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The Voyages

Hawai'i Space Flight Lab

-- Multidisciplinary Research and Education

By: Luke Flynn, Director HSGC & HSFL

The Hawai'i Space Flight Laboratory (HSFL) is a multidisciplinary research and education venture bringing together researchers from diverse areas to work on the exploration and understanding of the space environment. The HSFL was created on May 7, 2007 as a joint activity between the College of Engineering (CoE) and the School of Ocean and Earth Science and Technology (SOEST). The HSFL is also a Hawai'i Space Grant Consortium (HSGC) research infrastructure development project that caps all three of the HiSTEM educational pipelines in engineering, terrestrial remote sensing, and planetary science. Through HSFL, the University of Hawai'i will be able to design, build, test, launch, and operate its own satellites in low-Earth orbit.

HSFL has four objectives:

- Promote innovative engineering and science research for terrestrial and planetary space missions
- Develop, launch, and operate small spacecraft from the Hawaiian Islands to accelerate the validation of new space technologies
- Provide workforce training in all aspects of unmanned space missions
- Promote synergistic collaborations between educational, governmental, and corporate institutions interested in space exploration

Carried out in 4 key project areas:

Launch Support

HSFL is teaming with the Pacific Missile Range Facility (PMRF-Navy) located on the island of Kaua'i to provide a launch venue and launch range support for HSFL launch activities. PMRF's location offers orbital insertion missions into both polar and sun-synchronous orbit trajectories. HSFL, with support from Sandia National Laboratory and Aerojet, is developing a small launch vehicle capable of lifting over 250 kg to a 400 km circular orbit. Launch support infrastructure is being provided with Hawai'i Congressional support through the Low-Earth Orbit, Nanosatellite-Integrated, Defense Autonomous Systems (LEONIDAS) effort that is being programmatically managed by the Department of Defense Operationally Responsive Space Office.

Spacecraft Integration

HSFL faculty as well as a core engineering staff of former Space Grant Fellows are building the HawaiiSat small satellite. HawaiiSat will weigh ~ 70 kg and will be able



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to carry a number of experiments, including a hyperspectral thermal imager developed by SOEST faculty. The University of Hawai'i has invested in HSFL by providing the HSFL Integration and Test Facility with clean room space as well as funding for a Thermal Vacuum chamber and other necessary equipment. The HSFL I&T Facility is large enough to accommodate multiple spacecraft builds with stations for individual spacecraft subsystems as well as integration support hardware for small satellite construction. The HSFL I&T Facility will be available to university, government, and commercial entities, and represents a new and unique capability for Hawai'i.

Mission Operations

The University of Hawai'i has also provided funding for the HSFL Mission Operations Center (HMOC). HMOC has dual purposes of serving as the command and control center for HSFL missions as well as being the concurrent engineering design center where staff and student teams meet to discuss the HawaiiSat design and consider other spacecraft developments. Kauai Community College maintains a UHF/VHF uplink and downlink ground station that will be used both to control satellites and downlink data.

Instrument Development

The HSFL can call on a diverse group of instrument-developing faculty from the Hawai'i Institute of Geophysics and Planetology (HIGP) and SOEST. A number of businesses in Hawai'i

also develop a wide array of instrumentation. The HSFL will partner with these organizations to provide technology demonstration opportunities. HawaiiSat will carry a thermal hyperspectral imager that detects infrared radiation at 8.0 – 14.0 microns and will be used to monitor Earth's environmental processes. The imager was developed by HIGP faculty.

HSGC has worked closely with HSFL to define many employment options for college-level students. Traineeships and Internships are available to Kauai Community College students working on the HSFL Ground Station and associated weather station. Undergraduate students are working on Fellowships that support parts of the HawaiiSat project. HSFL employs graduate students through the HSGC Master's Apprenticeship Program to work on the HawaiiSat design and to construct the spacecraft with faculty and staff guidance. HSGC and HSFL have created a post-graduate fellowship to encourage promising undergraduate engineers to pursue post-graduate engineering degrees. Post-graduate fellow Jeremy Chan is the HawaiiSat Systems Engineer who is training with NASA Ames, Santa Clara University, as well as HSFL staff. Finally, HSFL employs Master's graduates in full-time staff positions. An example is Lance Yoneshige who completed a Master's degree in Mechanical Engineering through the HSGC Master's Apprenticeship Program and is now the Lead Mechanical Engineer for HawaiiSat. ☺

Higher Education

"The View from the Pipeline"

By: Jeremy Chan, HSFL Trainee Scholar



Back in 2007, I gave a presentation on air to ground telemetry at a Space Grant symposium. After my presentation, I was invited by a fellow student, Zachary Lee Ho, to join a meeting about a satellite. He was part of a relatively new project called 'Kumu A'o CubeSat'. They planned on making and launching a small 10x10x10cm remote sensing satellite into space. I signed on with them and Space Grant as a fellow. I really thought it was going to be easy. In hindsight, that was probably one of the most spectacular underestimations I've ever made.

Over two years of the project, we found problems and questions which went deep into advanced topics we didn't even know existed. Some were significantly beyond our levels of study and practice. Simple advice and book knowledge were not enough to solve our very real problems. To make things work, we had to trudge through a marathon of roadblocks on a schedule. That literally pushed us beyond our perceived limits at often inconvenient times.

CubeSat projects can be intense, and quite the shocker for new members. But teammates work hard and help each other. Many engineering students have participated in the project and even beyond their graduations, they continue to make significant contributions toward the project's completion. At the end, we aim to leave behind documentation and training videos to help the next generation of UH CubeSat builders.

2 For myself, the project ended up as a full-time job for the two years I worked on it. From the progress I've made with hundreds

of hours of work each semester, and each summer, I gained a lot of confidence in several areas: electronics, programming, fabrication processes, technical writing, and even teaching for a change. This experience was invaluable.

When I finally graduated, I was a bit burned out, and wanted to be done with the project. But, despite our best efforts, we couldn't finish in time. Shortly after, a great opportunity came up for me to stay and rejoin Space Grant as a trainee scholar. That gave me a great job and more time to wrap up the project. Under the scholarship, I now work for the Hawai'i Space Flight Laboratory as the systems engineer of a new mission called the 'HawaiiSat Mission'.

