TEXAS A&M UNIVERSITY-CORPUS CHRISTI

ANNUAL REPORT
RESEARCH & INNOVATION

2024

A Message from the Executive Vice President for Research and Innovation

ARTIFICIAL INTELLIGENCE AT THE ISLAND UNIVERSITY

As Texas A&M-Corpus Christi celebrates a historic milestone of over $50 million in annual research expenditures — an impressive increase of 25% from last year and 84% since 2017 — the university solidifies its position as the intellectual capital of the region. Our R2 research designation continues to shine, now reaching levels of excellence comparable to R1 institutions.

At the heart of this progress is the transformative power of Artificial Intelligence (AI), which is driving innovation across our academic, research, and administrative domains, unlocking new opportunities, and expanding the frontiers of innovation.

This report highlights how Islanders are harnessing AI to spearhead transformative research in critical fields such as health care, environmental science, and engineering. Additionally, the impact of AI is well-pronounced in the arts and other creative activities. More importantly, Islanders' innovations are driven by social and economic prosperity.

These advancements elevate our university's position as a leader in AI innovation, creating a dynamic environment where creativity and technology intersect. And, as we progress in our AI initiatives, we remain firmly committed to their responsible and ethical application.

I eagerly anticipate the continued progress and collaborative efforts that will define our journey into this exciting new era.

Ahmed Mahdy

Ahmed Mahdy
Executive Vice President for Research and Innovation
Texas A&M University-Corpus Christi

Research by the *Numbers*

#1

TAMUS regional university in research expenditures

#1

TAMUS regional university in federal, state, and local research funding

#1

TAMUS regional university in engineering research expenditures

#1

TAMUS regional university in atmospheric, ocean, and geoscience research expenditures

Per the FY2022 NSF Higher Education Research and Development (HERD) Survey

AI & AGRICULTURE

SMART FARMING

AI is increasingly transforming agriculture by improving productivity, efficiency, and sustainability.

At TAMU-CC, a project led by Dr. Dugan Um, Associate Professor of Mechanical Engineering, aims to revolutionize traditional farming practices by focusing on tomatoes to pave the way for a sustainable agricultural future. The four-year initiative has secured $647,704 in funding from the U.S. Department of Agriculture's National Institute of Food and Agriculture program. The production of fresh-market tomatoes in the United States has declined from 3.9 billion pounds in 2000 to 1.4 billion pounds in 2019. This drop is due to labor shortages, higher labor and production costs, and an increased international competition.

Enter the autonomous bio-cell: a revolutionary smart farming system that grows crops with minimal resources and human intervention. By leveraging AI-enabled engineering technologies, increasing automated tasks (including pollination, pruning, bad fruit and branch removal, and robotic harvesting), and integrating advanced computational methods with big data analytics for better decision-making, this innovative bio-cell can create a highly efficient, data-driven crop production system capable of performing and producing better tomatoes than can be produced using open-field farms.

Researchers envision a low-cost, mass production of tomatoes that will benefit farmers via large-scale bio-cells. The groundbreaking technology can even allow daily home harvesting of fresh tomatoes.

USDA National Institute of Food and Agriculture
U.S. DEPARTMENT OF AGRICULTURE

Read more about another USDA-funded program that integrates data science, AI, drone technology, and geospatial analytics to prepare Island University students for careers in both plant and animal agriculture systems.

Scan to learn more.

AI FOR CLEANER OCEANS

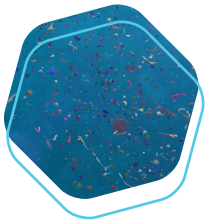
The Conrad Blucher Institute (CBI) reaffirms its commitment to advancing trustworthy AI to protect lives, resources, and ecosystems along the Gulf Coast. Working with the citizen science project Nurdle Patrol, CBI is developing Nurdle Count, an AI-powered tool to identify and count nurdles — small plastic pellets polluting oceans and waterways.

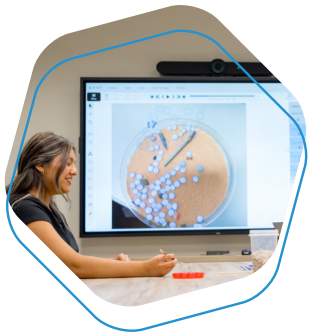
"AI enhances our ability to detect and quantify nurdles, improving our understanding of microplastic pollution and its impacts," said Seneca Holland, a geospatial research scientist leading the project.

Researchers are creating a library of high-quality nurdle photos in collaboration with citizen scientists to train the AI model to identify and count nurdles. Once the AI model is completed, Nurdle Count will be integrated into Nurdle Patrol's website and mobile apps, enabling users to upload photos and generate counts of their collected nurdles. The project is funded by a $284,505 gift from the Matagorda Bay Mitigation Trust.

