

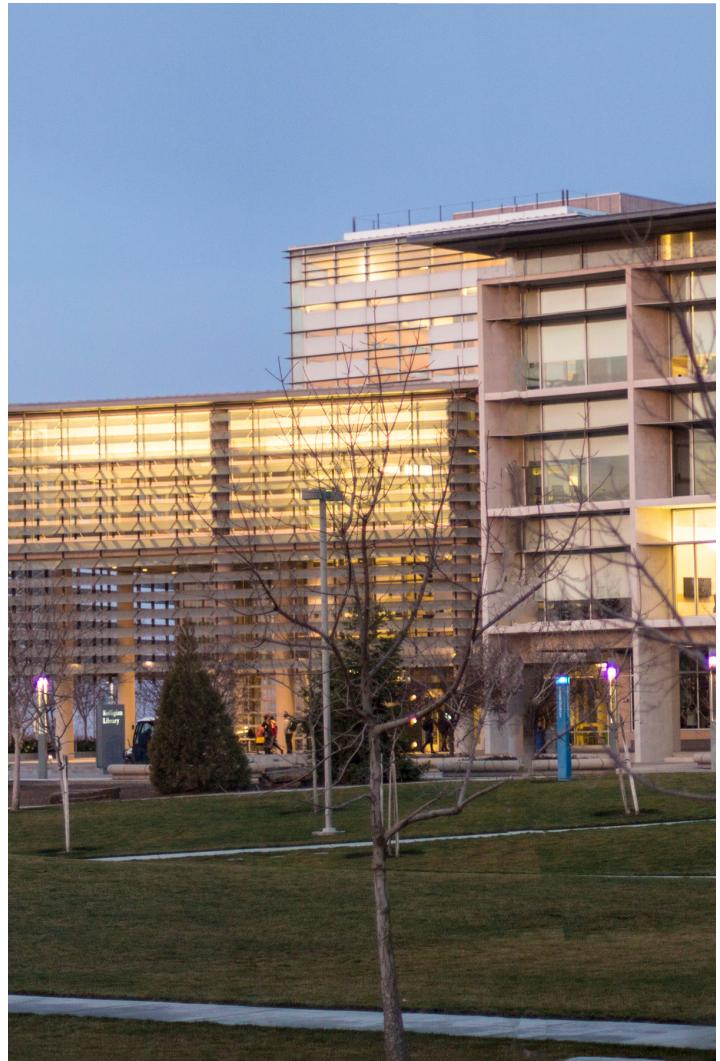


2014-2016

Impact Report

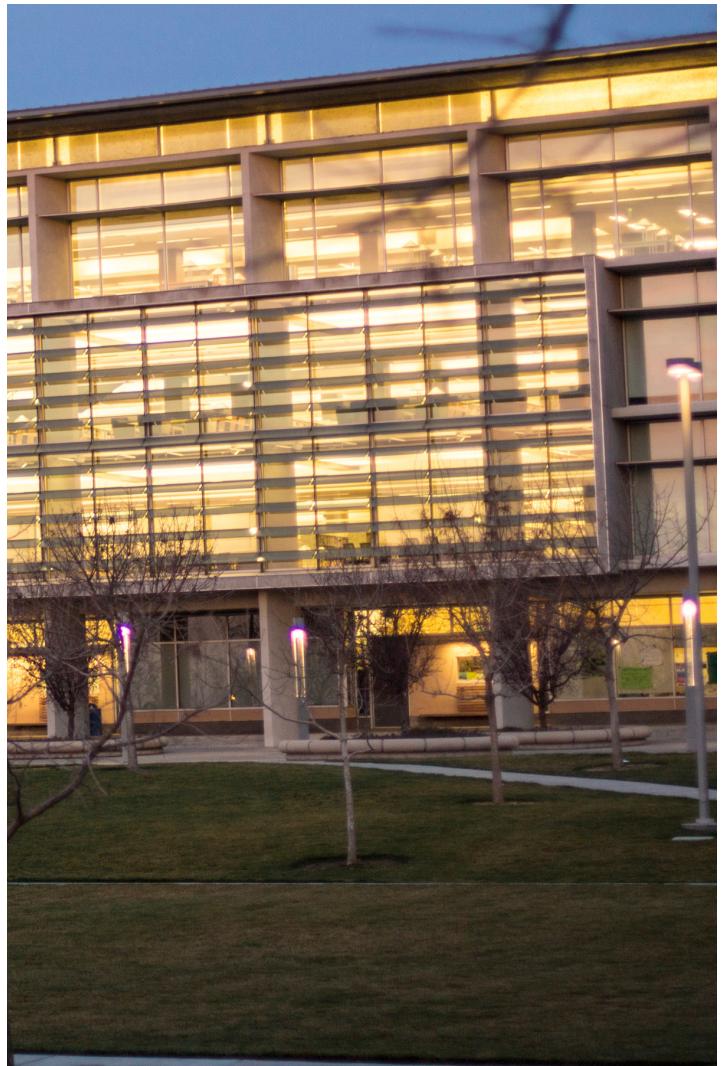
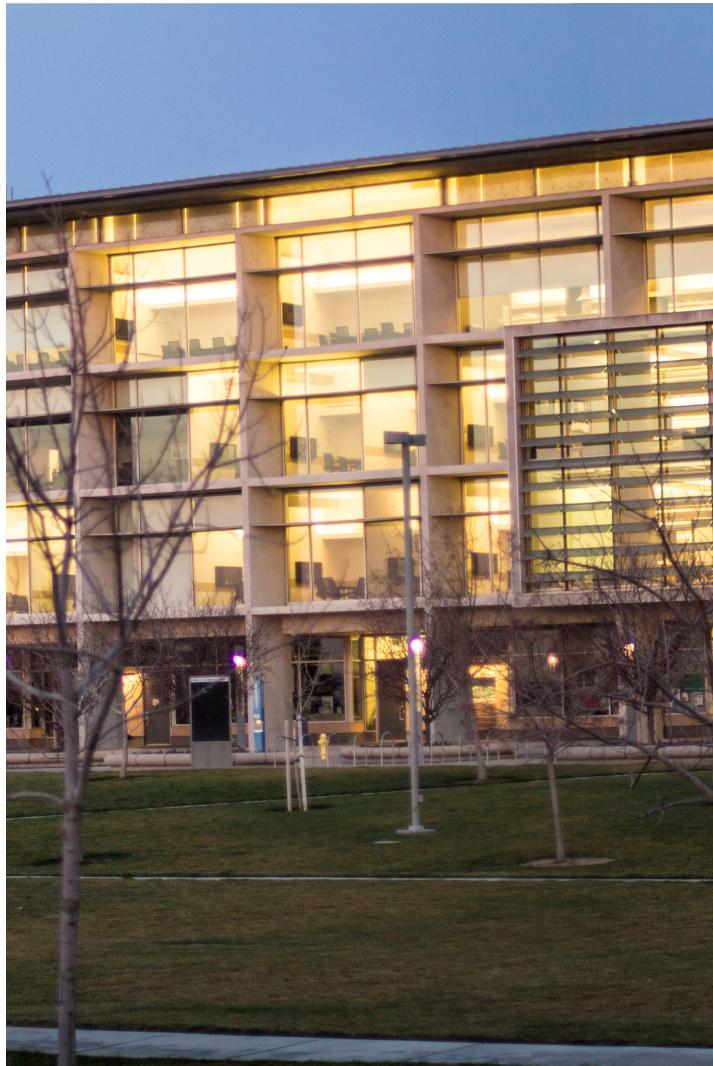
[citrис.ucmerced.edu](http://citrис.ucmerced.edu)

# WELCOME TO





# CITRIS Merced

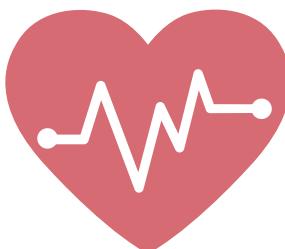


# Executive Summary

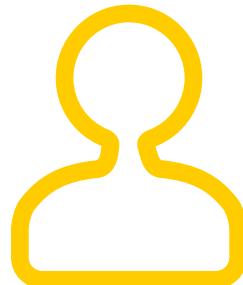
The Center for Information Technology Research in the Interest of Society (CITRIS) is an interdisciplinary research organization across four University of California campuses - UC Merced, UC Berkeley, UC Davis and UC Santa Cruz. The CITRIS Federation develops synergistic partnerships with academic institutions and corporate collaborators internationally, to collectively produce innovative solutions to challenges in four primary sectors.



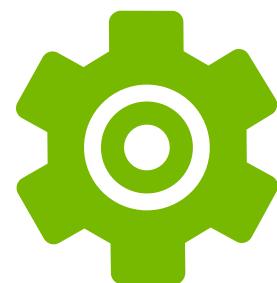
Connected  
Communities



Health



People & Robots



Sustainable  
Infrastructure

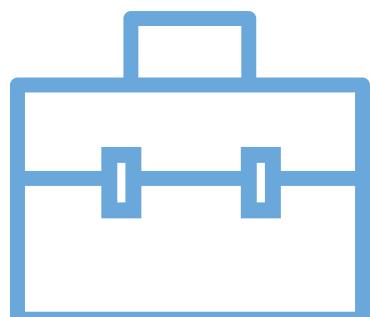
CITRIS at UC Merced addresses California's most pressing societal and environmental problems by leveraging cutting-edge technologies. The research unit's operations incorporate a convergence of the three following focuses:



