Re-Engineering for a Sustainable Future
The College of Engineering at the University of Hawai‘i at Mānoa (UH Mānoa) has approximately 1,100 enrolled students with approximately 900 undergraduates and 200 graduates. It has another 300 pre-engineering undergraduate students bringing the overall number to 1,400. It has approximately 55 tenure-track faculty members, staffing three academic departments: mechanical engineering, electrical engineering, and civil and environmental engineering and an organized research center, the Hawai‘i Center for Advanced Communications. The College generates approximately $7 million a year in research expenditures from federal and state sources.

**THE ENGINEERING DEAN**

Peter E. Crouch, the Dean of the Engineering College at UH Mānoa was elected a member of the Executive Board of the Engineering Deans Council of the American Society for Engineering Education in 2011 and is serving until 2014. He earned a doctoral degree in applied sciences from Harvard University, is a Fellow of the Institute of Electrical and Electronic Engineers and has over twenty years of academic leadership experience.

**THE PROFESSIONAL ENGINEERING ENVIRONMENT IN HAWAI‘I**

The College of Engineering at the University of Hawai‘i at Mānoa provides a very significant proportion of the engineering work force in Hawai‘i, being the only Hawai‘i institution graduating significant numbers of engineering students. The alumni of the program constitute an important support group for the College as well as constituting a large proportion of the professional engineers in Hawai‘i. The employers of the engineering profession are divided into the three principal areas: military support (Naval Facilities Engineering Command, U.S. Army Corps of Engineers, dual-use companies and major military defense suppliers, etc.), private engineering companies, including construction, utilities (Hawaiian Electric Company, etc.) and Hawai‘i state and local government (transportation, water, sewage etc.). These are complemented by growing industries such as renewable energy, high-technology (dual use, software, gaming, etc.) and food production. The industry provides membership of a vibrant Dean’s Council, advisors to the Dean.

**COLLEGE VISION**

**Re-Engineering for a Sustainable Future**

The College of Engineering is an indispensable facet of sustainable living in Hawai‘i and the Asia-Pacific region. It is recognized as leading the development of innovative solutions to meet the increasingly complex needs of our society.
The Department of Civil & Environmental Engineering offers the BS degree program in civil engineering, which is ABET Accredited. This program covers construction management, environmental and water resources engineering, geotechnical engineering, structural engineering, and transportation engineering.

The Department of Electrical Engineering offers the BS degree program in electrical engineering and began a BS degree program in computer engineering in 2010. The BS in electrical engineering program is ABET accredited and covers electro-physics (solid-state devices and sensors, analog and digital circuit design, microwaves, and photonics), and systems (telecommunications, automatic controls, signal processing). The BS degree program in computer engineering covers hardware and software aspects of computers and computing.

The Department of Mechanical Engineering offers the BS degree program in mechanical engineering. This program covers thermo-fluids, mechanics & design, and materials & manufacturing. The BS in mechanical engineering program is ABET accredited.

The Hawai‘i Center for Advanced Communications supports the BS degree program in electrical engineering, offering courses, research laboratory facilities, and project opportunities.

Undergraduate Degree Programs

The Department of Civil & Environmental Engineering offers the BS degree program in civil engineering, which is ABET Accredited. This program covers construction management, environmental and water resources engineering, geotechnical engineering, structural engineering, and transportation engineering.

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The Department of Mechanical Engineering offers the BS degree program in mechanical engineering. This program covers thermo-fluids, mechanics & design, and materials & manufacturing. The BS in mechanical engineering program is ABET accredited.

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Graduate Degree Programs

The Department of Civil & Environmental Engineering offers the MS and PhD degree programs in civil engineering. These programs cover construction management, environmental and water resources engineering, geotechnical engineering, structural engineering, and transportation engineering.

The Department of Electrical Engineering offers the MS and PhD degree programs in electrical engineering. These programs cover electro-physics (solid-state devices and sensors, analog and digital circuit design, microwaves, and photonics), and systems (telecommunications, automatic controls, signal processing), and computers (architecture, algorithms, networking, hardware, and software). It was recently ranked 84th in electrical engineering graduate programs in the US News and World Report Best Graduate Schools ranking.