"Citizen scientist contributions are crucial; they assist us in building an AI model that makes significant strides in measuring microplastic pollution and contributes to environmental conservation efforts," said CBI's Son Nguyen, a leading researcher on the project.

Automating the nurdle counting process will make data collection quicker and more consistent, improving the ability to understand and regulate microplastic pollution.





PREDICTION FOR PROTECTION

In collaboration with Florida International University and the AI Institute for Research on Trustworthy AI in Weather, Climate, and Coastal Oceanography (AI2ES), CBI is also using deep learning and explainable AI to help establish the Southeast Florida Coastal Environmental Data and Modeling Center. This center will develop AI methods to predict water levels, sea level changes, and coastal flooding in Florida, improving emergency preparedness, reducing infrastructure damage, and protecting communities and ecosystems from severe flooding impacts.

This project builds on nearly 25 years of CBI's pioneering work in environmental AI. Recognized for its early adoption of AI for environmental predictions, CBI has co-led one of the inaugural national AI institutes established by the National Science Foundation. Collaborating with educational institutions and industry giants like Google, NVIDIA, The Weather Company, and National Laboratories, CBI has developed trustworthy AI to improve the understanding and anticipation of beach inundation, coastal fog, and sea turtle cold stunning events. These advancements have led to enhancements in transportation safety, coastal sustainability, and emergency response efforts.

Turning The Tide

As harmful algal blooms threaten the Texas coast with severe economic and environmental damage, researchers at the Harte Research Institute for Gulf of Mexico Studies at TAMU-CC are turning to AI to stay one step ahead. Discover how cutting-edge technology is being used to monitor these toxic tides and prevent their devastating impacts.

Scan to learn more.

AI & HEALTH CARE

ADVANCING AI IN HEALTH CARE EDUCATION

A slow yet steady revolution is underway in the realms of AI and health care. AI has demonstrated its ability to enhance patient care, improve outcomes, and optimize training for health care professionals. However, it is important to understand that AI is designed to augment human capabilities, not replace them.

In 2023, Dr. Heather DeGrande, Associate Professor in the College of Nursing and Health Sciences, attempted to leverage ChatGPT in academic nursing. Islander nursing students were offered the option to use ChatGPT for writing argumentative essays. While many students found that well-crafted prompts yielded more effective results and sparked ideas beyond their assignments, they also reported significant drawbacks. Specifically, they noted that much of ChatGPT's output lacked supporting research and evidence and omitted key elements necessary for a strong argument.

Dr. Rinki Suryavanshi, the university's Instructional Design Team Lead in Digital Learning and Academic Innovations, joined DeGrande in the common interest of effective AI-prompt engineering in academic nursing. Together, they explored diverse strategies for prompt engineering in large language models like ChatGPT, aiming to enhance output, and created a presentation which highlighted creative techniques for crafting prompts that generate accurate responses, optimizing both the quality and relevance of the results.

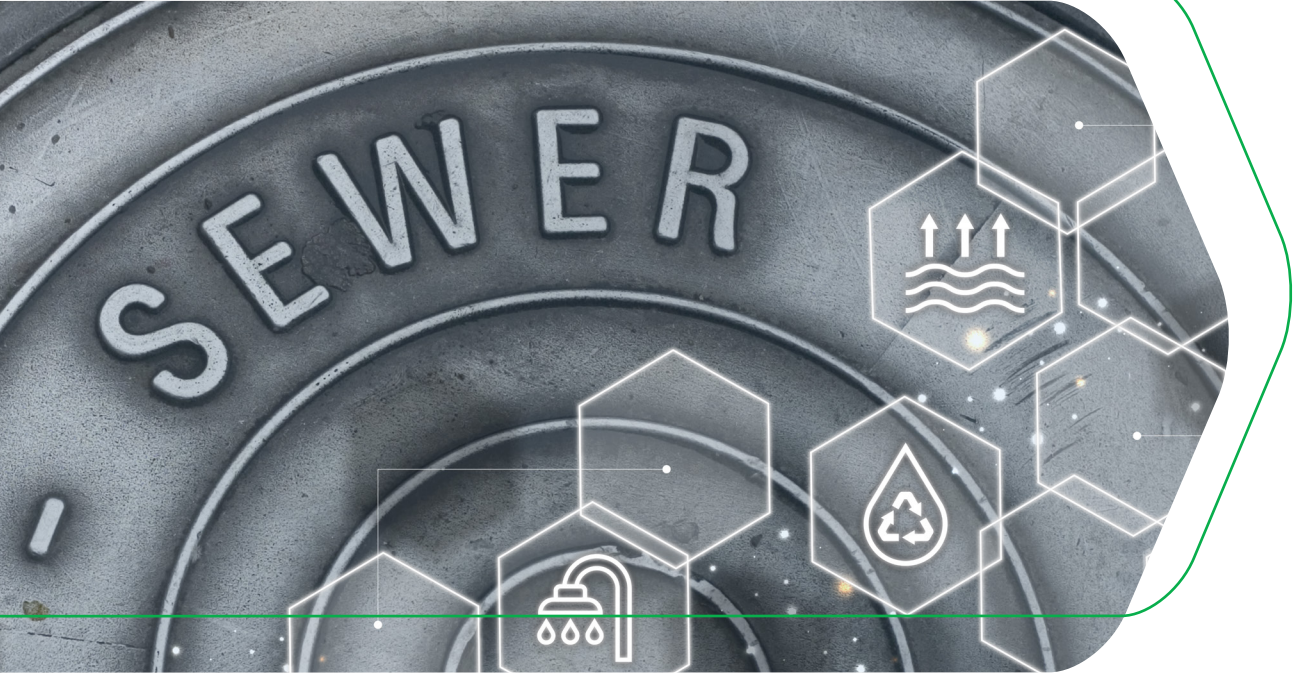
"AI-enabled large language models will continue to be a part of nursing academia for the foreseeable future," the researchers said. "The good news is that they are also predicted to improve exponentially. As educators, our job is to teach responsible use of AI and to remind our students that human oversight remains essential for verifying AI outputs. Progress with AI in healthcare has occurred slowly and incrementally with some hesitancy, but each new study or exploration will expand our knowledge base and uncover opportunities for advancement in the area of AI in the academy."

