



Entrepreneurship in Engineering

Engineering has always been a part of everyday life. Whether it was something monumental as sending men to the Moon or building the tallest skyscrapers, to more personal technologies like the automobile or the smartphone — engineers have designed, created and continue to maintain much of today's modern world.

These accomplishments, while seen as high-profile or “sexy,” are not typically credited or linked to the accomplishments of the engineering profession. For the most part, engineering has not done a great job at promoting itself beyond the stereotypical image of the engineer dressed in a lab coat endlessly toiling away in a room with slide rules and calculators. In fact, to become successful in modern engineering, business savvy has become almost as important as the technology itself.

Anticipating the trend for a better-rounded engineer, the University of Hawai'i at Mānoa College of Engineering is preparing itself to meet these new demands by creating and participating in numerous programs to foster entrepreneurship among its students and faculty. One needs to look no further than Holmes Hall, home to UH Mānoa Engineering, to see the process already in place and already churning up positive results.

In two competitions organized by the Pacific Asian Center for Entrepreneurship (PACE) at the Shidler College of Business, technologies developed by engineering faculty and researchers played key roles in each of the top three winning teams in the 2011 UH Business Plan Competition (BPC). The annual competition is an intense and unique learning opportunity for UH Mānoa



2011 Breakthrough Innovation Challenge 1st Place Finishers Nick Fisher and Larry Martin of engineering, with PACE's Susan Yamada.

students to pursue a business idea and develop their business savvy. The winners in the competition are awarded substantial cash prizes.

One of the most successful engineering-based companies to emerge from the UH BPC is Adama Materials, Inc., which received \$4.75 million in equity funding for nanotechnology based advanced materials in 2010.

In the 2010 and 2011 Breakthrough Innovation Challenge, teams from engineering took first and second place honors by successfully pitching their innovations and commercial value. The competition challenged UH Mānoa students and faculty to publicize their innovations through a two-minute YouTube video. The winners received a monetary prize to further develop their innovations.

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Professor Mehrdad Ghasemi Nejhad

Stronger, Better Materials are a Nanotube Away

Since the Hawai'i Nanotechnology Laboratory was established in the University of Hawai'i at Mānoa's College of Engineering in 2003, the group has made the *Guinness Book of World Records* for producing the world's smallest brush, developed new nano materials, dramatically improved composite materials and launched a start-up company to develop proprietary materials in Hawai'i. At the heart of each development is carbon nanotubes, microscopic marvels that hold the potential to improve the

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A Message from the Dean

Hope your 2012 is going well.



Peter E. Crouch

Last semester, the holiday season came early to the College of Engineering as we welcomed four excellent faculty members to our civil and environmental and mechanical engineering departments. In January, we were gifted with another faculty member in mechanical engineering. Later this fall, we expect a fifth member to join our electrical engineering family. I would also like to welcome Lee Taylor, our new entrepreneurship specialist.

As I've stated earlier, business and entrepreneurial acumen are becoming essential in the engineering profession. I'm pleased to note that our faculty and students continue to excel in these endeavors. In this issue, you will find out more about their success stories that range from patents and innovation competitions to the foundation of a technology company.

I am also proud to be associated with the SEE-IT initiative, as our College has partnered with locally based tech companies to promote STEM education and awareness in Hawai'i.

Aloha!

Peter E. Crouch
Dean



SSFM Pledges \$200,000 for Scholarships

Lee Takushi, Norman Kawachika, Corey Matsuoka, Dean Crouch, UHF's Donna Vuchinich and Michael Matsumoto



With a generous pledge of \$200,000, SSFM International, Inc. continued its support of the UH Mānoa College of Engineering with the SSFM International, Inc. Scholarship Fund, designed for SSFM employees who are full-time undergraduate students majoring in civil and environmental engineering.

"I am pleased that SSFM International Inc. is able to support the UH Mānoa College of Engineering and our future engineers in this important way," said Michael P. Matsumoto, president of SSFM International, Inc. "SSFM understands that scholarships play a key role in making education accessible for many promising future engineers. By partnering with UH Mānoa, we can participate in the education of the next generation of engineers for our state."