The Department of Mechanical Engineering offers the MS and PhD degree programs in mechanical engineering. These programs cover thermo-fluids (energy conversion, alternate energy, heat and mass transfer, two-phase flow, micro-electronic cooling, water desalination, biocolloids fluids, bioengineering, acoustics, combustion, computational fluid dynamics, and computer modeling & simulations), mechanics & design (robotics, biomedical engineering, mechatronics, vibration, dynamics, control, autonomous space and ocean systems, energy harvesting, renewable energy, smart structures, rehabilitation engineering, and mechanical and biomedical design), and materials and manufacturing (advanced materials, composites, thin films, electrochemistry, corrosion, and nanotechnology).

The Hawai‘i Center for Advanced Communication supports the MS and PhD degree programs in electrical engineering and, specifically, multidisciplinary research in telecommunications technology, with joint research and educational activities that promote national and international collaboration and partnership with industry.
Focus on Undergraduates

Student Clubs and Student Chapters of Professional Societies
The College houses over ten student clubs and student chapters of professional engineering societies with enthusiastic support from the students with many clubs making trips to the U.S. mainland to compete in regional and national competitions. These clubs often host student regional and national meetings of the respective societies.

Small Satellite Program
The College has a unique interdisciplinary program entirely within the College focused on building small satellites with a vertically integrated curriculum spanning freshman to seniors and graduate students. Alumni of this program have gone on to win national accolades as students and fill important positions in industry and academe.

Entrepreneurship Programs
The College has a record of graduating many entrepreneurial alumni. It supports the entrepreneurial aspirations of both its students and its faculty by working seamlessly with the UH Mānoa Shidler College of Business and the technology transfer programs in the University. It has a good record of involvement in the SBIR program and several faculty members have been and are part of start-up companies.

Research Experiences for Undergraduates
The College alumni fund a program for undergraduate students to participate in research projects sponsored by the College’s faculty. The students participate in a research competition with another College at UH Mānoa and exhibit their work to University alumni at multiple events during the year.

Engineering Consortium
The College has initiated a University of Hawaii System-Wide initiative including all the University of Hawaii Community Colleges and four year colleges with the main goal of enabling all students in the UH System to transfer to a four year engineering program or closely related STEM discipline. The Consortium, led by UH Kapi‘olani Community College, was successful in receiving a five year, $5 million NSF grant focused on Native Hawaiian students at the community colleges and their transfer to the College of Engineering. These programs work seamlessly with the College’s Native Hawaiian retention program.

Focus on K-12 STEM Recruitment, Retention and Placement

K-12 Outreach
The College offers extensive outreach programs inviting K-12 students and their teachers and parents to the UH Mānoa campus several times a year and sending College representatives to schools and career fairs all over Hawai‘i and the West Coast of the U.S. mainland. The College hosts a competitive intern program every summer for K-12 juniors and seniors.

Career Fairs
The College hosts career fairs every fall and spring semester, usually with over 70 participating companies and organizations recruiting both full time and intern positions. These often include large defense companies from the U.S. Mainland and federal agencies.

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Native Hawaiian Science and Engineering Mentorship Program (nHSEMP)
The College of Engineering houses a successful native Hawaiian student retention program, which has approximately one hundred enrolled native Hawaiian students from engineering and related STEM disciplines and receives substantial funding from the U.S. Department of Education and NSF.
Focus on Research and the Profession

College Research Clusters

The College has identified eight focus areas in addition to the areas above around which it is building focused clusters: research faculty and students in addition to the valuable independent research developed by individual faculty:

- **Coastal Infrastructure**: Due to climate change, it is important to develop coastal infrastructure that can withstand natural hazards, including hurricanes, storm surges, tsunamis, beach erosion and long term sea level rise. The College has a tradition of working in civil infrastructure, especially in coastal structures. Faculty members are focusing their efforts on developing simulation tools for hazard prediction and improved engineering design of resilient and sustainable coastal infrastructure.

**SUSTAINABILITY**

- **Renewable Energy and Island Sustainability**: An important challenge Hawai‘i faces is to become self-reliant in energy, especially due to its geography. The College is focused on reducing fossil fuels, (oil). College faculty members are working on energy and sustainability issues ranging from renewable energy, smart grids, energy efficiency, energy harvesting, and energy storage. For a sustainable future, materials need to be conserved and reused where possible due to impending raw materials shortages and the rising cost of energy for extraction and manufacturing. Locally, advances in remanufacturing are important for improving the effectiveness of the activities at Pearl Harbor Naval Shipyard to maintain the naval fleet. It is also important to the Navy and Hawai‘i. The Hawaiian Islands experience some of the steepest climatic gradients on Earth, generating a spatially diverse climate, making Hawai‘i a premier natural laboratory for corrosion research.

