computers & ag-tech

From the perspective of three sectors, this panel assembles experts in the food systems we all depend on to discuss the future of food and agricultural production. From data-driven decision-making with autonomous robotics to the social, economic, and behavioral issues that define producers' relationships with data, tech tools, and

- **Dr. Erin Hestir**
  UC Merced, Associate Professor
- **Dr. Ankita Raturi**
  Purdue University, Asst. Professor,
  Agricultural Informatics Lab
- **Dr. Jenna Rodriguez**
  Ceres Imaging, Director,
  Strategic Accounts
- **Dr. Shellye Suttles**
  Indiana University, Assistant Professor,
  O'Neill School of Public
  & Environmental Affairs

2022 Panel Discussion: Ag-Food-Tech: Feeding 10 Billion in a Hotter World

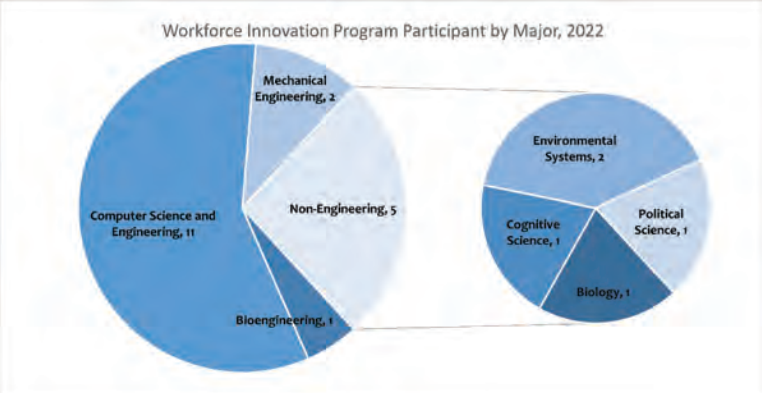
Agriculture, as the largest emitter of greenhouse gases, presents a crucial solution for climate change mitigation as a potential store for carbon and a way to manage waste, energy, and our food systems. This panel will explore both mitigation and adaptation strategies through up-and-coming questions in agricultural technology and natural resources and food production.

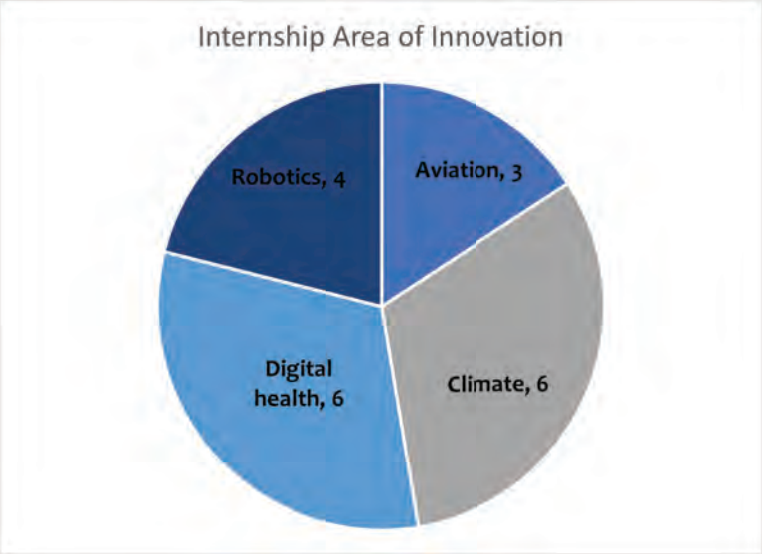
- **Dr. Erin Hestir**
  University of California Merced,
  Associate Professor and Associate
  Director Center for Information
  Technology Research in the Interest of
  Society & the Banatao Institute
- **Melissa Ho**
  World Wildlife Fund, Senior Vice
  President, Freshwater & Food
- **Dr. Alina Zare**
  University of Florida, Professor,
  Electrical and Computer Engineering
- **Ranjeeta Singh**
  Climate LLC, part of Bayer,
  Chief Product Officer.