Student-Driven  
Initiatives



Seed Grants &  
Faculty Research



Corporate  
Partnerships

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# 2015 – 2016 Leadership & Staff



Stefano Foresti  
Associate Director



Joshua Viers  
Director



Brittany Conn  
Program Analyst

## Student Assistants

Sweta Yonja  
Graphic Designer & Media  
Intern

Myka Alejandre  
Mobile App Challenge  
Coordinator

Kian Bradley  
Web Developer

Mark Santiago  
Web Developer

## Faculty Advisory Board

J. Elliot Campbell  
Associate Professor  
School of Engineering

Stefano Carpin  
Associate Professor  
School of Engineering

Teenie Matlock  
Associate Professor  
Cognitive & Information  
Sciences

Stergios Roussos  
Executive Director  
Blum Center for  
Developing Economies

## Student Success Interns

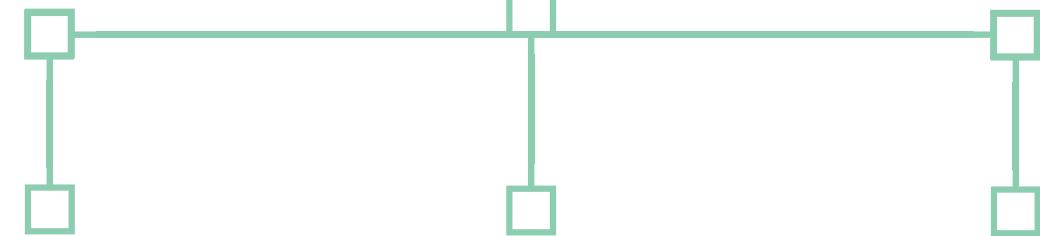
Deo Halili  
Mobile App Challenge  
Outreach Coordinator

Hoaithi Dang  
Digital Data  
Ownership Intern

Steven Dinh  
Mobile App Challenge  
Outreach Coordinator

Bridget Schick  
Agriculture Tech  
Fair Coordinator

Jonathan Deas  
CITRIS Research  
Exchange  
Outreach Coordinator



# CITRIS Grants & Research

Research is the cornerstone of everything we do at CITRIS; we strive to develop creative and impactful solutions by partnering with the brightest minds across disciplines, and shortening the pipeline to market readiness.



## THE SOLAR IRRADIANCE MAPPING INITIATIVE (SIMI)

Qinghua Guo & Jean-Pierre Deplanque

CITRIS researchers utilized SIMI, a new concept that combines state-of-the-art satellite and radar image processing with real-time data from ground solar stations to forecast solar power availability for the various atmospheric conditions found around California.



## SMART TINY HOME POWER PLANT

J Elliot Campbell

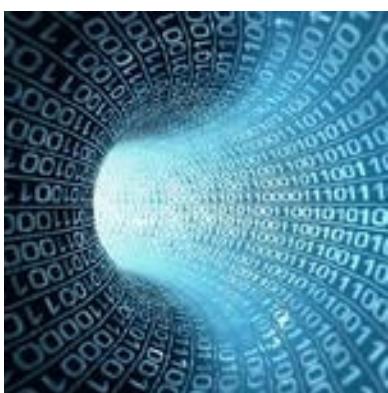
Designed to develop smart infrastructure to create affordable housing communities, a Tiny Row House (TRH) is two-story, modular structure of 500 - 750 square feet, designed to be built in groups of four to six structures that incorporate a menu of resources-conserving construction, sustainable materials, shared utilities and renewable energy microgrids, monitored by smart sensors.



## UNDERSTANDING IMAGE-BASED BIG DATA USING HUMAN COMPUTATION

Ming-Hsuan Yang

This project has four goals: characterize and benchmark human computation co-processors (HPUS) platforms, propose instructions and algorithms, implement instructions and algorithms, and evaluate work. Researchers seek to build an automated test suite of small tasks that can be run on a wide set of HPU platforms, providing a snapshot of the accuracy, latency, and reliability of each platform.



CITRIS Grants & Research



## AN EMR-BASED, PROBABILISTIC CLINICAL SUPPORT SYSTEM FOR THE DIAGNOSIS AND TREATMENT OF SEPSIS PATIENTS

J. Elliot Campbell

In the absence of a data-based tool for early prognosis and effective treatment of sepsis, researchers propose to create an adaptive, data-driven, probabilistic clinician decision support system (CDSS) that will employ state of the art machine learning tools to mine the data rich Electronic Medical Records of the UC Davis Health System and can be readily deployed throughout hospitals in CA and around the country.