The HawaiiSat mission involves building, launching, and operating a satellite to carry out several objectives. One of the objectives is an important technology demonstration of a Thermal Hyperspectral Imager. The imager is being developed by scientists and engineers at our very own Hawai'i Institute of Geophysics and Planetology (HIGP). The end goal is to have a low-cost system which can map temperatures of the entire Earth for scientific studies.

If I've learned anything from CubeSat, you won't catch me thinking that this mission is going to be easy. Instead, you might find me with my own office tooth brush, sleeping bag, and dresser. ☺

Bottom: From left to right: Zachary Lee Ho, Tyson Seto Mook, Windell Jones, Dennis Dugay, Jeremy Chan, Amy Blas, Reid Yamura, Matthew Patterson, Michael Menendez, Jordan Torres, and David Luis at the CalPoly SLO Conference.



Top: CubeSat internal stack. Above: CubeSat radio and sensor board.





Kapi'olani Community College

STEM Program: 2010



"My experience with the CanSat competition was amazing. It took a lot of work and many long hours. Right before the competition, our team pulled three all-nighters in a five day period just to finish the project. We were low on sleep, but it definitely paid off. We were the only community college in a competition comprised of well known universities. We ended up being the first team to launch a working CanSat, as well as the first team to transmit data. It wasn't until an hour later that other teams began transmitting data. What was even more rewarding was receiving fifth place out of over twenty teams. That was an amazing accomplishment and our team definitely deserved it. I was the team lead, and I must say, it was one of the best teams I have ever worked with, and I have worked with a lot of teams in the past during my Navy career. I'd say the biggest lessons learned from the competition were in the areas of time management and team work. We also learned that when it comes to engineering, things are easier said than done. However, after all was said and done, the most rewarding part of the competition was the relationships formed throughout the entire eight month process."

- Leon Santinizio, 2009 Kapi'olani CC CanSat Team Leader (pictured)

The annual CanSat (a CAN that is also a SATellite) competition is a student design-build-launch contest organized by the American Astronautical Society (AAS) and American Institute of Aeronautics and Astronautics (AIAA). The competition is open to college and university students from the United States, Canada, Mexico, and Europe. The goal of CanSat is to compensate for the lack of hands-on types of projects available to students. Although there are numerous writing-based space-related competitions in existence, both the AAS and the AIAA have recognized a need for activities that give students the experience of being involved with the life-cycle of a complex engineering project, from conceptual design, through integration and testing, actual operation of the system, and concluding with a post-mission summary and debrief. The CanSat competition provides students with a way to see written engineering concepts in action.

In 2010, Kapi'olani Community College (Kapiolani CC) will again have a team representing the college at the annual CanSat competition. The 2010 team has lofty goals for the upcoming competition, following an extremely successful 2009 campaign. Despite the fact that 2009 was the first year that Kapiolani CC sent a team to the CanSat competition, the team more than held their own. At the 2009 competition, which took place in Amarillo, TX, the Kapi'olani CC team placed fifth overall in a field that included prestigious universities from the US and Mexico. Travel funds for

the entire team were generously provided by the Hawai'i Space Grant Consortium (HSGC).

Kapi'olani CC's official 2009 CanSat team consisted of students Elizabeth Gregg, Jon Gunderson, Huilin Xie, Weifeng Li, and Chaoming Liang, along with team student mentor Jeremy Chan and team faculty advisor Herve Collin. Also included on the team were three students funded as trainees by the HSGC: Chamille Esteban, Alexander Williams, and team leader Leon Santinizio. The competition provided the students with an excellent opportunity to meet new people and to measure their skills against stiff competition. The faculty and staff at Kapi'olani CC were encouraged by the positive feedback received from all members of the 2009 team and choosing to return to the competition in 2010 was an easy decision.

Kapi'olani CC's involvement in the CanSat competition stems from the goals of their Science Technology Expansion Program in Urban Polynesia (STEPUP) grant, which is sponsored by the National Science Foundation (NSF). The overall mission of the STEPUP grant is to increase the number of island students receiving the Associates in Science in Natural Science degree from Kapi'olani CC and to increase the number of island students matriculating to the University of Hawai'i at Manoa, the University of Hawai'i at Hilo, as well as other four-year institutions for baccalaureate degrees

in science, technology, engineering, and mathematics.

One of the strategies for achieving this goal is to use undergraduate research opportunities as a way to increase student interest and enthusiasm. Faculty members at Kapi'olani CC have found that students perform at a higher level in their curriculum when they are exposed to an applied activity related to their field of interest. Students also respond positively when they are assigned responsibilities from the faculty as they work on their projects. In addition, students consistently produce better results when a competition aspect is added to the overall project. The competition gives students extra motivation and an added incentive to do well on their research project. This is where the CanSat competition has fit in perfectly with the goals of the STEPUP grant.

In 2009, the 10-student Kapi'olani CC team was instructed to design and build an airborne telemetry system capable of performing communication and telemetry functions. In addition, the team had to acquire atmospheric data during a controlled decent from a small, low-powered rocket. More specifically, the CanSat had to measure altitude during its ascending flight, measure and control its descending speed with a parachute, land safely on the ground, and then measure the soil temperature for two hours continuously. All of the measured data had to be sent to a control station in real time.

The 2010 Kapi'olani CC CanSat team currently consists of team leader Jeffery Griffith and team members Dana Johnson, Jiehua Hei, Sean Lesley, Elizabeth Gregg, Chamille Esteban, Panakhaporn Unchanpat, Stanley Webber, and Brian Hur. Returning members from the last competition have the advantage of one year's worth of experience under their belts. Expectations are high, but the 2010 Kapi'olani CC CanSat team is ready to face the challenge head on. ☺



From the top: (1) Team members, with Dr. John Rand, prepare the rocket on site. (2) Setting up the base station in Amarillo, TX. (3) Team members at the base station busy analyzing data. (4) Watching the rocket travel across the Texas sky.

