CITRIS HEALTH INITIATIVE

The **CITRIS Health initiative** seeks to transform health and healthcare by improving access and reduce disparities and costs through innovative technology solutions. The primary focus areas for CITRIS Health are "Hospital to Home" and "Precision Medicine."

The initiative focuses on developing transformative, scalable and sustainable information technology solutions to improve health and wellness. These technology-enabled solutions can improve the quality of care and health outcomes, while reducing health care costs. Current areas of focus address the primary drivers affecting health, including chronic disease and aging. Initiative projects build upon the principal technology solutions of telehealth; sensors; mHealth; and data analytics. Examples of CITRIS Health Initiative projects include innovations in electronic health records and analytics, the Transatlantic Telehealth Research Network, use of in-home sensors and feedback to reduce asthma in children, virtual reality environments for physical rehabilitation, and interactive mapping to assist wayfinding for older adults.

SAMPLE PROJECTS

Transatlantic Telehealth Research Network (TTRN)

The Transatlantic Telehealth Research Network (TTRN) is dedicated to developing cutting-edge research and innovation within telehealth. The research is interdisciplinary (medicine, engineering, nursing, organizational, economic), and focuses on developing new diagnostic, preventive care and treatment methods/technologies for patients in their own homes utilizing telehealth. Problem-based user driven innovation is a key underpinning for TTRN researchers.
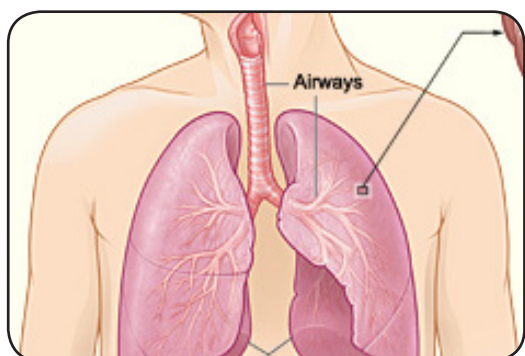
AQUA: Children's Asthma Technology Solution

This project explores home and outdoor pollution and how it affects the health of children with asthma. The study is testing whether an inexpensive home air quality sensor can distinguish between levels of particulate matter in homes of asthmatic children who live with smokers compared to those who do not. This study has the potential to inform future research avenues regarding air quality exposure in pediatric asthma and ultimately lead to possible behavioral modification techniques to improve symptom control.

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KEY AREAS

Data Analytics for Health
Telehealth
Sensors and Services
Mobile Health Apps and Gamification
Precision Medicine
Quantified Self and Wearables

Precision Medicine
Patient Engagement
Chronic Disease
Population Health
Global Health
Connected Health

To learn more, visit: **health.citris-uc.org**

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CITRIS SUSTAINABLE INFRASTRUCTURES INITIATIVE

The Sustainable Infrastructures Initiative pursues information technology research in energy, transportation, and water as parts of the cyber-infrastructure of a sustainable society.

ENERGY
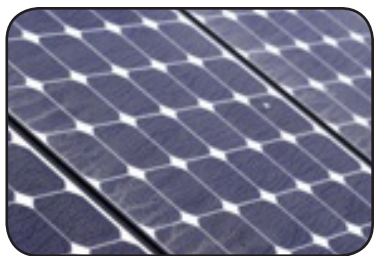
Researchers weave IT and Energy together in a number of projects to improve energy performance at the utility grid, building, and sensors levels. The Micro Synchrophasor project (US DOE ARPA-E funded) brings together CIEE, Computer Scientists from UC Berkeley, LBNL, and Power Standards Lab to develop a device to measure phase angle on utility distribution power lines in order to improve reliability. The Deep Energy Efficiency project of the UC Carbon Neutrality Initiative (UCOP funded) identify strategies to fully scale deep energy efficiency for one major end-use (lighting) at four campuses (including two medical centers), analyze related issues and make recommendations for implementation; UC Berkeley is working with CITRIS partner UC Davis, and UCLA, UCR, and UCSB. The CITRIS headquarters at Sutardja Dai Hall (SDH) showcases several Initiative endeavors, such as acting as a test bed for the Changing the Rules project (CEC funded). The Center for the Built Environment (CBE) and Software Defined Buildings SDB) research groups at UC Berkeley, CIEE, and Taylor Engineering are developing user-centered building services controls in order to improve comfort and save energy. Another project uses SDH as a test bed to use the inherent temporal flexibility in energy consumption to provide various ancilliary services (e.g. frequency regulating, ramping) to the grid in a automated fashion. At the sensor level, along with ChirpMicro, CBE and SDB are developing a low-cost MEMS-based ultrasonic anemometer that will improve building, laboratory, and hospital ventilation performance.