**WATER, WASTE AND ENVIRONMENTAL ENGINEERING**: Water is becoming a more and more scarce resource due to population growth, industrial development and global climate change. Island states/nations must deal with finite fresh water resources impacted by sustainable yield of ground water from basal aquifers and surface waters impacted by urban runoff. Equally, the disposal and recycling of municipal and industrial wastewater as well as solid and hazardous wastes must be part of the dynamic in sustainable water usage. On island states these issues are even more environmentally sensitive as coastal recreation competes with waste disposal. College faculty members have a tradition of effectiveness in these areas with connections to many university, government and commercial entities.

**Hawai‘i Center for Advanced Communications (HCAC)**

- **Sustainable Material and Manufacturing**: For Hawai‘i to be sustainable as an island-state in the middle of the Pacific Ocean, it must succeed in not only being self-sufficient in energy, but also in materials and manufacturing. In areas such as advanced materials, nanotechnology, recycling and remanufacturing, and environmental and sustainable manufacturing, efforts need to be focused on exploring and understanding of novel systems and robotics technology for space and other applications.

**bioEngineering**

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Developing Relationships

All five services of the U.S. armed forces: Air Force, Army, Coast Guard, Marine Corps, and Navy, have significant presence in Hawai’i and together with the civilian military complex, employ a significant proportion of the engineering professionals in Hawai’i. Consequently, the College is developing relationships with the military and their suppliers in Hawai’i and the U.S. West Coast, in conjunction with the relationships being developed by the University of Hawai’i:

• The Dean worked closely with the military in Hawai’i in chairing the 2012 annual engineering dean’s conference sponsored by the American Society of Engineering Education held in Hawai’i, with a focus on the military in engineering education. Many senior naval officers attended the meeting.
• Over the last four years Pearl Harbor Naval Shipyard, of historic importance since World War II, has hired an average of 20 students per year from the College of Engineering, or almost 30 percent of their total intake. The Shipyard’s leadership plays a significant role in the external advisory structure for the College.
• HSFL is part of the ground system supporting the U.S. Naval Research Laboratory’s MC3 Cube-Sat Program. As part of this program, it is working with the Naval Postgraduate School to install a portable MC3 UHF- and S-band ground station to support the MC3 space missions. HSFL worked with NRL and Vandenberg Air Force Base to install radar transponders and a Doppler instrument on HSFL’s first satellite, which is funded by NASA and ONR.
• The College has received funding from NSF and DARPA for autonomous vehicles and has received sub-contracts from local companies funded by DARPA for work on cyber security.
• Several College faculty members enjoy funding from the U.S. Army Corps of Engineers, both locally and nationally and the College has recently developed a formal relationship with their Engineering Research and Development Center (ERDC).
• The College has received funding from the U.S. Navy for its work on corrosion, from the U.S. Navy for its work on smart structures and nanotechnology and from the U.S. Air Force for its work on computer modeling and optimization.
• Several College faculty members participate with the Space and Naval Warfare Systems Command (SPAWAR) Systems Center Pacific, both in Hawai’i and San Diego. The College has developed an MOU with SPAWAR to facilitate the relationship.
• The College participates with the Marine Corps Forces Pacific Experimentation Center to develop low cost water purification systems for humanitarian assistance and disaster relief. This is part of a wider effort guided by a memorandum of understanding between PACOM and UH for collaborations that promote regional stability and sustainability in the Asia Pacific region, with focus on energy, water and disaster management.
• The College has participated in joint military exercises, Crimson Viper, between the U.S. and the Thai military, and the joint exercises, Balikatan, between the U.S. Navy, Air Force and Army for its work on corrosion, from the U.S. Navy for its work on smart structures and nanotechnology and from the U.S. Air Force for its work on computer modeling and optimization.