The scholarships will help students with the costs of attending UH Mānoa including tuition, books and fees.

"The recent support by SSFM underlines the important long-term partnership between the company and the College of Engineering," said Dean Crouch. "These scholarships will help students make the most of their time within the college as they prepare to fill positions in key companies like SSFM."

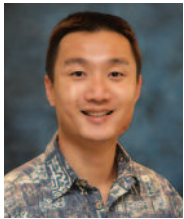
"We are grateful to SSFM for both the timing and size of the gift. It will assist the college in its goal of supporting the workforce needs of Hawai'i. Today more than ever, the engineering and construction sectors are critically important in building and renewing the infrastructure needs of the community."

SSFM International, Inc. is a Hawai'i-based business with a long history of supporting the University of Hawai'i. The company's lifetime support now totals \$493,516.

New College Faculty

This past fall, the College welcomed the arrival of one civil and environmental and two mechanical engineering faculty members. A third member joined the mechanical engineering faculty in January. In fall 2012, the College will welcome one more faculty in electrical engineering.

Civil and Environmental Engineering



Lin Shen

Assistant Professor Lin Shen earned a BS in civil engineering from Tongji University in 1999, an MS in civil engineering from National University of Singapore in 2002 and a PhD from the University of Illinois at Urbana-Champaign in 2007. His research interests include concrete rheology, sustainable concretes, aggregate packing, characterization of microstructure of cementitious materials and early age properties of concrete. Most recently, Dr. Shen worked at Kal Krishnan Consulting Services, Inc. in Oakland, CA, helping to develop various anti-terrorism barriers, including an underwater barrier system made of medium density polyethylene to protect the Bay Area Rapid Transit (BART). Dr. Shen is a registered professional engineer in California.

Mechanical Engineering

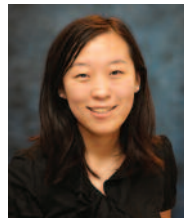


Dilmurat Azimov

Assistant Professor Dilmurat Azimov earned his MS in mechanics from Tashkent State University in Uzbekistan in 1986, a PhD in mechanics from the University of People's Friendship (Russia) in 1992 and a DSc in

dynamics, ballistics and flight vehicle control from the Moscow Aviation Institute in 2008. Prior to arriving at Mānoa, Azimov served as a research engineer/scientist associate at the Center for Space Research at the University of Texas at Austin. His research interests include: guidance, navigation and control design for autonomous space systems, trajectory design and optimization. His interests are in development of on-board software tools, nonlinear dynamical models of control systems, analytical and numerical synthesis of optimal and extremal space trajectories, high-order optimality conditions in trajectory design, analytical integration

methods in space dynamics and optimal control. Azimov is a member of the AIAA.



Jingjing Li

an MS degree in statistics in 2010 and a PhD in mechanical engineering in 2011, both from the University of Michigan. She also worked in the General Motors R&D Center for three successive summers from 2009 to 2011, and was a visiting scientist at GM during her academic years. Her research focuses on materials processing and manufacturing; particularly, on the characterization of mechanical and microstructural properties of metallic materials during processing. Dr. Li received the Best Paper Runner-Up Award from the 2011 ASME International Manufacturing Science and Engineering Conference (MSEC). She is also a member of the ASME.

Assistant Professor Jingjing Li received a BS degree from Beijing University of Aeronautics and Astronautics, China in 2002 and an MS degree in materials science and engineering from Tsinghua University, China in 2005. She earned



Zachary Trimble

Technology (MIT), and was awarded the Carl G. Sontheimer Prize for Excellence in Innovation and Creativity in Design for his work on "Flexure Based Resonant Energy Harvesting Devices". In addition to vibration and energy harvesting research, Dr. Trimble has worked on a device for correction of esophageal atresia in infants, an underwater robot for large ship hull inspections, an unmanned remote aerial survey vehicle, a passive tuning mechanism for military field radios, MRI actuated medical devices, CNC machine coding and expandable structures for dynamic seals. Currently, Dr. Trimble is interested in vibration energy harvesting, precision machine design especially as applied to electro-magnetic machine elements and systems and adrenaline sports such as snowmobiling and SCUBA diving.