TRANSPORTATION

Led by the Transportation Sustainability Research Center, a newly funded CEC project called Plug-In EV Smart Charging in California brings together faculty and researchers from multiple departments across UC Berkeley including Computer Science and the Energy and Resources Group. The project partners with BMW to integrate electric vehicle charging with other building loads and the electric grid. The Connected Corridors program is a collaborative effort to investigating how corridor components (highways, arterials, buses, and rail) can work together efficiently so they can be managed as an integrated system, to reduce congestion and improve mobility. Connected Corridors will leverage new technologies: the internet, cellular and mobile devices, GPS technology, and social networking; along with building on the experience from previous PATH projects including Tools for Operational Planning (TOPL) and Mobile Millennium. With the Rossmoor Carsharing project, researchers at TSRC have teamed with Nissan in a four-year research effort to explore methods of improving elderly mobility. In the Smart Bay project, cellular data are securely anonymized and used to generate a virtual population.

WATER

The newly formed UC WATER Security and Sustainability Research Initiative (UCOP funded) focuses on strategic research to build the knowledge base for better water-resources management. UC WATER brings researchers together from multiple University of California campuses—Berkeley, Davis, Merced (lead), Santa Cruz, San Diego—and CITRIS. And the embedded sensor network in the American River basin continues to collect data from 12 wireless sensor clusters distributed across the seasonally snow-covered portion of the basin to provide excellent performance and delivery of real-time data on temperature, snowpack and soil moisture, together with less spatially intense energy-balance data.

FACULTY DIRECTOR

David Culler, EECS, Software Defined Buildings

ASSOCIATE FACULTY DIRECTORS

Claire Tomlin, EECS; Control, Intelligent Systems, and Robotics
Duncan Callaway, Energy and Resources Group

CORE FACULTY

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Alexandre Bayen Civil and Environmental Engineering	**Mark Modera** Mechanical and Aerospace Engineering	**Alberto Cerpa** Civil and Environmental Engineering	
Tim Lipman Transportation Sustainability Research Center			
Paul Wright Berkeley Energy and Climate Institute			
Ed Arens Center for the Built Environment			

KEY AREAS

Energy Efficiency	**Transportation**	**Mobile Apps**
Smart Grid	**Electric Vehicles**	**Modeling**
Water Conservation	**Internet of Things**	**Participatory Sensing**
Snow Water Hydrology	**Wireless Sensor Networks**	**Software Defined Buildings**

To learn more, visit: **sustainable-infrastructures.citris-uc.org**

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CITRIS CONNECTED COMMUNITIES INITIATIVE

The Connected Communities Initiative at CITRIS focuses on the affordances of information technology to enhance communities – of learning, of practice, and of governance.

The new initiative embraces the development of experimental online platforms and novel hardware and software systems that connect peers to each other and to institutions in meaningful and productive ways. Building on leadership expertise in human-computer interaction, user interface design, as well as political, social and economic development, the initiative supports projects in domains including education (in MOOCs, peer-to-peer expertise sharing and "maker" communities), collaborative design, philanthropy, journalism, public health, citizen science, and ICT policy. It contributes to our understanding of crowdsourced learning, decision-making and funding. The Connected Communities Initiative supports ongoing activities in the CITRIS Invention Lab, Social Apps Lab, Mobile App Challenge, as well as events related to open data, privacy and security, governance, and related topics.