AI-ENABLED SIMULATION

An AI-enabled mannequin is revolutionizing how Islander nursing students master critical care. This advanced interdisciplinary patient simulator, named "Hal," can mimic health emergencies such as facial droop, seizures, sweating, and tears, providing realistic scenarios for students to practice ultrasounds, airway management, blood draws, catheterization, defibrillation, and more.

This new mannequin has allowed the college to expand its simulation education offerings, which already included VR simulation goggles.

Lexi Vacek '25



AI & TECHNOLOGY

SMART SEWERS

While sewage overflows are often an unfortunate consequence of much-needed downpours, a glimmer of optimism is emerging. The Island University, in collaboration with the City of Corpus Christi, has launched a groundbreaking partnership to not only mitigate sewage overflow challenges, but also revolutionize how cities manage their aging sewer systems.

The project is led by Drs. Wenlu Wang, Assistant Professor of Computer Science, and Dr. Hua Zhang, Associate Professor of Civil Engineering. Their secret weapon? Cutting-edge AI, which will usher in a new era of proactive, tech-driven solutions to address environmental, public health, economic, and legal concerns.

Traditionally, assessing an aging urban sewer system is a daunting and reactive task due to its complexity and the significant workforce required. Fortunately, the AI models and technological advancements introduced by TAMU-CC make this ambitious goal achievable.

"Until now, the city had to manually inspect each sewer pipe, a tremendously time-consuming process often prompted only by resident reports," Zhang said. "Our AI model can scan and identify hydrologic and hydraulic dependencies throughout the entire sewer system. By working with a series of sensors, we can detect potential leakage or overflow risks before they become problems."

The project, which is supported by the National Science Foundation and the City of Corpus Christi, also sponsors the training of up to three TAMU-CC doctoral students.

"This project not only benefits the local community, but also serves as the foundation for future engineers and computer scientists to work with this advanced technology for the greater good," Wang said.

The team hopes their process can create a prototype that can then be adapted to suit the needs of other cities.

ISLANDER ADVANTAGE WITH AI RESUME TOOL

Current Islander students can use Quinncia, an AI-powered career platform that boosts job search success. It offers instant, personalized resume feedback and customized mock interviews with AI-driven critiques to help students refine their presentation skills.

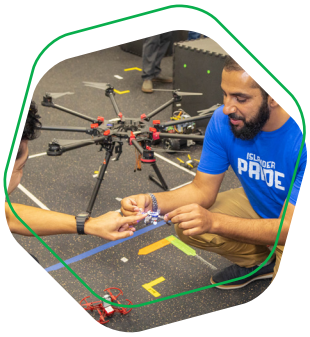
Scan to learn more.

AUTONOMOUS MULTI-ROBOT SYSTEMS

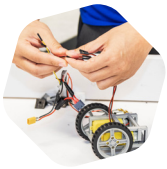
The university's Coordinated Autonomous Systems for Exploration and Reconnaissance (CASER) project aims to enhance the capabilities of Unmanned Autonomous Systems (UAS) for exploration and reconnaissance in complex land and aerial environments. A group of engineering faculty and student researchers is experimenting with robust multi-robot teams to test swarm coordination and autonomy while collecting multimodal data using 3D remote sensing methods such as 3D light detection and ranging (LiDAR) instruments and cameras.

