UC RIVERSIDE
Research and Economic Development

OASIS - Internal Funding Awards

Plan Bee: Breeding Healthy Honeybees using Intelligent Sensing to Safeguard Sustainable Food Production

Principal Investigator: Boris Baer, Professor, Entomology

Co-Principal Investigators: Hyoseung Kim (electrical & computer engineering), Ashok Mulchandani (chemical & environmental engineering), Vassilis Tsotras (computer science & engineering)

Area of focus: Agriculture Technology & Food Security

For thousands of years, honeybees have provided mankind with food, such as honey, or through their pollination activities for over 80 different crops. These contributions were often taken for granted, but beekeepers now struggle to keep these six-legged friends alive, resulting in unsustainable losses each year. To address this issue, we have formed a network of researchers and beekeepers to develop new and innovative tools for breeding and maintaining healthy bees.

We have identified locally occurring bees that can tolerate environmental stressors, including adverse climatic conditions and various parasites. To monitor their breeding performance and detect early signs of declining bee health, we have begun developing sensors that we deploy inside beehives to collect key data related to colony function. With funding from OASIS, we anticipate significant advances in our research.

Our first objective is to test novel sensors that can quantify bee defensiveness and identify gentle bees. Additionally, we aim to build and deploy a bee-specific sensor to detect disease outbreaks in colonies. Finally, we will design, test, and optimize an upgraded sensor platform to monitor bee health during environmental stress conditions in both laboratory and field settings.

The collection of large datasets will enable us to utilize machine learning and artificial intelligence to develop algorithms capable of identifying early signs of declining bee health. A functional bee health sensor would be a game changer for beekeepers, extending far beyond California's borders, as it could diagnose specific problems within hives early enough to prevent colony collapses.

Prytaneum: Collaborative Public Meetings on Implementing K-12 Mental Health Spending

Principal Investigator: Kevin Esterling, Professor, Public Policy & Political Science

Co-Principal Investigators: Mehdi Nemati (public policy), Michail Faloutsos (computer science & engineering), Mariam Salloum (computer science & engineering), Mark Wolfson (social medicine, population, and public health)

Area of focus: Community Health & Health Disparity

This collaboration between the State of California Mental Health Services Oversight and Accountability Commission (MHSOAC) and UCR faculty in Public Policy, Political Science, Computer Science, and Social Medicine aims to complete the development of Prytaneum, an online platform designed to host inclusive, constructive, and effective public meetings. The platform will then be evaluated in regional public meetings focused on implementing mental health services in Riverside County public schools.

Prytaneum is specifically designed to create robust opportunities for residents to share their thoughts on policy topics synchronously during public meetings. This will enable public officials to understand the diverse perspectives within their community. This community health and health disparities project advances three of the OASIS horizontal goals.

To advance innovation, Prytaneum reinvents and reimagines traditional webinar technology, providing opportunities for all participants to engage. Unlike current webinar tools that disempower community members, Prytaneum is expected to usher in a new generation of tools that enhance democratic dialogue and constructive communication.

To advance social inclusion, Prytaneum ensures that underrepresented voices in the community are heard and prioritizes balanced and constructive user engagement. Our meetings will inform outreach efforts to identify early signs of unmet mental health needs, reduce stigma and discrimination, and prevent unmet mental health needs from becoming severe and disabling. We will particularly focus on addressing the needs of historically underserved communities.

To advance education and workforce development, this project will provide valuable insights to the MHSOAC as it oversees millions of dollars in grant funding in Riverside County to support mental health initiatives in schools and the community.

If successful, Prytaneum will serve as a general solution for enabling inclusive engagement at scale for any research team or public agency in the region, state, and beyond.