Assistant Professor Zachary Trimble's research focuses on precision machine design and renewable energy. Dr. Trimble received both his PhD (2011) and MS (2007) in mechanical engineering from the Massachusetts Institute of

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Hakulau

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College of Engineering

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Ohta and Shiroma Awarded \$344,424 NSF Grant



Aaron Ohta



Wayne Shiroma

UH Mānoa Electrical Engineering Assistant Professor Aaron Ohta and Professor Wayne Shiroma were recipients of a three-year, \$344,424 grant from the National Science Foundation to study the use of liquid metal in circuits to create new types of tunable communication systems.

The development of reconfigurable antennas and components that can adjust and adapt to changing conditions could result in communication systems that are more versatile, multifunctional, robust and economical. Liquid metal can be moved and changed, adjusting the properties of circuits, which will allow wireless communications systems to be quickly optimized for various conditions.

Professor Ohta, the principal investigator, specializes in micro-electromechanical systems (MEMS) and nanoelectromechanical systems (NEMS), with an emphasis on microfluidics and optofluidics. He received his BS in electrical engineering from UH Mānoa, his MS from UCLA and his PhD from the University of California at Berkeley.

Professor Shiroma, the co-principal investigator, specializes in novel architectures for next-generation communication and sensor systems that integrate high-speed devices, circuits and antennas. He received his BS in electrical engineering from UH Mānoa, his MEng from Cornell University and his PhD from the University of Colorado at Boulder.

"Holmes" coming Wrap-Up



Holmescoming participants enjoy poker, music, food and drink

In its fourth successful year, "Holmes"coming brought over 600 alumni and friends of the UH Mānoa College of Engineering back to campus for an evening of festive food, fun and games. The popular event, which is fast becoming a College tradition, was held on October 11th in the friendly confines of the Stan Sheriff Center.

Guests were treated once again to an evening filled with excitement from the karaoke, poker and blackjack tournaments, to the stylish performances by UH Mānoa engineering alum George Kuo on slack key guitar and energetic jazz of Funk & Fusion.

As guests to "Holmes"coming have also come to expect, Chef D.K. Kodama and his staff from d.k. Steakhouse and Sansei Seafood Restaurant & Sushi Bar were in full swing, crafting their tasty selections that paired well with the refreshing beverages being served.

"I'd like to thank event co-chairs Ken Hayashida and Glenn Nohara for putting together a great event," said Dean Crouch. "We hope to create a UH Mānoa engineering tradition and it looks like we're definitely starting to build one with 'Holmes'coming."



Barry Toyota of Wilson Okamoto enjoys the evening with colleagues



Chef D.K.Kodama happily explains his culinary creation to guests

SEE-IT Hawai'i Exhibit

At 12,000 square feet, the Science & Engineering Exposition – Innovative Technologies (SEE-IT) exhibit at the Hawai'i Convention Center is quite large. However, its founders are hoping to leave an even bigger and more indelible footprint of science and technology on the minds of local students.

Featuring interactive displays of technologies from 18 Hawai'i-based companies, SEE-IT focuses on the critical role of science, technology, engineering and math (STEM) in raising the quality of life for people in the Islands and around the world.

SEE-IT's three founding members: entrepreneur Henk Rogers, Dean Peter Crouch and management consultant Galen Ho, hope to create a permanent exhibit that will be available for school children and the public to understand the role of science, engineering and technology in everyday life.

"Technology is the industry of the future in Hawai'i," said Rogers, SEE-IT chair. "But in order to develop the tech industry, we need to raise awareness of the need for STEM in our educational system, and raise public awareness of the importance of technology in our lives."

SEE-IT Exhibitors

Avatar Realty, LLC
BAE Systems, Inc.
Hawaiian Electric Company, Inc.
Makai Ocean Engineering, Inc.
Natural Power Concepts, Inc.
NOAA Pacific Island Region
Oceanit
Pacific Biodiesel, Inc.
PISCES/International Lunar Research Park
Pearl Harbor Naval Shipyard/IMF
Referentia Systems Incorporated
Robotics Organizing Committee – Hawai'i
SEE/Rescue Corporation
Skai Ventures
Sopogy, Inc.
UH Mānoa, College of Engineering
UH Mānoa, Institute for Astronomy
Thirty Meter Telescope
W.M. Keck Observatory
Williams Aerospace, Inc.