Winward Community College in ARLISS & USLI

By: Premo Ames II

WCC Student, ARLISS 2009 Project Manager

Sponsored by the Hawaii Space Grant Consortium (HSGC), Windward Community College (WCC) competed in its fourth year of A Rocket Launch for International Student Satellites (ARLISS) CanSat competition. The 2009 ARLISS team included Premo Ames II, Joleen Iwaniec, Todd Esposito, and Makana Ciotti. Mentors include Dr. Joseph Ciotti and Dr. Jacob Hudson from WCC, and Helen Rapozo from Honolulu Community College (HCC). Titled "Holomua – Moving Forward," the project centered on redesigning the CanSat body from the previous year, which allowed for several improvements.

The redesign entailed enlarging the CanSat housing to maximize interior space for the new, updated electronics and parafoil. Enlargement of the parafoil ejection chamber also allowed for smoother and consistent parafoil deployment. The CanSat module was also manufactured in carbon fiber, which decreased weight while increasing capacity.

Weight saved from the body was replaced by new electronics. As in the previous design, electronics were separated into three parallel systems so that if one system failed the others would still operate. The three separate systems were navigation, data collection, and parafoil deployment. Additionally each system had a redundant data acquisition function.

The navigation system is the most critical of all the systems as it is the brains of the module telling it where it is, and what direction it needs to steer to. The navigation system consisted of a Parallax Propeller microcontroller and GPS unit using the Spin programming language. The Prop chip was designed to send signals to the Parallax servo unit, turning it one way or another, depending on the degree off-axis from the target destination the Prop chip calculated. Passenger Board 2 (PB2) was designed to collect location, altitude, date, and time from the GPS system and the internal temperature of the Holomua CanSat and store it on memory chip and transmit some of the information to a ground station via a radio link.

The final system comprised of a G-Wiz HCX flight computer. The decision to use an off-the-shelf flight computer was made to ensure deployment of the parafoil. The HCX model was chosen because of its flexibility and ability to capture flight data.

Flight testing of individual systems was done on the Kaneohe Marine Corps Air Station. Full-scale testing was not possible due to limited land space availability. Nevertheless, Holomua was successful, landing within 0.25 miles from the target at ARLISS 2009. To carry on the success for 2010 Todd Esposito will be joined by Patrick Lancaster and Jasmine Maru.



(Above, left to right) Todd Esposito, Joleen Iwaniec, and Premo Ames II at the Space Grant Western Regional Conference in Reno, NV. (Below) Rocket team at the 2009 ARLISS competition in Black Rock, NV.



Hawai'i Space Grant Consortium

The success of WCC's ARLISS program has led to a new competition, University Student Launch Initiative (USLI). WCC's USLI team, Premo Ames II, Joleen Iwaniec, and Todd Esposito, with help from this year's ARLISS team has completed the first hurdle of the competition by having their USLI proposal accepted by NASA Marshall Space Flight Center (MSFC). Students are tasked with building and launching a rocket closest to a mile high, but the real competition is the actual procedure NASA uses for projects. Reports, sourcing, purchasing materials, managing finances, building, testing, educational outreach and website presence, present individual challenges to the students. With a multitude of reports, missing a deadline can mean disqualification. More information can be found on WCC's USLI website at: www.windward.hawaii.edu/usli. ☺



GG 460-Geological Remote Sensing

In Spring 2009, GG 460 celebrated its 10th birthday! On April 30 to May 3 we went on our annual trip to Kilauea so that the students could study the thermal properties of live lava flows and also ground-truth the students' final projects. After the 2008 debacle, when we found our favorite Mauna Iki final project site inexplicably closed by the National Park, we this year switched to Mauna Ulu. The trip involved one day of studying young and warm (but no live) lava flows near the coast, and two days of ground-truthing the Mauna Ulu site. We combined forces with GG 130 – Geologic Hazards, so we also enjoyed a visit to Hawai'i County Civil Defense, where administrator Quince Mento was kind enough to give us a presentation about their efforts. ☺



Undergraduate Fellowships, Traineeships, and Internships

Fellowships are awarded to full-time students at the University of Hawai'i campuses at Mānoa and Hilo. Awards are given for space-related research with a mentor and provide a stipend of \$3000/semester to the student. Fellows are also eligible for travel and supply funds. In previous semesters, these funds have been used for activities including observing runs at Mauna Kea telescopes, fieldwork to collect ground-truth information for interpreting satellite data of the Hawaiian Islands and other locations, and travel to meetings to present project results.

Mānoa Fellows - Spring 2009

Jason Axelson, a senior in Electrical Engineering, worked with mentor Dr. Wayne Shiroma on hardware and software issues for small satellites on a project titled, "Design of a CubeSat Payload Interface." Jason created a modular interface to support CubeSat payloads in an effort to systematize development efforts and meet budget constraints.

Amy Blas, a senior in Electrical Engineering, continued her efforts with the Kumu A'o CubeSat team as project manager and co-lead for the telecommunication subsystem. Working with mentors Lloyd French and Bryon Wolfe, of the Hawai'i Institute of Geophysics and Planetology, Amy and undergraduate teammates worked toward completing a low-Earth-orbiting CubeSat satellite mission, from design to construction, launch, and operations.

Jeremy Chan, a senior in Electrical Engineering, was the systems engineer and co-lead of the Kumu A'o CubeSat team, responsibilities he began last semester. He also managed the official documentation for the entire project under mentors Lloyd French and Bryon Wolfe of the Hawai'i Institute of Geophysics and Planetology.

Jeff Fines, a senior in Electrical Engineering, worked on developing a telecom standard for CubeSat small satellites, helping to set a protocol for sending and receiving telemetry data. Jeff worked on his project titled, "Design and Realization of a Standard for Telemetry Data Packeting," with mentor Jason Akagi, Avionics Engineering Lead for the Hawai'i Space Flight Laboratory.

Jeffrey Guzman, a senior in Mechanical Engineering, continued his work with mentor Dr. Weilin Qu of the Department of Mechanical Engineering on experiments to improve spacecraft thermal control. In his study titled, "Two-phase

Micro-Channel Heat Sink Cooling Loop," Jeffrey concentrated on system assembly to determine the effects of gravity on the thermal performance of the cooling loop.