Making Magic: Building a Collaborative Relationship between the Department of Theater Film and Digital Production (TFDP) and the Bourns College of Engineering (BCOE) through Projects in Theater and Film

Principal Investigator: Rickerby Hinds, Professor, Theater Film & Digital Production

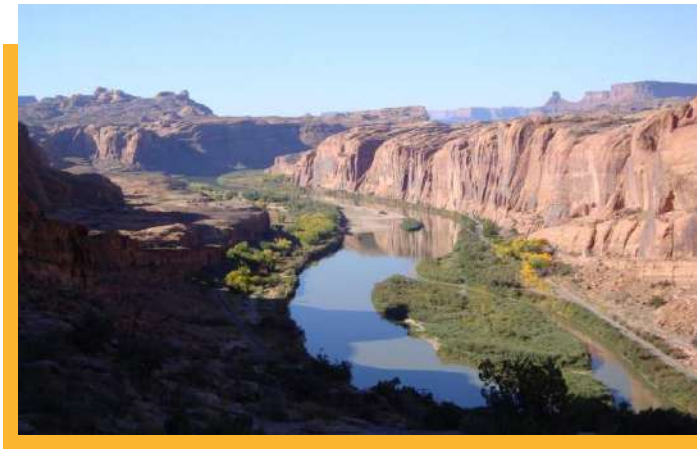
Co-Principal Investigators: Roman Chomko (electrical & computer engineering), Sundararajan Venkatadriagaram (mechanical engineering)

Area of focus: Human Development

Theater and Engineering are vastly different disciplines, yet they share a common goal: creativity. The Department of Theater Film and Digital Production (TFDP) at the University of California, Riverside, is a pioneer in promoting interdisciplinary collaborations in the arts, and the Bourns College of Engineering (BCOE) is known for its excellence in innovation and engineering research. By combining the strengths of these two parts of UCR's campus, we aim to create a unique and innovative program that will provide students with opportunities to work in the arts and engineering, translating their skills to the real world upon graduation. Additionally, we believe that Making Magic can serve as a model for interdisciplinary collaboration.

Making Magic will bridge the gap between the arts and engineering. It will produce a new generation of versatile, adaptable graduates with diverse skills that will serve them well in the rapidly changing job market. The future workforce will require creative, innovative, and flexible individuals capable of working collaboratively across different fields and disciplines. By closing the gap between the arts and engineering, this collaboration will produce graduates uniquely equipped to meet the demands of the 21st-century workforce.

In addition, Making Magic will prioritize sustainability by selecting environmentally friendly materials and manufacturing techniques. We will explore using recycled materials and build on an established practice in TFDP by repurposing previously used materials. By incorporating sustainable practices into our collaboration, we hope to set an example for our students and the industry.



Implications of Sharing Colorado River Water to Southern California Under Climate Change: A User-friendly Tool

Principal Investigator: Mehdi Nemati, Assistant Professor, Public Policy

Co-Principal Investigators: Hoori Ajami (environmental sciences), Ariel Dinar (public policy)

Area of focus: Natural Resource Management

The Colorado River basin supplies roughly one-third of all water for Southern California cities and supports a large farming industry in Imperial and Riverside counties. However, the basin faces significant challenges due to climate change-induced aridification processes and over-allocation problems. These challenges are further complicated by conflicting agricultural, environmental, municipal, and political interests. The impacts in the upper and lower regions of the Colorado River basin will directly affect Southern California.

To address these complex water challenges, the Colorado River Basin Hydro-Economic Partnership, consisting of researchers and basin stakeholders, proposes the development of a hydro-economic model. This model will link natural and built water infrastructure with environmental and socio-economic activities, providing valuable insights into policy options and their impacts on the California part of the basin. We have two primary goals for this proposal, which we consider essential for addressing public interests.

Our first goal is the development of an analytical model that will accurately simulate the current and future impacts of climate change on the basin. We will then test various policy interventions to evaluate their effectiveness in resolving water supply issues. Our model encompasses municipal, industrial, hydropower, agricultural, and environmental uses, as well as Native American Tribes, physical infrastructure, and institutional arrangements.

Our second goal is to develop a user-friendly online tool. This tool will enable state and local elected officials, water utility leaders, water managers, and stakeholder groups to collaborate on policy and decision-making. It will be publicly accessible and designed to ensure inclusion and representation in the decision-making process, particularly for climate-vulnerable communities.