## ENABLING ROBOTS TO EXPRESS BASED ON HUMAN DEMONSTRATIONS



Marcelo Kallmann

The goal of this project is for robots to leverage "body language" to express a state of awareness, hesitation, excitement, disappointment, etc. The project is a collaboration between roboticists, computer graphics experts, and professional dancers. The team will develop methods for transferring motion capture data of a human dancer expressing emotions to a robot arm in a manner that preserves the emotional content of the motion.



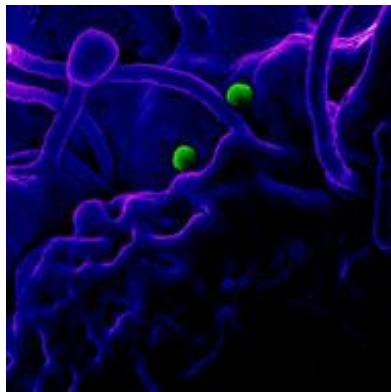
## DIGITAL PRESERVATION IN HISTORIC BODIE

Nicola Lercari & Brandon Smith



Bodie Digital Community – Connect with your Past is an augmented reality application for mobile devices created in collaboration with California State Parks. This app promotes public engagement in heritage preservation, fosters connection among visitors, and generates data that improve the management and preservation of California natural and cultural resources.

## GENOME-LINKED ANTIBIOTIC RESISTANCE DATABASE



Miriam Barlow

In an effort to inform hospitals about the antibiotic resistance threats most likely to result in treatment failures, this project sequences the genomes of microbial isolates collected from Mercy Medical Center to determine what genetic components are making them resistant to antibiotics and creates a network available to hospitals for both accessing and disseminating information about what resistance has been found in other hospitals.



## CENTER FOR SIERRA NEVADA WATER INFORMATION SYSTEM



Roger Bales

The Center for Sierra Nevada Water Information System (CSNWIS) project resulted in a web portal which provides Sierra Nevada satellite-snow-cover information, wireless-sensor-network data, and analyses which are useful for water scientists, engineers, regulators, and managers. CSNWIS will continue to expand with more data sets to provide information to users with research and operational forecasting interests.



## AN AUTOMATIC WEARABLE SPEECH SUPPLEMENT IN FACE-TO-FACE AND CLASSROOM SITUATIONS



Millions of individuals with language and speech challenges require additional support for language understanding and learning. The proposed activity will develop a real-time system to automatically detect robust characteristics of auditory speech and to transform these continuous acoustic features into continuous supplementary visible features. This information combined with watching the speaker's face provides enough information for a person with limited hearing to perceive and understand what is being said.



## THERMOVOTE: PARTICIPATORY SENSING FOR EFFICIENT BUILDING HVAC CONDITIONING

Alberto Cerpa

The goal of this research is to increase the conditioning effectiveness of the HVAC system by incorporating participatory sensing and making adjustments to the building management systems in real time. Part of this goal is to show how participatory sensing is an effective tool for augmenting and maintaining the building management systems.



## ECONOMIC VALUE OF IMPROVED WATER OPERATIONS ENABLED BY SENSOR-BASED INFORMATION TECH



Roger Bales

The goal of this project is to collect and analyze data on the economic uses of water, understand the value of accuracy and timeliness of this information, and develop an improved economic model that can assess the value of better information concerning the release of water from watersheds above the river and reservoir system of California.



## VIRTUAL REALITY TECHNOLOGIES FOR ROBOTIC AIDED FIRST RESPONSE

Stefano Carpin

Every day, robotic technologies save human lives in a variety of situations. Thanks to a synergy between the robotics group at UC Merced and the Merced Sheriff Office SWAT team, the goal of this project is to explore how this interplay between virtual reality and robotics can lead to the development of better training tools for first responders.

## IndianaDrones: SMART CAVE DRONES AS ROBOTIC CO-ARCHAEOLOGISTS



Yang Quan & Chen Hmoyes

The goal of this CITRIS seed project is to advance technological development in mapping archaeological cave sites using low-cost drones for cave exploration as robotic "co-archaeologists." Using video imagery collected by drones, we plan to produce high resolution, accurate, 3D images with smart lighting control. This is a major advance in archaeological practice, enabling us to quickly map these complex spaces so that we may conduct 3D analyses.