Joshua Irvine, a senior in Biological Engineering, pursued his research interests in bioenvironmental and agricultural engineering with a project that addressed new technologies that enable long-duration human space exploration. Joshua's project titled, "Biological Treatment and Reuse of Human Wastewater in Space" was conducted with mentor Dr. P. Y. Yang of the Department of Molecular Biosciences & Bioengineering.

Reece Iwami, a senior in Electrical Engineering who has worked on U.H. CubeSat projects since his freshman year, including as a project leader, took a new research direction into antennas. Reece's project was titled "Determination of the Effects and Applications of Multiple Interrogators on Retrodirective Arrays." Serving as mentor was Dr. Wayne Shiroma of the Department of Electrical Engineering.

Kaveh Khosroshahi, a senior in Mechanical Engineering, put his skills to work for space technology and applications in a project titled, "Mechanical Performance and Alignment of Carbon Nanotubes." Kaveh continued his study of carbon nanocomposite materials grown on unidirectional carbon fiber tapes. Serving as mentor was Dr. Mehrdad Ghasemi Nejhad of the Department of Mechanical Engineering.

Christina King, a junior in Art, worked with mentor Dr. Norbert Schorghofer of the Institute for Astronomy to research



Front Row (Left to Right): Reece Iwami, Isaac Rodrigues, Amy Blas, Alexander Williams, Chamille Esteban, Christina King, Whitney Reyes, Lauren Elder, David Trang, and Jordan Olive. Back Row (Left to Right): Jason Axelson, Jeff Fines, Leon Santinizio, Reid Yamura, Kaveh Khosroshahi, Joshua Irvine, Erin Miller, Yu Ming Cai, and Jeremy Chan.

the characteristics and timing of the formation of dark streaks on slopes on the Martian surface. In her project titled, "Seasonality of Slope Streak Formation," Christina learned digital processing and analysis techniques of geological remote sensing data.

Erin Miller, a senior in Geology and Geophysics, continued to work with mentor Dr. Cecily Wolfe of the Department of Geology and Geophysics to study seismic data of Hawaiian volcanoes to help explain geologic behavior on other planetary bodies, detachment faulting in particular. Erin's project was titled, "Magmatism and Faulting at Kilauea Volcano: An Analog to Tharsis Volcanoes on Mars."

Whitney Reyes, a junior in Botany, continued to pursue her interests in documenting land cover in Hawai'i in a project titled, "Mapping and Analysis of Vegetation Abundance, Diversity, and Health in a Hawaiian Locale Using Hyperspectral Remote Sensing." Whitney is conducting field work to support her remote sensing work, with mentors Dr. Barbara Bruno of the Center for Microbial Oceanography and Harold Garbeil of the Hawai'i Institute of Geophysics and Planetology.

Isaac Rodrigues, a senior in Electrical Engineering, continued working for the Kumu A'o CubeSat team as lead engineer of the telecommunication subsystem. Serving as mentors were Lloyd French and Bryon Wolfe, of the Hawai'i Institute of Geophysics and Planetology.

Reid Yamura, a senior in Electrical Engineering, continued to work on the electrical power subsystems for the Kumu A'o CubeSat team. Working with mentors Lloyd French and Bryon Wolfe, of the Hawai'i Institute of Geophysics and Planetology, Reid and undergraduate teammates were learning to develop, test, launch, and operate a CubeSat mission.

Hilo Fellows - Spring 2009

Jordan Olive, a freshman in Computer Science, researched dust-reflection systems for use in the lunar environment; a continuation and expansion of Jordan's summer, 2008 internship project at NASA Ames Research Center, CA. Jordan's project was titled, "Applying Electrodynamic Dust Shield Technology to an Optical Surface on a Lunar Rover." Serving as mentor was Riley Ceria, Robotics Advisor for the College of Engineering.

David Trang, a senior in Astronomy, Geology, and Physics, worked with mentor Dr. Bo Reipurth of the Institute for Astronomy on a project monitoring stars in the Orion Nebula using two robotic telescopes at Mauna Loa Observatory. The title of David's project was "Surveying Stellar Flares: Preparing for the VYSOS Telescope."

Traineeships are awarded to full-time students at U.H. Mānoa and Hilo, U.H. Community Colleges, and the University of Guam. Awards provide lab training and practical experience with a mentor in any space-related field of science, technology, engineering or math. Trainees receive a stipend of up to \$1000 /semester and may be eligible for supply funds.

Mānoa Trainees - Spring 2009

Yu Ming Cai, a senior in Mechanical Engineering, worked with mentor Dr. Marcelo Kobayashi of the Department of Mechanical Engineering on "Analysis and Design of the Thermal Control Sub-System of LEO-1." Yu Ming's thermal models and analyses are relevant to all small satellite projects.

Summer 2009

Internships at Local Industries & Companies

All full-time undergraduates enrolled at a university or community college in Hawai'i or a mainland state are eligible to apply for Internships. The main objective of the program is to promote the use of NASA technology and educational opportunities in Hawai'i and internships focusing on NASA's science goals are especially encouraged. In pursuit of creating a high-tech workforce, the HSGC Internship Program encourages all opportunities relating to STEM disciplines.

There were 11 Interns funded at six companies on Kaua'i for the 2009 Summer Internship Program. Interns at Manu Kai at the Pacific Missile Range Facility (PMRF) on Kaua'i were Mark Guirao & Brycen Nakashima. Angel Hernandez & Ryan Parangao both interned at Trex Hawai'i, PMRF. Crystal Whitehill continued her internship from summer 2008 to work with ITT Corp., PMRF. Interning with the Navy at PMRF were Eric Fune, Keelan Sakuda, Keonimana Shigematsu, and Geoffrey Tran. Harold Shimono served as intern at Oceanit Laboratories, Inc. Kawa'i Island Utility Cooperative (KIUC) sponsored Thad Fuji.



Front Row (L to R): Eric Fune, Crystal Whitehill, Kolby Javinar, and Geoffrey Tran. Back Row (L to R): Victor Rundbaken, Keelan Sakuda, Brycen Nakashima, and Harold Shimono.