CITRIS Workforce Innovation Program: UC students pursue world-changing research and accelerate their careers

In its inaugural year, the WIP internship was one of the most popular applications at UC Merced and across the CITRIS system. Paying high wages for students across disciplines to pair with host organizations and labs served as an important opportunity for students to level up. State funding supported the program to provide real-world experience and cohort training to cultivate entrepreneurial mindsets among UC students. Overall, nineteen UC Merced students participated in the program in summer 2022, and here are some quick statistics:

- WIP students worked in four areas of innovation: robotics, aviation, digital health, and climate.
- 58% worked for campus research labs with UC Merced Professors Ayyaswamy, Carpin, Castro, Khan, and Zhang.
- 31% worked for industry partners like, Adventest, RePicture, Future N Focus, Hydroplane and Leap Photovoltaic.
- 11% worked for other research groups like the Feminist Research Institute and USDA Agricultural Research Service.
- The program served 9 women and 10 men across different majors.





THE
FUTURE IS NOW:

DIVERSITY IN STEM EDUCATION

USDA Hispanic Serving Institution Education Program: UC Merced FARMERS

Led by Dr. Rudy Ortiz, to retain and to train students in agriculture, UC Merced funds undergraduate and graduate students in STEM to conduct research, share their research with community elementary schools, train in computational workshops, and participate in the cohort. Supported by United State Department of Agriculture Hispanic-Serving Institutions funding, the CITRIS, the Wonderful Company, Almond Board of California, our affiliated partners, and the esteemed faculty of UC Merced, we expand research training opportunities to our diverse population of students. The program aims to attract outstanding students and produce graduates capable of enhancing the nation's food and agricultural scientific and professional work force. Our USDA HSI FARMERS STEM research fellows have higher rates of graduation than their peers, and many have built successful careers in science.

CITRIS UC Merced supported the grant renewal in 2021, administration of the program, media, and coordination, and establishing the evaluation plan.

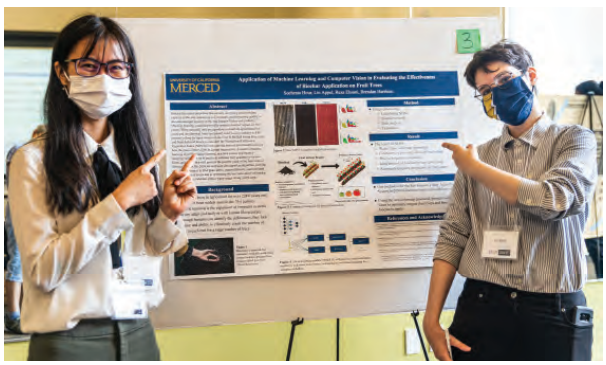
Learn more: usdahsi.ucmerced.edu

USDA NIFA FACTS Internship

The **San Joaquin Valley Food and Agriculture Cyberinformatics Tools and Science Bridge Program** also known as FACTS gives incoming UC Merced students a jump on research experience and engagement with the Central Valley's economic engine of agriculture. Research can be a powerful tool for retaining students in STEM and early exposure to career paths has been shown to help students work in agriculture, both of which are goals of the National Institute of Food and Agriculture that funded this program in 2020. There is a lack of diverse and qualified graduates in food and agriculture to meet demand and feed a growing population under a changing climate. UCM, a Hispanic Serving Institution, is well situated geographically, demographically, and programatically for this program.