Attracting Opportunities

The College of Engineering at the University of Hawai’i at Mānoa lies at an optimal location between the Asia-Pacific region and the continental United States to benefit from the enormous flux in technology and engineering know how in both directions. As an indicator, Hawai’i is host to scores of technical conferences every year and the College is a significant contributor and supporter for many of these and the College faculty are organizers or co-organizers. This brings valuable recognition and opportunities for many of the College faculty. As some examples we mention:
• The College has been an integral part in establishing and organizing the Asia Pacific Clean Energy Summit and Expo for 2009–2013.
• The College organized the First International Conference on Multifunctional Nanocomposites at the East-West Center, Honolulu, in 2006.
• The College organized the Workshop on Engineering of Coastal Structures for Tsunami and Coastal Storm Surge Hazards in 2012 involving several universities and research institutions from Korea, and the Asia-Pacific Resilience and Sustainability Workshop in 2012 in collaboration with the College of Social Sciences, especially the Department of Urban and Regional Planning and several Asia Pacific universities including UII of Indonesia.
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Selected for host IMS again in 2017. In 2007 the IEEE Signal Processing Society held the International Conference on Acoustics, Speech, and Signal Processing in Honolulu. College faculty members were the general and technical chairs.
• In 2014 the IEEE Information Theory Society will hold the International Symposium on Information Theory in Honolulu. Three College faculty members are prominent members of the organizing committee.
• In 2012 the IEEE Control Society held the Conference on Decision and Control in Maui. One of the College faculty members was the local arrangements chair.
• The College coordinated the International Symposium on Green Manufacturing and Application (ISGMA) in 2013 and plays a significant role in organizing the Annual Conference on Commercializing Micro and Nano Systems for 2014, and the International Congress on Ultrasonics for 2017.

Hawai’i as a Technology Conference Hub

Anthony Sylvester pilots the Deep Discoverer ROV while working on the RV Okeanos Explorer. Photo courtesy of Art Howard.
Pursuing Partnerships

The College has initiated and re-executed memorandums of agreement (MOUs) with engineering colleges and universities in Japan, Korea, China, Hong Kong, Taiwan, Singapore, Vietnam, Indonesia, Australia, Spain, Italy, France, Brazil, Russia, Turkey and Uzbekistan. Among these agreements with Monash University of Australia, Kanazawa Institute of Technology of Japan, and Nara Institute of Science and Technology of Japan are UH Mānoa-wide student exchange agreements coordinated by the College.

• The College gratefully acknowledges an endowment from a Hawai‘i-based company, Geolabs, to assist in building relationships with universities in Asia, specifically in the area of civil engineering, and with a goal of bringing techniques developed in Asia to the Hawai‘i engineering community. Within this agreement, College faculty members have visited Tongji University in Shanghai and several Tongji students have visited the Department of Civil & Environmental Engineering. Geolabs support is assisting in the building of relationships in the field of water resources: faculty members from the College have visited the Asian Institute of Technology (AIT) in Bangkok, Thailand and faculty members have reciprocally visited the College and an MOU is being formalized. Faculty and post-doctoral fellows from Tohoku University in Sendai, Japan have visited UH Mānoa College of Engineering and other units at the university. Faculty members from the College have visited Tohoku under an existing MOU and have written joint proposals together. Also with the support of Geolabs, the College is developing relationships with Universities in Korea on coastal engineering and infrastructure. In particular, College faculty members organized a first conference in Hawai‘i on this field with participants from Chungbuk National University, Donggul University, Kangwon National University, the Korea National Disaster Management Institute, and the Institute of Daewoo Construction Technology as well as participation of College faculty and engineers from local companies. It is intended to continue organizing these events to initiate a long-term collaboration between UH and Korea in this area.

• An MOU with the Tokyo University of Agriculture and Technology (TUAT) of Japan specifically focuses on summer exchange of undergraduate students at UH Mānoa with undergraduate students at TUAT.

• Two MOUs with two Colleges at Zhejiang University in China have enabled post-doctoral fellows from Zhejiang to work at UH Mānoa with faculty in civil and environmental engineering and ocean and resources engineering in SOEST.

• In conjunction with Hawai‘i Natural Energy Institute in SOEST, the College is initiating an MOU with the Korea Institute of Energy Research in the area of renewable energies.

• The College has recently executed an MOU with the Universitas Islamic Indonesia and students from the Islamic University will attend classes at UH Mānoa in various fields including engineering.

• The College and the Hawai‘i Center for Advanced Communications have MOUs and international partnership agreements with The State Key Lab on Microwave & Digital Communications, Tsinghua University, China; The Centre National De La Recherche Scientifique, University of Nice-Sophia Antipolis, Nice, France; Communication Research Center, Yuan Ze University, Taiwan; and the Department of Signal Theory and Communications, Universitat Politecnica de Catalunya, Barcelona, Spain.