Kaua'i Community College

There were six fellows funded for the 2009 Summer Fellowship Program at Kaua'i Community College. Kaua'i Fellows were Kelan Adachi, Taylor Alfiler, John Crescenzi, Kolby Javinar, and Victor Rundbaken. These students worked under the guidance of Dr. Matthew Cochran.

NASA Summer Experience 2009

Daniel Hong interned at NASA Ames Robotics Academy located at NASA Ames Research Center, CA. He worked on developing a solar shroud conceptually. Many designs were modeled in Solidworks and evaluated to determine the optimal shading and power generation within the constraints. Many variables were also taken into account such as how internal and external factors would affect the rover. After brainstorming and creating computer models, he worked on a basic physical model of the design. It was entitled "Lunar Solar Shroud".

Jordan Olive interned at NASA Ames Robotics Academy located at NASA Ames Research Center. He worked on an electrodynamic dust shield to work in a zero atmospheric environment such as the Moon. Testing included varying the voltage, waveform, and frequency applied to the dust shield. Results ensure that this part, which will be used on a lunar micro rover, will not interfere with other systems. Testing done in a vacuum chamber qualified this dust shield as a "space worthy" part. This project was entitled "Applying Electrodynamiv Dust Shield on a Lunar Rover".

Sophie Milam interned at the NASA Ames Academy, where she was involved in a NASA researcher's project as well as a group project with other interns in the program. Leadership training is the final aspect of the Academy and was reinforced through travel, outdoor activities, seminars, and group projects. Her research project was entitled "The Impact of Rapid Climate Change on Mars and Earth Lake Habitats". "It was by far the best experience of my life!"



Above: Jordan Olive (left) and Daniel Hong



Above: Sophie Milam



Hawai'i Space Grant Consortium

Mānoa Fellows - Fall 2009

Michael Andonian, a senior in Mathematics, applied his mathematical skills to address the issues of control theory developed for autonomous underwater vehicles (AUVs) and how they can be applied to robots in space, specifically vehicles that will someday explore the oceans under the icy crust of Europa, Jupiter's moon. Michael worked on his project titled, "Guidance and Control of Autonomous Underwater Vehicles," with mentor Dr. Monique Chyba of the Department of Mathematics.

Jason Axelson, a senior in Electrical Engineering, continued his work with mentor Dr. Wayne Shiroma of the Department of Electrical Engineering on hardware and software issues for small satellites. With his project titled, "Design of a CubeSat Payload Interface," Jason's goal was to create a modular interface to support CubeSat payloads in effort to systematize development efforts and meet budget constraints.

Yu Ming Cai, a senior in Mechanical Engineering, expanded on a project he began as a Space Grant Trainee (Spring 2009) on thermal modeling and analyses relevant to all small satellite projects. Yu Ming used advanced simulation tools during his project titled, "Analysis and Design of the Thermal Control Sub-System of LEO-1." Dr. Marcelo Kobayashi of the Department of Mechanical Engineering served as mentor.

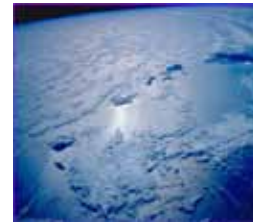
Samantha Jacob, a sophomore in Physics, worked with mentor Dr. Norbert Schorghofer of the Institute for Astronomy on a project titled, "Are Martian Slope Streaks Triggered by Dust Devils?" Samantha worked with orbital remote sensing images and learned digital imaging processing techniques specifically to identify dust devil tracks and slope streaks, to document the timing of their appearance and determine cause/effect relationships.

Windell Jones, a senior in Mechanical Engineering, had previous Space Grant Fellowship (2007-2008) and NASA Ames Robotics Academy (Summer 2008) experience. Windell worked on attitude correction for small satellites in a project titled, "The Design of Simple Attitude Control for a Cube Satellite." Dr. Amit Sanyal of the Department of Mechanical Engineering served as his mentor.

Christina King, a junior in Art, continued her work with mentor Dr. Norbert Schorghofer of the Institute for Astronomy researching the characteristics and timing of the formation of dark streaks on slopes on the Martian Surface. In her project, "Seasonality of Slope Streak Formation," Christina used advanced digital processing and analysis techniques on geological remote sensing data to further test hypotheses of formation mechanisms, seasonal dependence, and localized streak activity.

Scott Lee, a junior in Electrical Engineering, designed, fabricated, and tested a thermoelectric generator circuit for improved efficiency in storing and dissipating electricity. Scott's project, "Renewable Energy Using Thermoelectric Devices" has important applications for space components. His mentor, Dr. Aaron Ohta of the Department of Electrical Engineering, was a former Hawai'i Space Grant Fellow (2002) and Trainee (2001).

Bao Jun Lei, a senior in Electrical Engineering, worked with mentor Dr. Wayne Shiroma of the Department of Electrical Engineering on nanosatellite technology. With his project titled, "Design of Electrical Power Subsystem using the CubeSat Stackable Interface," Bao planned, created, and tested modular designs that can be integrated within any type of CubeSat payload for optimum performance.



Front Row (Left to Right): Todd Esposito, Crystal Whitehill, Jasmine Maru, Premitivo Ames II, Samantha Jacobs, Christina King, and Sophie Milam. Second Row (Left to Right): Kolby Javinar, Windell Jones, Kendra Dilcher, Joleen Iwaniec, Scott Lee, Jordan Olive, Bao Jun Lei, and Daniel Hong. Third Row (Left to Right): Patrick Lancaster, Victor Rundbaken, Brycen Nakashima, Harold Shimono, and Geoffrey Tran. Fourth Row (Left to Right): Eric Fune, Keelan Sakuda, Jason Axelson, Michael Adonian, and Yu Ming Cai.

Building with Brains and Beauty

By: Jeffrey Iwaniec

Joleen Iwaniec



"Hawai'i Space Grant Consortium has afforded me the opportunity to be a part of Windward Community College CanSat team, to attend the ARLISS competitions in Black Rock, Nevada and to be a member of the NASA-University Student Launch Initiative, or USLI Team."