## MANAGED AQUIFER RECHARGE NETWORK (MAR-NET)

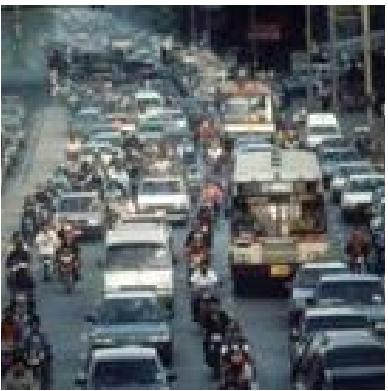


Thomas Harmon

Groundwater is often over-looked by the average Californian, but is an important—albeit overused—local source of water throughout the state. The objective of the project was to create a prototype for an end-to-end Managed Aquifer Recharge Network (MAR-net) to help ensure a sustainable water supply for California. This project will design and test a scalable system for maintaining a continuous account of our groundwater resources.



## SENSING CO<sub>2</sub> DOMES FOR ADAPTIVE MANAGEMENT OF URBAN GREENHOUSE GAS EMISSIONS



J. Elliot Campbell

A growing number of studies have addressed urban and suburban CO<sub>2</sub> fluxes, current experimental techniques are not robust with respect to policy or scientific objectives. The goal of the project was to create proof of concept results and a science plan for developing, deploying, and assessing a new COS sensor and atmospheric modeling strategy for the application of greenhouse gas emissions measurement at the city scale.

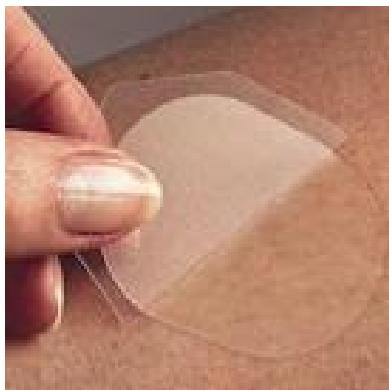


## MAGNETICALLY ACTUATED MEMS POWER CONDITIONING CIRCUITS FOR ENERGY SCAVENGING IN SMART GRID APPLICATIONS

Wireless sensor networks are becoming commonplace: for example, companies currently link miniature wireless radios together with sensors to measure and report data in refineries and manufacturing plants. This research is focused on novel devices that will efficiently obtain and store electrical energy scavenged from energized conductors such as common electrical cords and higher voltage power distribution and transmission lines and circuit components.



## SMART TRANSDERMAL DRUG DELIVERY PATCH



Ashlie Martini

Transdermal patches are the least invasive of available drug delivery techniques. This project aims to design a smart controllable membrane, which combines the simplicity of a membrane based patch with the precise drug delivery of a complex micro-machine based system. This has the potential to decrease the cost and increase the applicability of transdermal delivery.



## ESTABLISHING THE CENTER ON AUTONOMOUS AND INTERACTIVE SYSTEMS AT UC MERCED

Stefano Carpin & Marcelo Kallmann



This research focuses on intelligent systems that can be used to train and assist people in preparation for or during complex and difficult situations. Two of its main sub-projects include wireless based localization and design of human-like motion interfaces. Intelligent systems must achieve the ability to seamlessly cooperate with humans in order to be successfully integrated into society. These systems can be fully autonomous, remotely operated, or directly controlled.



## CLIMATE FEEDBACK - CROWDSOURCING THE EVALUATION OF CLIMATE CHANGE INFORMATION

Teenie Matlock

Climate Feedback works towards creating a comprehensive database on the scientific trustworthiness of major climate change reporting that would allow anyone to easily compare and contrast the credibility of different news sources and identify sources of information they can trust. This approach has the potential to provide a strong incentive for news sources to ensure that their reporting is scientifically accurate.

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## EFFICIENT STRATEGIES FOR CONDITION MONITORING AND FAULT DETECTION OF HVAC SYSTEMS FOR ENERGY EFFICIENT BUILDINGS



Jiao - Qiao Sun

Large and complex HVAC systems are naturally difficult to monitor. The objective of this project is to develop methods for effective monitoring of system conditions and fault detection of large and complex HVAC systems. This project contributes to the development of intelligent control, monitoring, and fault detection technologies that are integral part of energy-efficient carbon-neutral buildings.

---

## MOBILE REMOTE-SENSING PLATFORM FOR PRECISION AGRICULTURE



Stefano Carpin

This project develops of a transformative measurement and analytical tool to empower crop managers with data to make critical decisions in the areas of water conservation and resources administration. The system consists of an autonomous robotic platform equipped with sensors to ground-validate and enhance data provided by currently available satellite systems. The robot autonomously navigates orchards collecting data that is otherwise not accessible from satellite or UAVs.

## MOTION INTERFACES FOR PHYSICAL THERAPY



Macelo Kallmann

There are three main objectives for this research project: evaluate latest sensor technologies for use on virtual therapy applications, design an interactive prototype application for prescribed and personalized therapy rehabilitation, and to evaluate novel solutions for tracking finger, hand, and facial skin deformations for rehabilitation of hand motor control and facial expressions after burn injuries.