The first six-week summer immersion program at the University of California Merced (UCM) in agricultural science and technology served 12 students each year in 2021 and 2022, with two more summers planned. Led by Dr. Colleen Naughton, FACTS supports (1) undergraduate research, (2) peer-to-peer mentoring, (3) practical immersion in food production through UC Cooperative Extension and industry experiences, and (4) critical life and university skills. Students engage in "Field Trip Fridays" visiting large scale agribusinesses like Hilmar Cheese and some of California's 400 specialty crops like Pageo Lavendar and the natural resources infrastructure that supports agriculture in the Central Valley. At the end, the FACTs Symposium assembles mentors and participants in presenting their research findings. The ultimate outcomes are a diverse and competitive agricultural workforce from our scalable model that will increase agricultural productivity and resiliency in food security, in turn leading to economic development and rural prosperity. LACA supported interns in 2021 as well.

Learn more: citris.ucmerced.edu/facts



AWARDS

CITRIS has outstanding colleagues and leadership, people whose lifetime achievements illustrate what can be done with dedication, teamwork, and addressing the real problems that matter. The Athena Awards are an opportunity to nominate the most inspiring efforts in inclusive and engaging research and programming.

- In 2022 the **Athena Award for Executive Leadership** went to Dr. **Sepi Hejazi Moghadam**, Google Research, University Relations, Inclusion and North America Academic Development Lead
- In 2021, UCM Founding Faculty Dr. Teenie Matlock, Vice Provost for Academic Personnel earned the **Athena Award for Academic Leadership**

Faculty Mentorship awards

2022 Excellence in Faculty Mentorship awarded to Dr. Josh Viers. In recognition of excellence in faculty mentorship.

2022 Divisional Council award for shared governance to Dr. Erin Hestir, Chair, Graduate Council.

Invited Presentations

Dec. 1, 2021 – Josh Viers presented to the Association of California Water Agencies Conference.

Dec. 16, 2021 – Alvar Escriva-Bou, John Abatzoglou, Joshua Viers, Josue Medellin-Azuara presented at the American Geophysical Union on "Economic Impacts of the 2020-2021 California Drought on Agriculture: Insights from Early Stages of Groundwater Sustainability Regulation and the Role of Forecasting."

Mar. 18, 2022 – Ellen Bruno, John Abatzoglou, Joshua Viers, Josue Medellin-Azuara, Leigh Bernacchi, Safeeq Khan, Sarah Naumes brought together high-level stakeholders to discuss SWF and SWF-adjacent research. CDFA Secretary Karen Ross and local irrigation districts were present.

Mar. 19, 2022 – "Just Water" talk hosted by the California-Nevada United Methodist Women featured Josh Viers presenting to approximately 66 participants.

Apr. 5, 2022 – Profs. Josue Medellin-Azuara and Josh Viers presented as invited speakers to the California Department of Food and Agriculture Board Meeting at UC Merced on the Economic Impact of the 2021 Drought on Agriculture.

Apr. 26, 2022 – Josh Viers served on the ARPA-E panel on "smart farms."

Online Presentations

Jul. 15, 2020 – Dr. Leigh Bernacchi presented "A hole in the bucket: News media representation and California Groundwater Management" at the ISSRM 2020 virtual meeting.

Mar. 9, 2021 – USDA Project Director meeting for HSI in Education Program. Dr. Leigh Bernacchi presented on behalf of Dr. Rudy Ortiz to share the work of UC Merced FARMERS and how working with schools has benefitted both undergraduates in the program and the community.

Dec. 2, 2021 – ENEL, an energy company based in Italy, held the hybrid conference "Inclusive Business as a shared value opportunity" and Dr. Leigh Bernacchi served on the Academic Roundtable, presenting CITRIS UC Merced's inclusion and tech-prep programming, especially ¡Valle! and how industry engagement in education is critical to overcoming the lack of diversity in the sector.

Jan. 13, 2022 - Alice Waters, food activist and founder of the Edible Schoolyard Project, headlined Frontiers of Science "Feeding Ourselves in the Future." Dr. Leigh Bernacchi stood in for Dr. Viers to discuss UC Merced's climate change, agriculture, and student engagement programming, and what she hopes will be the future of food: plant-based, sustainable, available, and delicious.