Through close collaboration with stakeholders and an inclusive approach, we aim to develop a robust model and user-friendly tool that can support informed policy and decision-making, promote sustainable outcomes, and address the complex water challenges faced by the Colorado River basin.

Ammonia as a Hydrogen Carrier: Processing and Feasibility

Principal Investigator: Lorenzo Mangolini, Professor, Mechanical Engineering

Co-Principal Investigators: Bryan Wong (chemical & environmental engineering), Francisco Zaer (chemistry), Ashish Sood (marketing)

Area of focus: Renewable Energy and Fuels

Hydrogen is often considered the solution to the main problem associated with hydrocarbon-based fuels: carbon dioxide (CO_2) emission after combustion. Shifting from hydrocarbons to hydrogen as a chemical energy storage medium is an undertaking that requires massive-scale technical innovation. One crucial aspect of this technology shift is hydrogen transportation. However, hydrogen poses challenges in terms of long-term storage and liquefaction. But ammonia is simpler to store than propane. Although burning ammonia directly may release nitrogen oxide, leading to environmental issues such as acid rain, it would be preferable to dissociate ammonia into nitrogen and hydrogen, ideally at the point of use.

This project addresses the need for a technology that efficiently dissociates ammonia at a small scale, compatible with the distribution and on-board utilization of ammonia as a hydrogen carrier. Our team comprises experts in process design, computational chemistry, catalyst design and characterization, and techno-economic analysis. This combination of expertise is essential for advancing the fundamental science of ammonia as a novel hydrogen carrier and assessing its economic viability. This project aligns with the "Renewable Energy and Fuels" pillar because it focuses on displacing carbon-based fuels contributing to anthropogenic CO_2 emissions and global climate change. Students involved in this project will gain a rich educational experience, as they will not only learn about the fundamental scientific aspects of disruptive technology, but also understand its implications from an economic perspective, making it an excellent opportunity for entrepreneurial activities. In summary, this proposal directly addresses the "sustainability," "innovation," and "education and workforce development" horizontal goals of OASIS.

Equity, Sustainability, and Community Engagement in AI-Integrated Disaster Management

Principal Investigator: Basak Guler, Assistant Professor, Electrical & Computer Engineering

Co-Principal Investigators: Hamed Mohsenian-Rad (electrical & computer engineering), Tony Grubesic (public policy), Ran Wei Grubesic (public policy)

Area of focus: Sustainable Transportation & Infrastructure

Artificial Intelligence (AI)'s role in disaster management, including climate-change-intensified disasters, is becoming increasingly more significant. It has critical applications in damage assessment, crowdsourcing, prediction, planning, and preparedness.

However, to successfully utilize AI for emergency and disaster management, it is crucial to develop holistic response strategies that address the priorities and needs of the communities. Customized or tailored tactics are necessary to align resource allocations with local needs while considering existing neighborhood capacities, resilience, and the utility of the AI-integrated decision-making process

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The project aims to tackle these critical social and environmental challenges, informing the roadmap and decision-making infrastructure to achieve equity, sustainability, and community engagement in AI-integrated disaster management for common climate-exacerbated natural disasters. The proposed research contributes to the horizontal goals of OASIS in sustainability, innovation, and social inclusion. It will establish the foundation of sustainable AI in disaster management (sustainability), develop the algorithmic principles of AI-integrated disaster management for fairness and sustainability (innovation), and enhance the quality of service, community engagement, and representation of underrepresented and underserved communities in data-driven systems (social inclusion).

Furthermore, the research contributes to the vertical goal of OASIS in sustainable transportation and infrastructure. It addresses sustainability in logistics for disaster management and critical infrastructure hardening, such as the energy infrastructure, and examines its impact on AI-driven computations.