## COLLABORATIVE VIRTUAL ENVIRONMENTS FOR VIRTUAL HERITAGE



Macelo Kallmann

To explore innovation in human-computer interfacing for virtual environments, this project focused on reconstructing environments from historical sites. This will eventually lead to the creation of networked virtual heritage sites connecting multiple UCs and other institutions. It creates natural interfaces for collaborative virtual environments, and facilitates computer interactions accessible for non-computer experts to program virtual environments.



## MOBILE SENSOR NETWORKS FOR INDEPENDENT LIVING AND SAFETY AT HOME



The senior population in the U.S. will grow to 72 million by 2030, representing 20% of the total U.S. population; there is a growing need for computer and information technology to improve senior citizen quality of living while reducing the overall cost of health care. CITRIS researchers developed a mobile sensor, Using a research version of Roomba, the iRobot Create platform, for use in monitoring, home security, and personal assistance using relatively inexpensive hardware.

## ARCHAO-PEDIA 3D: COLLABORATIVE RESEARCH IN CYBER-ARCHAEOLOGY



Maurizio Forte

One of the key challenges in archaeology is successfully communicating data, even within the scientific community. The primary goal of this project is to create a network of virtual collaborative environments across UC campuses to develop novel techniques for collaborative research and learning in archaeology. These environments allow users to interact and learn in rich 3D virtual spaces, where they can exchange data and information.

## AGGRESSIVELY DUTY-CYCLING BUILDINGS: THE NEXT FRONTIER IN ENERGY EFFICIENCY



Alberto Cerpa

Researchers plan to use an existing wireless sensor test bed of micro-cameras deployed on the SE1 Building at UC Merced in order to measure real-time occupancy. They plan to develop a system to take the real time occupancy data from the testbed and interface with the EMS system in order to actuate part of the building. They plan to run control experiments obtaining quantitative and qualitative data of energy savings and levels of thermal comfort for the users.

## TERRESTRIAL REMOTE SENSING FOR MONITORING ATMOSPHERIC PARTICULATES



Shawn Newsam

Using digital cameras, this project monitors for particulates in the air. California's Central Valley suffers from some of the worst air pollution in the nation and yet there are only a handful of monitoring sites that can provide real-time measurements of pollution levels. Digital cameras of static scenes focusing on fixed objects, like the Sierra Nevada Mountains, offer a cost-effective alternative to using specialized monitoring equipment.

## TOWARDS SEMANTIC SPATIAL AWARENESS: ROBUST TEXT SPOTTING FOR ASSISTIVE TECH APPLICATIONS



Stefano Carpin

The main goal of this project is the development of computer vision techniques that can be used to assist both categories of users mentioned above: persons who, due to visual impairment, experience difficulty self-orienting, and persons with mobility impairment who are unable to independently control the trajectory of their motorized wheelchair. Specifically, researchers will develop technology that promotes semantic spatial awareness in manmade environments by means of direct access to printed textual information.



## PWNING ASTHMA TRIGGERS: HEALTHING GAMES AS TECHNOLOGIES OF SOCIAL ENGAGEMENT



This research is combining three strategies: data mining, anthropological field work, and dramatization through game design. In the game, researchers will correlate spatial maps of public records and scenarios of future climate change and population growth with gameplay data to see if players develop effective strategies in a simulated game environment to manage asthma triggers and optimize their healthcare.



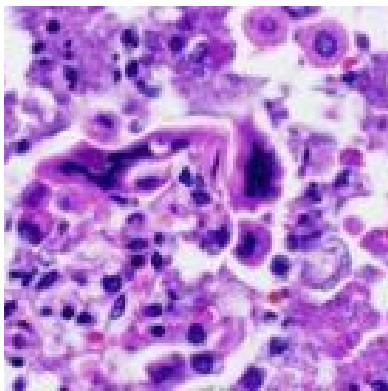
## THE SENSING ENTITY TRACKING INITIATIVE (SETI): A CITRIS CENTER FOR SMART ENERGY INFRASTRUCTURE



Alberto Cerpa

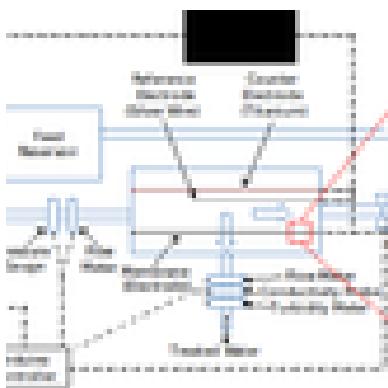
The brand-new UC Merced campus represents a once-in-a-lifetime opportunity to create a full-scale test-bed for advanced energy management in campus buildings and systems. Goals of this research include developing and deploying a sensor network system for real-time accurate estimation of person transitions among different parts of the buildings when using public hallways.