The Connected Communities Initiative emerges from a long history of projects to improve communications among community members and the elected officials, policymakers and institutions making decisions on their behalf. The Data and Democracy Initiative, founded in 2011 and a precursor to the present Initiative, showcased and supported such projects regarding political, social and economic issues. Examples include the California Report Card, Vote Your Mind, Stories of Solidarity, Peer-to-PCAST, and others.

SAMPLE PROJECTS
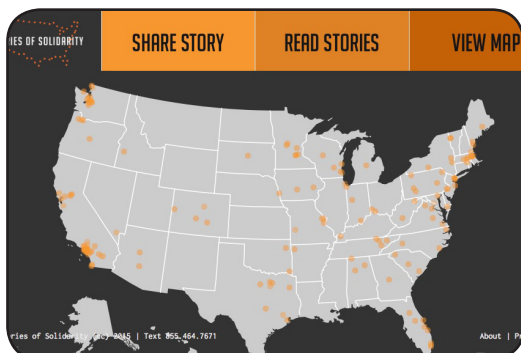
Stories of Solidarity

Stories of Solidarity is a digital labor organizing tool built to connect the experiences of low-income, precarious workers and build connections and solidarity among them. Winning enthusiastic response from gatherings of labor organizers and researchers at UC Davis and UCLA as well as at the 2014 national AFL-CIO convention, Stories of Solidarity has continued to develop technically and enhance its connections and collaborations with labor organizers and academics.
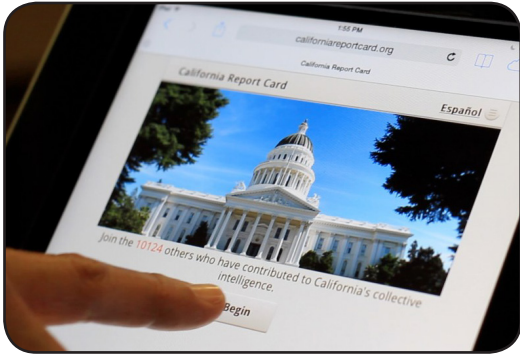
The Collaborative Assessment and Feedback Engine (CAFE)

CAFE is an open source, e-participation platform that provides participants dynamic visual feedback about their position on key social issues, relative to other participants. The platform applies statistical models and collaborative filtering to rapidly discover emerging trends as data is collected. By fostering open-ended dialogue and facilitating a more nuanced assessment of public opinion about complex issues, CAFE enables more informed organizational decisions while increasing participant engagement in decision-making processes.

INTERIM FACULTY DIRECTOR

Eric Paulos, UC Berkeley, Electrical Engineering and Computer Science

CORE FACULTY

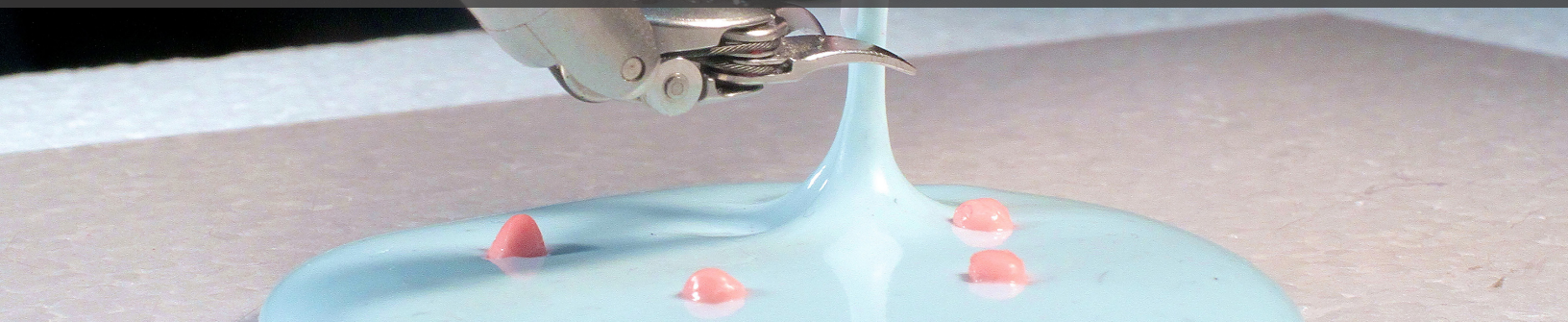| UC Berkeley	UC Davis	UC Merced	UC Santa Cruz
Bjoern Hartmann Electrical Engineering and Computer Science	**Jesse Drew** Cinema and Technocultural Studies	**Steve Roussos** Blum Center for Developing Economies	**Warren Sack** Film and Digital Media
Eric Paulos Electrical Engineering and Computer Science	**Glenda Drew** Design	**Robin DeLugan** Anthropology	