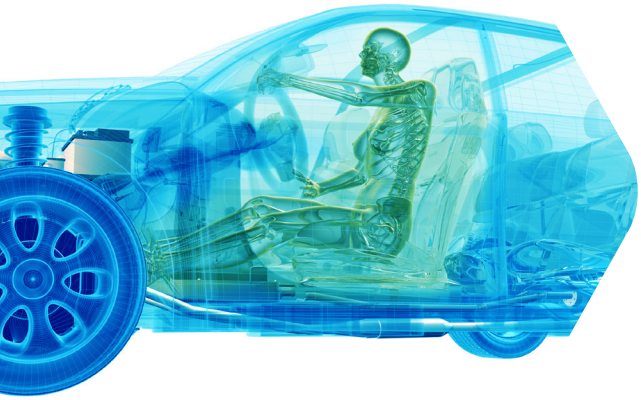
"Multi-robot teams serve various purposes, such as in search-and-rescue scenarios, coastal resilience, transportation, and even space exploration," said Dr. Jose Baca, Associate Professor of Engineering and Primary Investigator. "Our study engages AI strategies to enable robot teams to create formations, identify terrain characteristics, obstacles, environmental conditions, and to perform structural assessments without compromising the mission by maximizing tactical maneuvers, minimizing exposure, and reacting successfully to contact."

The work is being conducted in the university's Collaborative Robots and Agents Lab and various outdoor locations. Co-PIs include Drs. Thang Nguyen and Pablo Rangel, Engineering Assistant Professors, along with Dr. Miguel Cid Montoya with Clemson University. Their work is sponsored by a $752,000 Department of Defense (DoD) HBCU/MI grant that spans four years.







AI-DRIVEN AUTOMOTIVE RESEARCH

Since 2017, the Island University has maintained steady research collaborations with Hyundai Motor Company, conducting various research projects focused on automotive ergonomics.

The latest study involves the use of AI-driven statistics to design a more comfortable seat by analyzing the relationships between a driver's body size and shape, seat material properties, and seating comfort.

The project is a collaboration between two additional institutions, including the University of Ulsan in South Korea and the University of Michigan Transportation Research Institute.

Autonomy Research Institute

Learn more about the Autonomy Research Institute (ARI), the next chapter for Lone Star UAS Center of Excellence and Innovation at TAMU-CC. The university's newest institute is dedicated to pioneering advancements in autonomous systems across air, land, water, and space with varying degrees of human oversight — from tasks requiring constant human intervention to tasks performed entirely independently.

Scan to learn more.

Ian Manseau '26

AI & ART

SCULPTING THE FUTURE

Ian Manseau '26, a Master of Fine Arts (MFA) candidate and a retired United States Air Force veteran, is revolutionizing his creative process by integrating AI. Under the mentorship of Jonathan Durham, Assistant Professor of Art, Manseau employs ChatGPT to fuel his artistic inspiration for his groundbreaking MFA project, "Artificial Aesthetics."

"Artificial Aesthetics" challenges traditional notions of authorship, creativity, and technology's role in art. Manseau engages in dynamic conversations with ChatGPT, using the chatbot to generate ideas and guide the construction of his sculptures. This interactive process infuses an element of unpredictability and randomness into his work, allowing the chatbot's decision-making to influence final outcomes.

"The component of relinquished control introduces a level of surprise in the creation process, blurring the lines between the intent of the artist and the execution and interpretation of AI," Manseau said. "The project is not just another sculptural series, but a philosophical discussion of the nature of art and creativity in the 21st century."

Manseau hopes his series sparks conversations on the potential for new forms of artistic collaboration, heralding a new era where technology and art collide.

LIGHTS, CAMERA, AI IN ACTION

An integral focus of the film program at the Island University pertains to AI, which enables student filmmakers to access world-building techniques like never before — all from their computers.

Traditionally, filmmakers faced significant costs related to special effects, location shoots, and hiring large crews. However, AI offers a new paradigm, allowing emerging filmmakers to achieve high-quality results without prohibitive expenses.

"Thanks to AI, filmmakers can now add intricate details like virtual graffiti or generate larger-than-life effects, such as explosions or fantastical creatures, with little associated cost," said John Darbonne, Assistant Professor of Media Production. "AI empowers a new generation of creators to bring their visions to life with a level of quality and sophistication previously reserved for well-funded studios."

AI can also be used in film color correction, sound design, and film marketing and distribution.

"As educators, we must adapt our teaching to include AI to maximize the employability of our students, as AI literacy is one of the most sought-after new skill sets in the film industry," Darbonne said.