## BIOMIMETIC LUNG-BASED BIOSENSOR FOR RAPID DETECTOR OF AIRBORNE POLLUTANTS



Wei-Chun Chin

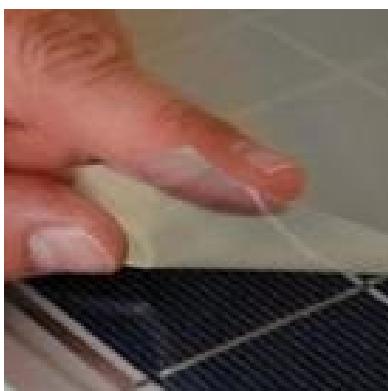
CITRIS researchers aimed to design and develop small-scale biosensors to incorporate airway epithelial cells to detect airborne pollutants through microfluidic devices. These devices detect harmful airborne agents, which, when integrated into a wireless system, would enable a detection system linked into a real-time communications network.



## INTEGRATING ELECTRICALLY CONDUCTING MEMBRANES AS IN-SITU SENSORS IN AUTONOMOUS WATER TREATMENT SYSTEMS

Mark Matsumoto

In this project, we will develop membrane-based systems that couple electrically conducting membranes with open-source hardware and software to produce a modular and autonomous water treatment technology that can adjust operating conditions to respond to changes in feed water quality, as well as initiate cleaning and maintenance operations without the need of human intervention.



## NEW PIEZOELECTRIC TRANSDUCER MATERIAL PLATFORM FOR TECHNOLOGICAL INNOVATION

This CITRIS research project was primarily focused on synthesizing a new type of a photo-response polymer system. Polymers' responsive behaviors, response frequency, amplitude, force generated and the number of cycles before failure as a function of light and heat stimulations will be characterized. Energy and force transduction efficiency include converting thermal energy into electricity and transforming electrical "force" to mechanical displacement will be investigated.

# Project SpotLIGHT



UC Merced Professor Nicola Lercari is leading an effort to preserve, through 3-D renderings, the deteriorating ghost town of Bodie.

## The Problem

Much of the Bodie State Historic Park is in a state of decay, and many of the town's oldest structures are in danger of being lost forever.

## The Big Idea

Some of the buildings in Bodie, once a thriving mining town near the California-Nevada border, have been carefully preserved for visitors to the Bodie State Historic Park. The rest, exposed to the elements for more than 130 years, are in danger of being lost forever due to decay or wildfire.

## The Solution

Thanks to \$60,000 in seed funding from the Center for Information Technology Research in the Interest of Society (CITRIS), Lercari and his team will be continuing and expanding the project for another year.

Using drones, airborne laser-scanning technology, digital sensors and photography, Lercari and his team are recreating Bodie in three dimensions. From individual artifacts to the park's topography, archaeologists are working alongside land surveyors and drone operators to capture a level of detail that was previously unimaginable.

Park officials plan to make the interactive digital renderings available in the Bodie visitor center, and an augmented reality app and web app for visitors will bring the town to life for scientists and the public worldwide.

# 2016 Mobile App Challenge

## 2016 Mobile App Challenge



Special Thanks to our  
Corporate Sponsors



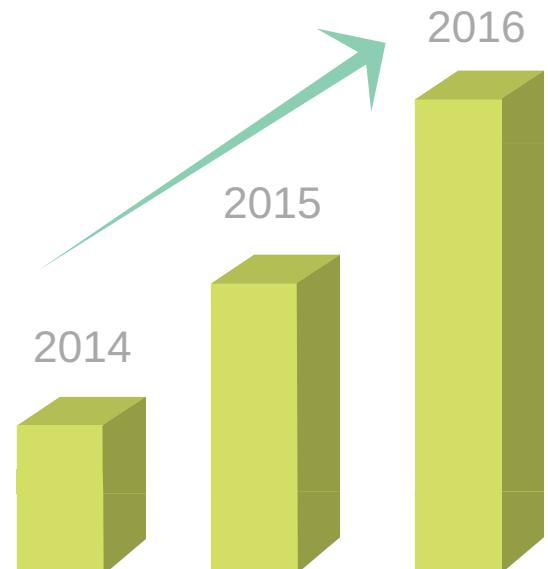
E&J Gallo Winery

"The Mobile App Challenge is where students can compete with the skills they have gained in entrepreneurship and computer science to create apps that have an impact on society."