KEY AREAS

Participatory Platforms and Social Apps
Interactive Media
Connected Devices
Online Learning Communities
Crowdsourcing

Communitysourcing
Open Data
Privacy and Security
Digital Governance

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Cloud Robotics, Deep Learning, Human-Centric Automation, and Bio-Inspired Robotics

are among the primary research themes of the **CITRIS People and Robots Initiative** that focuses on new theory, benchmarks, software, and approaches that address challenges in the interest of society.

SAMPLE PROJECTS
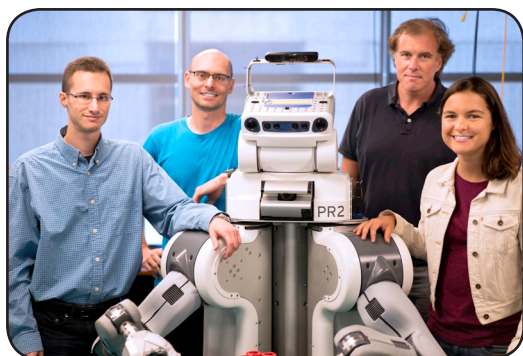
Deep Learning for Robotics

In this project we aim to develop deep learning techniques that can be deployed on a robot to allow it to learn directly from trial-and-error, where the only information provided by the teacher is the degree to which it is succeeding at the current task. Deep learning is a branch of machine learning that is concerned with learning structure, representations, and underlying patterns in complex "raw" data, such as images and sounds. *rll.berkeley.edu/deeplearningrobotics*
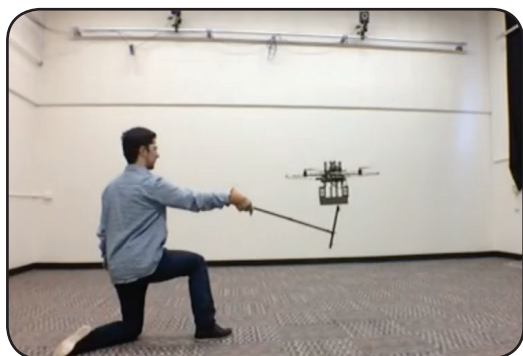
Human-centered Automation

A key focus of this initiative is human-centered automation, that is, designing automation that works well with people. We are developing a principled design framework that takes the human into account, particularly for systems in which the control authority is shared between the human and the automation. Our framework incorporates machine learning with safety-based control, so that the system can learn properties of human interaction while still providing certificates of safety.

Cloud Robotics and Automation

Rather than viewing robots and automated machines as isolated systems with limited computation and memory, "Cloud Robotics and Automation" provides access to 1) Big Data: access to updated libraries of images, maps, and object/product data, 2) Cloud Computing: access to parallel grid computing on demand for statistical analysis, learning, and motion planning, 3) Collective Learning: robots and systems sharing trajectories, control policies, and outcomes, and 4) Human Computation: use of crowdsourcing to tap human skills for analyzing images and video, classification, learning, and error recovery. Cloud Robotics and Automation raises critical new questions related to network latency, quality of service, privacy, and security.

FACULTY DIRECTOR

Ken Goldberg, UC Berkeley, Medical Robotics, Learning, Manufacturing, Automation

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Claire Tomlin Controls, Perception, Human Machine Systems			

KEY AREAS

Cloud Robotics
Deep Learning
Human-Centric Automation
Bio-Inspired Robotics
Statistical Sampling
Robustness
Privacy

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