Entrepreneurship continued

Engineering students are also taking their own initiative by joining fellow UH Mānoa MBA and law students to enroll in a high growth entrepreneurship course conducted by local venture capitalist Bill Richardson. The course, limited to only 16 students a semester, focuses on building a company based on UH Mānoa technology and making their pitch to venture capitalists.

Engineering faculty are also experiencing success in the licensing of their technology as well. Recently, a new DNA sequencing device that incorporates biosensor technology derived from research done by electrical engineering Professor Emeritus James Holm-Kennedy, hit the open market. Utilizing both Stanford University and UH Mānoa technologies, the device promises to deliver quicker and less-costly sequencing for biological research.

To help facilitate engineering's growing entrepreneurial program and technology licensing, the college recently hired Lee M. Taylor as its entrepreneurial specialist. Taylor, who has worked as a technology licensing associate at the UH Office of Technology Transfer and Economic Development (OTTED), is a licensed attorney and well-versed in intellectual property matters. He was a member of

the winning UH BPC team that later incorporated into Adama Materials, Inc.

"To be successful, today's engineer must understand technology as well as the essential principles of business," said Dean Crouch. "I'm pleased that our faculty and students are embracing the spirit of innovation and entrepreneurship."



2011 Breakthrough Innovation Challenge
2nd Place Finishers
David Hummer and
Michael Menendez
of engineering

Nanotechnology continued

performance of products from wind turbines to fuel cells.

A nanometer is one-millionth of a millimeter—about 50,000 times finer than the average human hair—so manipulation is a tricky business, says lab director Mehrdad Ghasemi Nejhad, professor and chair of mechanical engineering.

Japanese physicist Sumio Iijima made the first nanotube in 1991. Carbon nanotubes form on a silicon-oxide coated silicon wafer when a source of carbon, such as xylene, is combined with a liquid containing a catalyst, such as iron, cobalt or nickel, on a silicon wafer and baked at very high temperature. The iron particles precipitate as the liquid evaporates, creating islands on the wafer. The carbon atoms settle on the iron particles, building up in hollow cylindrical structures held together covalently in nature's strongest chemical bond.

"The key for achieving desired properties for a host material or structure is finding the right form, amount and integration technique for the nanomaterial," Nejhad says. Nanotubes form the bristles of the group's record-book brush, which could be used to clean micro-electromechanical systems as well as micro-capillaries, separate harmful ions from industrial waste waters or paint surfaces with molecule-thin coats.

Get the carbon nanotubes to grow in the form of forests, and you have the potential to "turn fiber cloths super strong," he continues. Composite materials, such as fiberglass polyester and carbon epoxy, combine a fiber system with a polymer system for increased strength and performance. But cracks can form and propagate between the layers, causing the composite to delaminate.

Researchers work with Nejhad to improve composite material performance in two ways.

Vamshi Gudapati, Ben Stein, David Hummer and Kaveh Khosroshahi are tackling the carbon nanotube forests that strengthen the fiber materials; and perfecting the polymers that hold composite layers together employing carbon nanotubes, graphene nanosheets (a flat version of the cylindrical carbon nanotube, but with much higher surface areas) and nanoparticles. Picture Velcro reinforced with Super Glue. Or, rather, imagine it. You'll need a high-resolution electron microscope to see these nanomaterials, and some secret steps in the process to ensure uniform and bubble-free dispersal.

The payoff, Nejhad says, is that carbon fibers are almost the same strength as steel, but just a third of the weight. Carbon nanotubes are 50–100 times stronger than steel. When integrated into polymers or onto the fibers, they result in nanocomposites with 100- to 400-percent property improvements over their traditional counterparts, such as carbon epoxy. "Hence, we can use them anywhere composites are used, from boats to automobiles to spacecraft, with much better performances and durability," he says. Reduced weight translates into decreased costs.