These challenging programs allow university students to think outside the box in researching, designing, and building a rocket which will later launch, in competition, to one mile in altitude. Joleen hopes to inspire and motivate students at all levels to pursue higher levels of study in science and technology, including those in traditionally underserved and underrepresented communities that deserve our greatest support. With all this training she hopes it will propel her to a position within the NASA community. "My dream is to one day be a member of the NASA team."

Of her many exploits outside of school, volunteering, horseback riding, and pageantry are her specialties. On February 21, 2010 Joleen competed in the Miss Island Oahu Scholarship Program, which is a preliminary to the Miss Hawai'i Scholarship Pageant. Her platform is NASA and science education, specifically a program she developed called K.I.T.S. or Kids in Technology and Sciences.

Joleen is a leader both in and out of school. She is pursuing a degree in Electrical Engineering and plans to apply her degree to exposing the youngest members of our society to the critical role technological advancement has for our future as human beings. Young adults must have their eyes open to the world of opportunity within technological studies and educated as to their possible contributions to it. With that aim in mind Joleen developed K.I.T.S. to enhance the knowledge of technology, its place in our society, and the role young adults will have in shaping our future. But this goal would not be possible if not for the affiliation and support of the Hawai'i Space Grant Consortium, which has enabled her to broaden K.I.T.S.' horizons as far as Kaua'i.

⊖

This Windward Community College student won the Miss Congeniality distinction in the 2009 Miss Hawaii pageant. She didn't know that building rockets would become a passion until she met Astronomy professor Joseph Ciotti and rocket mentor Jake Hudson. "She has a self-drive that's incredible. When you have a positive attitude, it opens up so many doors," said Ciotti.

Photos: Joleen Iwaniec, "Miss Ka'ena" and (at right) working with WCC CanSat teammate Premo Ames II.



Fellowship Project in Mars Research

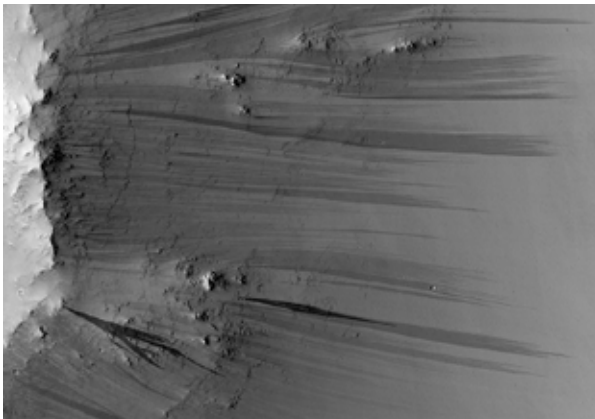
By: Christina King
U.H. Mānoa Student

I started my undergraduate career in Art, but realized that I wanted to pursue a career in Astronomy. I met with a handful of astronomers and advisers, to ask how I could begin to meet my new career goals, and they all referred me to Space Grant. Space Grant is an excellent opportunity for anyone who would like a chance to apply their skills outside of the classroom, and my experience has truly convinced me that Astronomy is the right field for me.

When I was accepted to the program, I began to work with Dr. Norbert Schorghofer on his research on Martian slope streaks. Slope streaks are avalanches of dark material that continue to form on the Martian surface. Similar streaks have been observed on Earth, in the Antarctic Dry Valleys, a landscape similar to the environment on Mars. These Antarctic Dry Valley streaks have been attributed to the melting of seasonal frost, which implies that the streaks on Mars may be formed in the same way. I found this opportunity especially exciting because among other things, we were studying the possibility that liquid water could exist on the surface of Mars.

To establish how the streaks on Mars form, Dr. Schorghofer and I would carefully select a site to study over time. We would pick a site based on how many times the site had been imaged, and whether or not we could observe active streak formation in these images. Overlapping images were important because we needed to study the site over time. My task was to look at each pair of overlapping images, and find any newly-formed streaks. Once I found a streak, I could tell approximately when the streak formed, by comparing the dates that the images were captured. In this way, I linked each new streak I found to a time interval during which it must have formed.

Finally, we would compile the data and analyze it. If streaks on Mars were formed by melting frost, then we would expect



Above: Slope streaks on rim of Henry Crater, Mars. NASA/JPL / Univ. of Arizona HiRISE image. Right: Christina King.



to see streak formation only during the summer, when the temperature at our study sites would rise above freezing. Instead, we saw that streaks form continuously throughout the year, even during the winter. This evidence argues against the possibility that streaks form because of water-related processes. Instead, our data supports other theories. Our results show that slope streaks are most likely caused by wind-related processes, such as dust devils.

My two semesters with Space Grant were extremely rewarding! It was so exciting to get out of the classroom and discover something that no one else has ever seen. In these two semesters, I have learned a lot about what options are available for me as a young Astronomer. I've gained some experience in using scientific inquiry to answer a question, and with the help of my mentor, I was able to contribute something new to the wealth of human knowledge. Not only has the Hawai'i Space Grant Consortium made this research possible, but they are also sponsoring me to fly to Houston, to present our results at the 41st Lunar and Planetary Science Conference. Undoubtedly, my experience with Space Grant is one that I will never forget! ☺

Former Space Grant Fellow now an Assistant Professor

By: Aaron Ohta

U.H. Mā noa Assistant Professor

As an undergraduate student at the University of Hawai'i, I was fortunate enough to be supported by the Hawai'i Space Grant Consortium as both a Trainee and Fellow, over several semesters. The support provided by the Traineeships and Fellowships enabled me to pursue several interesting research projects, as I received support for the purchase of necessary supplies. The stipends associated with these programs was a great help as well, since I did not need to work at another job while attending UH, allowing me to concentrate on my studies and my projects.

The projects I worked on ranged from the design and fabrication of a component used in wireless transceivers, such as mobile phones, to building a small satellite. Space Grant support allowed me to gain experience in a variety of project-based activities, which was a great supplement to the curriculum of the Electrical Engineering department. Working on these projects helped me to realize that I enjoyed hands-on experimental work, which has shaped my career.