ADDITIONAL EVENTS

CITRIS UC Merced is pleased to exercise its convening powers around advancing our research initiatives. Leadership regularly engages with CITRIS roundtables, Chancellor's and Advisory Board meetings, and related organizations to represent UC Merced's work. We also seek events to engage in that will further our research mission.

For example, CITRIS hosted Central Valley Community Foundation and former California Water Commissioner Joe del Bosque. CITRIS supported UC Merced researchers in presenting to the California Department of Food and Agriculture, the Strategic Growth Council, and UC Merced Board of Trustees members.

ENTREPRENEURSHIP AND INNOVATION OXYGEN FUND

UC Merced is a locus of innovation. When business-minded students, many who presented at Innovate to Grow, needed runway to make their concept a reality, the UC Merced Board of Trustees funded $3000 early investments in student innovation. In the first round of the Oxygen Fund, CITRIS provided branding, recruitment, review, and administrative support.

CITRIS GRANTING SUPPORT

Need help with a proposal? CITRIS UC Merced supports all grants with a tech component and specializes in large, complex, multi-million, multi-campus, interdisciplinary granting. CITRIS staff support faculty through matchmaking with academics, industry partners and educational programs for building strong broader participation impacts. Intern students contribute to graphics and web presence for pre-award branding. Contact **citris@ucmerced.edu**

WHAT'S NEXT FOR CITRIS?

UC MERCED. FIRST. FURTHER. FORWARD.

Like the campus, CITRIS UC Merced strives to empower students, faculty, and the community to be first, to take ideas further, and to use technology to take society forward to a better future. In the grand experiment, CITRIS asks, can a public institution of higher education transform the economic development of a region? Can empowering programs support students in pursuing a higher vision for themselves and their communities?

We believe that from small programs, like screening diversity in tech films, to tackling big problems, like how much water do we really use, that CITRIS at University of California, Merced is making a difference.

CITRIS has added new capacity and talent to our team and plan to continue to grow in our areas of expertise. Undergraduate interns bring creativity, problem solving and energy to all CITRIS programs.

We strive to adopt new tools and technologies to improve our work and better support our faculty, students, and

Through UC Merced, F3 will launch the agrifood technology hub to spur innovation and collaboration with industry, farms, and researchers to create jobs and to build economic development for the region.

community. New programming in Fall 2022 includes "TensorFlow for Social Good" and the "Women in STEM Film Series." Expanding the FLY CITRIS program to Central Valley schools and students is a top priority. And on the research front, CITRIS continues to explore new funding, outreach, and research opportunities in these core areas:

- Ag-Food-Tech*
- Aviation
- Climate Change
- Expanding Diversity and Gender Equity in Tech
- Food-Energy-Water Systems*
- Health
- People & Robots
- Sustainable Infrastructures
- Wildfire.

CITRIS as a multi-campus research unit continues to collaborate with CITRIS campuses of Berkeley, Davis and Santa Cruz as well as with industry, government agency, community and educational partners. The unique research foci of CITRIS UC Merced are annotated with an * and are areas that will continue to support research that serves the interests of society.

As this report was going to press, the Biden Administration announced the US Economic Development Agency's Build Back Better Regional Challenge **$65.1 million award** – the largest federal grant to the Central Valley – to the **Fresno-Merced Future of Food Innovation Coalition**.

The Center for Information Technology Research in the Interest of Society and the Banatao Institute at University of California, Merced is the premiere tech research and outreach organization on campus. CITRIS creates information technology solutions for society's most pressing challenges. The organization supports interdisciplinary, multi-campus granting, cultivates industry, educational, and community partnerships, and delivers cutting-edge research to effect change and adaptation in the region, state, and world.

To learn more or join our newsletters, please visit:

citris.ucmerced.edu
citris-uc.org
securewaterfuture.net
laca.ucmerced.edu
usdahsi.ucmerced.edu

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