Consider the wind turbine. The energy it produces is proportional to the length of its blades, which are essentially ribbed, skin-covered structures like airplane wings. Longer blades are subject to higher stresses as they turn, which can cause them to fail. Glass epoxies allowed engineers to increase blade length to 150 feet, and graphite epoxies, to about 300 feet. Nanocomposite blades could potentially double that, Nejhad says.

Nanotechnology also has applications in fuel and solar cells. For example, Nejhad envisions someday painting the roof of homes with a nanomaterial-based thin film to capture solar energy without the need for more costly silicon-based photovoltaic cells.

Improving hydrogen fuel cell performance and durability is key to making hydrogen a

more feasible alternate fuel. A proton exchange membrane fuel cell requires a hydrated membrane, two electrodes and two catalyst layers, usually carbon paper coated with platinum, to split hydrogen gas into proton and electron. Completing the circuit produces electric energy, with water as the by-product. Using hydrophobic carbon nanotubes as the electrodes and catalyst layer bed increases surface area, electrical conductivity and hydrophobicity for the catalytic reactions. This reduces the need for auxiliary humidification equipment, in turn reducing size, weight and costs for the fuel cells.

Researchers are also working on the use of nanomaterials in energy storage. High surface-to-volume ratio and super properties could improve the durability, performance and efficiency of batteries and supercapacitors while reducing their weight, size and costs. One postdoctoral fellow, four graduate students and eight undergraduate research students round out the lab staff.

An American Society of Mechanical Engineers Fellow and associate editor of the *Journal of Thermoplastic Composite Materials*, Nejhad holds several patents. He has received support from the U.S. Congress, Office of Naval Research and Department of Energy (as a part of the Renewable Energy and Island Sustainability, REIS, Program). In addition to his university research, Nejhad is the founder and chief technology advisor of Honolulu-based Adama Materials, Inc.

"Adama represents the ideal model of cross-disciplinary development of technology, business and law at UH and demonstrates how UH discoveries can be successfully transferred to industry," says Jonathan Roberts of the UH Office of Technology Transfer and Economic Development.

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Transportation Engineers Win Sustainability Award



Panos Prevedouros

UH Mānoa Engineering Professor Panos Prevedouros and Lambros Mitropoulos, an engineering doctoral student, co-authored a scientific paper that received the sustainable development category award from the World Road Association (PIARC). The award was presented in September at the 2011 World Road Congress held in Mexico City.

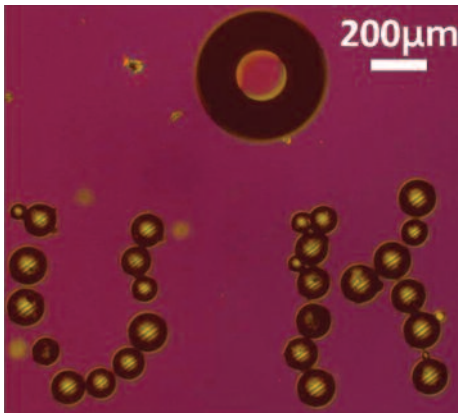
Entitled, *Life cycle assessment through a comprehensive sustainability framework: A case study of urban transportation vehicles*, Prevedouros, Mitropoulos and E.G. Nathanail, an associate professor of civil engineering at the University of Thessaly in Greece, presented a unique approach of measuring the life cycle of passenger cars, pickup trucks and transit

buses in enabling transportation sustainability. In addition to regular gasoline and diesel engines, vehicles with hybrid, electric and fuel cell technologies were examined. Awards were given out in eight different categories and were selected from 600 eligible entries.

"We congratulate Professor Prevedouros and Mr. Mitropoulos on a job well done," said Dean Crouch. "One of our main thrusts is sustainability and I'm pleased that our faculty and students are continuing their outstanding efforts in this vital area of research."

Established in 1909, the World Road Association continues to foster and facilitate global discussion and knowledge sharing on roads and road transport. The association now boasts 118 government members worldwide and retains consultative status to the Economic and Social Council of the United Nations.

UH Mānoa Microrobotics Team Takes Second in First Competition



The UH microrobot (circular object in top center) assembled these tiny glass beads into a mini "UH."