With the help of my Space Grant mentor, Prof. Wayne Shiroma, I was able to use my Space Grant experiences to co-author 9 conference publications, and get a great head-start for graduate school. I'm sure that my Space Grant project experiences were a factor in obtaining a National Science Foundation Graduate Research Fellowship, which provided a \$30,000 stipend for each of 3 years, and \$10,500 per year for tuition costs. With this support, I was able to attend graduate school at UCLA and UC Berkeley, respectively, where I received my M.S. and Ph.D. degrees in electrical engineering. During my graduate school career, I worked on research in microelectromechanical systems (MEMS), which are devices with very tiny features (smaller than the width of a human hair). Although this was a markedly different area from the projects I worked on at UH, many of the same principles I learned in my Space Grant projects applied.

After graduating from UC Berkeley, I was lucky enough to be able to return to UH as an assistant professor. I am happy to have come full-circle, and am now serving as a Space Grant mentor for a new generation of Trainees and Fellows. One of my goals is to give back to UH and the community by providing students with opportunities to do cutting-edge research. I encourage all students to take advantage of the wonderful experience provided by the Hawai'i Space Grant Consortium's Traineeship and Fellowship program, and to take part in interesting research as an undergraduate. ☺



K-12 Education *A variety of K-12 education projects bring hands-on experiments, gadgets, and the excitement of space exploration to thousands of participants.*

Future Flight Hawai'i

<http://www.higp.hawaii.edu/futureflight/>

Apollo: the Next Generation, Return to the Moon, was the theme of the 19th annual Future Flight Hawai'i summer program, in celebration of the 40th anniversary of Apollo 11's landing on the Moon. Ten hands-on learning modules, a culminating BrushRobot contest, and the traditional science demonstration closing program highlighted the weekend activities. Future Flight Hawai'i, a space-themed, summer educational program designed to catalyze student interest in science, engineering, and technology, will celebrate its 20th anniversary in June 2010 with its annual Family Exploration Program theme, Mission to the Blue Planet. Future Flight Hawai'i is registered as an official Earth Day event in celebration of the 40th anniversary of Earth Day. ☺ (<http://earthday.net/node/16756>)



Astronaut Onizuka Science Day

<http://www.spacegrant.hawaii.edu/OnizukaDay/>



Astronaut Lacy Veatch Day of Discovery

<http://www.spacegrant.hawaii.edu/Day-of-Discovery/>

The 9th annual Astronaut Onizuka Science Day, held on January 24, 2009 in Hilo, and the 8th annual Astronaut Lacy Veatch Day of Discovery, held on October 24, 2009 in Honolulu, provided over 1,200 children, parents and teachers with a variety of science and technology workshops and displays along with inspiring keynote speakers, Astronaut Daniel Tani, and Lacy Veatch's son, Scott Veatch. Hawai'i Space Grant with community co-sponsors, the American Savings Bank, the Hawaiian Electric Company, Punahou School, and the University of Hawai'i at Hilo, and over 300 community volunteers and facilitators, provide the community with a day of learning hands-on science through 40 workshops sponsored by teachers and community organizations. The 10th annual Astronaut Onizuka Science Day will celebrate the 25th anniversary of Ellison Onizuka's first flight into space onboard the space shuttle, Discovery. ☺



FEST=Family Exploring Science Together

Continuing the growing interest in programs which partner parents and their children in a common science learning experience, the Space Explorers FESTivals continue to provide hands-on science experiences for thousands of students and parents annually, while providing an opportunity to share NASA's Vision for Space Exploration and inspiring a new generation of explorers. Featuring rockets, micro gravity, challenges of space travel, and future space colonization as themes, a pilot program featuring BrushBots (made from toothbrushes & cell phone miniature, vibrating motors) brings the excitement of robotics to many thousands. ☺



Oahu Vex Robotics

Hawai'i Space Grant Consortium was primary sponsor along with facilities hosts, Iolani School & Moanalua High School, for the two Oahu VEX Robotics Tournaments held in October and November 2009. A combined 76 teams participated in the 2009 Clean Sweep challenges in which tournament alliance champions & teams receiving the prestigious Team Excellence Award advanced to the World VEX Championships to be held in Dallas, April 2010. Assoc. Directors, Dr. Jeff Taylor and Dr. Ed Scott, welcomed the student participants and highlighted the importance of developing a more technical work force. ☺

Science Professional Development Partnership

Hawai'i Space Grant Consortium is included in a three-year partnership with Stevenson Middle, Manoa Elementary, and Lincoln Elementary Schools to provide content workshops for the elementary and middle school teachers who will assist other teachers in developing contextually based curriculum to engage their students in addressing the science standards. Coordinated by education specialists, Art and Rene Kimura, the sessions have included a NASA Digital Learning Network event from NASA Ames Research Center and Kennedy Space Center, and covered science content in geology, volcanology, oceanography, physics, chemistry, and astronomy provided by Space Grant affiliated scientists and instructors from the University of Hawai'i at Manoa's Hawai'i Institute of Geophysics and Planetology, the Honolulu Community College, the Windward Community College, and the Leeward Community College. Parent and child engagement programs in the evening, along with individual assistance to teachers and grade levels are provided by the Hawai'i Space Grant Consortium. ☺

‘Imiloa Astronomy Center of Hawai‘i

Funded primarily by NASA, the ‘Imiloa Astronomy Center of Hawai‘i, opened in February 2006, provides a unique experience for visitors and students to explore the connections between Hawaiian cultural traditions and astronomy. The \$28 million, 40,000-square-foot exhibition and planetarium complex is located on nine acres in the University of Hawai‘i’s Science and Technology Park, above the UH-Hilo campus. The Hawai‘i Space Grant Consortium has partnered with the ‘Imiloa Astronomy Center of Hawai‘i in initiating several educational and community events and programs at ‘Imiloa including advising and supporting the new Camp ‘Imiloa, which was patterned after the Future Flight Hawai‘i program, volunteer training and a family science night by Dale Olive, Waiakea High School physics teacher on contract with the Hawai‘i Space Grant Consortium, a BrushBot teacher workshop for 50 teachers, the world’s first BrushBot Tournament featuring 100 students from 28 teams and 14 schools including an international school (Myanmar) participating virtually, a BrushBot Family Science Night with 100 participants, and the Big Island VEX Robotics Tournament with 24 teams competing. Currently, the Hawai‘i Space Grant Consortium has been asked for collaboration on a new exhibit to feature exploration, past, present and future, through highlighting the friendship and common dreams of Astronaut Lacy Veach and Polynesian navigator, Nainoa Thompson. ☺