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AGRICULTURE TECHNOLOGY & FOOD SECURITY

A Novel Multifunctional Crop Performance Stimulant for Sustainable Controlled Environment Agriculture
Principal Investigator: Thomas Eulgem (botany and plant sciences)

Genetic Manipulation of Calcium-binding EF-hand Proteins to Improve Thermotolerance in Select Sorghum Varieties
Principal Investigator: Dawn Nagel (botany and plant sciences)

Leveraging a Novel Symbiosis to Expand Nitrogen Fixation in Crops
Principal Investigator: Joel Sachs (evolution, ecology, and organismal biology)

Power-Free and Pipette Free CRISPR Detection Device for Leaf Spot Diseases
Principal Investigator: Ke Du (chemical & environmental engineering)

Quantifying the Impacts of Feedstock Fermentation on Black Soldier Fly Frass Fertilizer Qualities and Greenhouse Gas Emissions
Principal Investigator: Kerry Mauck (entomology)
Co-Principal Investigators: Marco Gebiola (entomology) and Francesca Hopkins (environmental sciences)

COMMUNITY HEALTH & HEATH DISPARITY

Climate Anxiety and its Impact on Mental Health and Brain Development among Preadolescent Latina Girls in the Inland Empire
Principal Investigator: Kalina Michalska (psychology)
Co-Principal Investigator: Jade Sasser (gender & sexuality studies)

Curriculum Reforms, Adult Health and Mortality
Principal Investigator: Ozkan Eren (economics)
Co-Principal Investigators: Bahadir Dursun (public administration & policy, American University) and Erdal Tekin (economics, Newcastle University)

HUMAN DEVELOPMENT

Resilience of Human Social Systems in Marginal and Changing Environments Examined through Archaeological Skeletal Remains
Principal Investigator: Elizabeth Berger (anthropology)
Co-Principal Investigator: Sara Becker (anthropology)

Advancing Gender Equity through Dialogue Systems Tailored for Inland Empire Education Agencies
Principal Investigator: Yue Dong (compUter science and engineering)

NATURAL RESOURCE MANAGEMENT

Climate and Air Quality Impacts Associated with Methane Shortwave Absorption
Principal Investigator: Robert Allen (earth and planetary sciences)

Development of a Biosensor for Facile, Rapid, On-site Detection of GenX in Water
Principal Investigator: Ying-Hsuan Lin (chemical & environmental engineering)

Equitable Wildfire Preparedness: Influence of Homeowner Wealth on Wildfire-Resilient Landscaping
Principal Investigator: Erin Conlisk (Center for Conservation Biology)
Co-Principal Investigator: Helen Regan (biology)

Improving Thermal Treatment Technologies for the Sustainable Remediation of Per- and Polyfluoroalkyl Substances (PFAS)-Contaminated Waste and Environmental Matrices
Principal Investigator: Ashok Mulchandani (environmental sciences)

Scaling Climate Solutions from Tree Neighborhoods to Whole Forests with Real-time Tree Health Data
Principal Investigator: Marko Spasojevic (evolution, ecology, and organismal biology)
Co-Principal Investigator: Louis Santiago (botany and plant sciences)

RENEWABLE ENERGY & FUELS

Engineering an Environmental Sensing Network of a Filamentous Fungus for Plant Cell Wall Deconstruction
Principal Investigator: Katherine Borkovich (microbiology and plant pathology)

Incorporation of Extremophile Genes for Improved Yeast Biofuel Production
Principal Investigator: Joshua Morgan (bioengineering)
Co-Principal Investigator: Ian Wheeldon (chemical & environmental engineering)

Stakeholder Collaboration on Land and Transmission Availability for Solar and Storage in Inland California's Energy Transition (SOLSTICE)
Principal Investigator: Alfredo Martinez (CE-CERT)
Co-Principal Investigators: Ronald Loveridge (political science) and Fred Schwartz (CE-CERT)

Predictive Simulations and Experiments for High-Throughput Screening of Promising Hydrogen-Storage Materials
Principal Investigator: Bryan Wong (chemistry)
Co-Principal Investigator: Charles Cai (chemical & environmental engineering)

SUSTAINABLE TRANSPORTATION & INFRASTRUCTURE

CooperScene: Cooperative Autonomous Driving Dataset
Principal Investigator: Hang Qiu (electrical and computer engineering)
Co-Principal Investigator: Amit Roy-Chowdury (electrical and computer engineering)

Robust Learning for Sustainable Vehicular Edge Computing Networks
Principal Investigator: Shaolei Ren (electrical and computer engineering)