UH Mānoa's first microrobotics team finished second at the 2011 Microrobotics Challenge held in Shanghai. Organized by the National Institute of Standards and Technology (NIST), the annual competition is designed to promote innovation to overcome the challenges facing microrobots. The event attracted teams from the United States, France, Italy and Canada.

The UH Mānoa team consisted of electrical engineering graduate students Wenqi Hu and Kelly Ishii, who traveled to China for the competition. They were advised by Assistant Professor Aaron Ohta. Additional team members included Michelle Zhang and Assistant Professor David Garmire.

The microrobots in this competition are very tiny: they must be less than 0.6 mm in their largest dimension. The tiny robots

competed in miniature arenas under a microscope. The competition consisted of two events: a mobility challenge, where the robots were timed as they moved around a figure-8 track, and a micro-assembly challenge, where the robots assembled tiny triangles in a designated area. The UH Mānoa team finished second in the mobility challenge and was the only team besides the winning team that was able to assemble more than a single triangle in the micro-assembly challenge.

"These events are very challenging for such tiny robots," said Ohta. "So UH Mānoa's showing was very impressive for a first-year team."

UH Mānoa's microrobot consists of a very tiny air bubble inside of a microchamber. Light from a computer projector is used to heat the surface of the microchamber, which generates a force to move around the microrobot. The microrobot can also be used to move around objects that are less than a millimeter in size. This can be useful for assembling tiny electronic components or building structures made up of living cells.

UH Mānoa Engineering and China's Zhejiang University Partner to Promote Academic Exchange

The University of Hawai'i at Mānoa College of Engineering and China's Zhejiang University (ZJU), Hangzhou, College of Civil Engineering and Architecture signed a Memorandum of Understanding (MOU) for the purpose of promoting research collaboration in various areas of civil and environmental engineering under a five-year agreement.

"China represents a tremendous area of growth in science and technology for the world," said Dean Crouch. "I'm pleased that both institutions recognize the mutual value of strengthening our academic cooperation and exchange in the area of civil and environmental engineering."

The agreement between the UH Mānoa College of Engineering and ZJU proposes the development of a PhD candidate exchange program, faculty exchange program, joint research endeavors and discussion on recommendations for the establishment of a new English instruction-based curriculum for ZJU.

"The Department of Civil and Environmental Engineering is ecstatic about our new international collaboration agreement with our colleagues from Zhejiang University," said C.S. Papacostas, chair of the department. "We anticipate many mutually beneficial results as a consequence."



Trevor Sorensen with Mark Lewis, AIAA immediate past-president

HSFL's Sorensen Named AIAA Fellow

Trevor C. Sorensen, a project manager/specialist with UH Mānoa's Hawaii Space Flight Laboratory (HSFL), was recently elected a Fellow by the American Institute of Aeronautics and Astronautics (AIAA). Sorensen specializes in astronautics, including space system design, space mission operations, spacecraft autonomy, satellite remote sensing and lunar missions. He received his BS, MS and DE in aerospace engineering from the University of Kansas.

An AIAA Fellow is among the highest honor that can be bestowed upon an aerospace professional and represents recognition from colleagues and peers for important contributions to the field and the technical community. Sorensen was cited for his "outstanding service to AIAA and the space community and for exemplary achievements that have contributed to the exploration and use of space."

HSFL was established in May 2007 within the School of Ocean and Earth Science and Technology and the College of Engineering at UH Mānoa as a multi-disciplinary research and education center to bring together individuals from diverse areas to work on the exploration and understanding of the space environment.

AIAA is the world's largest technical society dedicated to the global aerospace profession. With more than 35,000 individual members worldwide, and 90 corporate members, AIAA brings together industry, academia and government to advance engineering and science in aviation, space and defense.

For more information about upcoming
College of Engineering events, please visit
www.eng.hawaii.edu/events
or call (808) 956-7727.

Engineering Alumni Picnic in L.A.



Last July, over 60 UH Mānoa engineering alumni gathered with their family and friends for a picnic in Los Angeles. The event, organized by alum Nolan Tanaka of Northrop Grumman, gave folks the opportunity to reconnect with their Hawai'i roots and to meet Dean Crouch.