~Myka Alejandre, 4th Year  
Computer Science & Engineering  
MAC Program Coordinator

"The Mobile App Challenge is a great opportunity for students to learn about different technologies and help their communities by creating these apps."

~Mark Santiago, 4th Year  
Computer Science & Engineering  
CITRIS Web Developer



Corporate sponsorship for the MAC has tripled over the last three years.

# 2016 MAC Winners



**DRYVE**  
1st Place Winner & Most  
Environmentally Aware

DRYVE makes carpooling easy and intuitive for college students, and can significantly decrease the UC Merced carbon footprint.

**UpNote**  
Runner-Up & Best Design/ User  
Interface

UpNote is a modern study app designed by students for students where classmates can post notes with information needed for classes and up-vote the best notes posted. Democratizing note taking and bringing it to the 21st century.



"The Mobile App Challenge allows students to get an idea and transform it into an actual product, and present it to real investors. It allowed me to feel confident in my public speaking and coding skills, and I feel much better when going to interviews."

~Austin Mittman, 4th Year  
Computer Science & Engineering  
UpNote Team Member

# 2016 Speakers

Innovation is at the heart of the University of California. In university labs and private companies, UC researchers and alumni work do research and develop solutions with the goal of improving the future of society. From healthcare to the environment, from clean energy to big data, we live in an era of unprecedented technological challenges and opportunities.

Now more than ever, creativity and analytic thinking are in great demand. Sponsored by CITRIS and supported by EECS, the new "Frontiers in Information Technology" seminar series brings visionary innovators from leading industries to UC Merced. These leaders share their stories about working to create the next big technological breakthrough, and inspire students to pursue their passion. It offers a unique chance to learn the unique challenges of a career in technology, understand how to overcome obstacles in the workplace, and develop skills needed to turn ideas into products.



**Paul Scerri**  
Co-founder & President  
Sense Platypus

""Platypus Cooperative  
Robotic Boats: Learning to  
Balance R&D and  
Productization"



**James Kuffner**  
Chief Technology Officer  
Toyota Research Institute

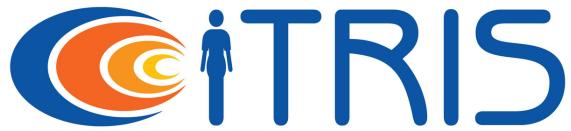
"Robot Intelligence in a  
Cloud-Connected World"



**Dale Dougherty**  
Founder & CEO  
Maker Media, Inc.

"We are all Makers"

# 2015 Speakers



**Gary Kremen**  
Founder  
Match.com

"Q&A Session with the Founder of Match.com

**Costas Spanos**  
Director  
CITRIS @ UC Berkeley

"In the Interest of Society"



**Ivan Di Federico**  
Chief Strategy Officer  
TopCon Positioning System

"Engineering and R&D at Topcon Positioning Systems



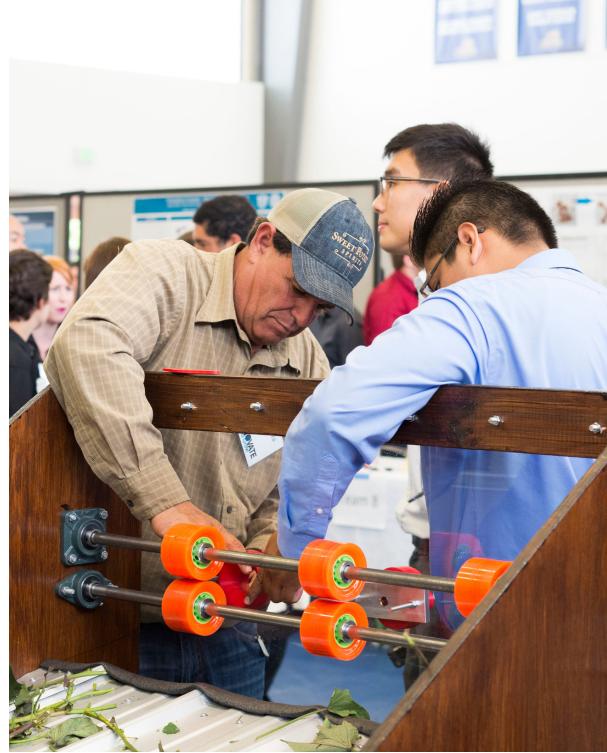
"The FIT speaker series allows students to see technology applied to real world problems. Most importantly, they get to see how it can be applied to different fields and solve problems that they may not have known existed."

~Myka Alejandre  
CITRIS Program Coordinator

"Frontiers in Technology" Speaker Series

# 2016 Ag Tech Fair

## Agriculture Technology Fair



# Interested in CITRIS UC Merced?

Check out the exciting work happening at our sister campuses!