International Super Science Fair

Hawai‘i Space Grant Consortium education specialists, Art and Rene Kimura, initiated and offered a unique, two-week historic educational journey to Japan for 13 students from the Waiakea High School Robotics Club and five mentors (see picture). Invited as only one of four schools from the U.S. to the International Super Science Fair, hosted in Kyoto, there were 35 schools from 15 countries who shared science projects, hosted poster sessions, participated in team problem solving activities, shared cultural presentations and made friends from throughout the world. Dale Olive, Waiakea High science teacher, and a member of the Future Flight staff for 18 years, provided one of five keynote presentations with a science demonstration program and a special presentation to visiting Japanese elementary school classes. Following the week-long Super Science Fair, the students enjoyed a two-night home stay with Kyoto families, participated in the International Micro Robot Maze Contest at Nagoya University, and helped to initiate the first Japan VEX Robotics Tournament hosted at the American School in Japan. A long-term exchange agreement will allow a school from Hawaii to attend the International Super Science Fair each year. ☺



Aloha from Space STS-119 Hawai‘i Downlink



March 27, 2009 marked the spectacular, 20-minute live video downlink shared between STS-119 astronauts and Hawai‘i students. The 12-day STS-119 mission to the ISS delivered the final set of solar arrays. On mission day 11, the crew answered questions from students assembled from public and private schools on Oahu. The program was sponsored by Hawai‘i Space Grant Consortium, Punahou School, ‘Olelo Community Television, and the state Department of Education. The coordination of many technical resources and dozens of people in multiple agencies made it so successful. Space Grant’s Art Kimura reminded us that this was the only live downlink with students during this shuttle mission. Students ranged in grades from 3 to 12; they came from Pearl City Elementary, Stevenson Middle, Punahou, Noelani Elementary, Manoa Elementary, Gus Webling Elementary, Mid Pacific Institute, Lincoln Elementary, and St. Ann’s. In addition to the ‘Olelo broadcast, all the local affiliates of major broadcast networks reported on the event, as well as local newspapers. The NASA Education Office also posted a news item. ☺

Hawai‘i Space Grant Consortium

Participation in the 10th Biennial SOEST Open House

As part of the Hawai'i Institute of Geophysics Planetology, in the School of Ocean & Earth Science & Technology (SOEST), the Hawai'i Space Grant Consortium (HSGC) faculty and staff were very committed in celebrating the 10th biennial SOEST open house from October 16 – 17, 2009. SOEST funding comes from state, federal, and public institutions to conduct teaching and research. The SOEST open house presents a diverse array of entertaining and educational hands-on activities that highlight the research conducted by the faculty, students, and staff. At this year's event, there were over 4,000 K-12 students and an estimated 2,500 public guests in attendance. Exhibits and demonstrations catered to the various age groups. Videos, posters, interactive demonstrations, and distribution of NASA curriculum resources to educators were a few of the HSGC contributions. Below is a collage of how HSGC mixed fun into education.



Thirty Meter Telescope

The proposed Thirty Meter Telescope (<http://www.tmt.org>), with proposed first light in 2017, has committed a million dollar a year community benefit package that will support education and other community development on the Big Island. Through the support of Hawai'i Space Grant Consortium education specialists, Art and Rene Kimura, a \$30,900 grant was funded by TMT to the Waiakea High School Robotics Club, which assisted the school in significantly increasing access to their micro robotics program and community outreach. The outcomes include: a two-day training workshop for six other high schools, professional development for 200 teachers statewide in BrushBot robotics, hosting the first BrushBot Tournament at the 'Imiloa Astronomy Center of Hawai'i, competing in the International Micro Robot Maze Contest at Nagoya University for the third consecutive year, and planning for hosting a 3-day Micro Robot Conference and Tournament in Hilo in July 2010. ©



An artist's interpretation of the TMT on Mauna Kea.

Website Action

There's nothing quite like hearing from satisfied customers! The emails we receive from readers of our educational web sites--and we get quite a few comments each year--help spur us to do the best job we can to provide engaging and accurate science materials. Comments come from educators, pre-service educators, parents, and students themselves.

Exploring Planets in the Classroom -- http://www.spacegrant.hawaii.edu/class_acts

Here is just a sampling of what people are saying about Exploring Planets in the Classroom, the website that evolved from our set of professional development workshops for K-12 educators and received about 47,000 hits/month last year.

"I live in Hamilton, Ontario. I am currently a student completing my Masters of Science in Elementary Education (teachers college). I just wanted to thank all those that make a web site like this possible."

"I am a fifth grade teacher. I have been to the spacegrant website for educators and have seen some fun activities I can use in my classroom."

"I have been using your page with helpful references on the solar system as guide for my science class."

This website was also recognized with a Kid Scoop Choice Web Award "for content that is engaging, informative and valuable for kids and their families." Kid Scoop is an internationally syndicated newspaper page for children that appears in nearly 400 newspapers and has a circulation of more than 7 million. Their companion website, www.kidscoop.com, links to Exploring Planets in the Classroom, which is a compilation of more than 25 hands-on science activities. Topics of the activities cover an introduction to the Solar System, planetary properties, volcanology, impact craters, dynamic Earth, gradation, gravity forces, rockets, the Moon, remote sensing, and Mars. Exploring Planets in the Classroom began as a long-running summer workshop in Planetary Geosciences offered on the campus of the U.H. Manoa for the state's K-12 educators and librarians under the direction of Jeff Taylor. Hands-on activities were developed and/or tested by Hawai'i Space Grant in cooperation with educators statewide. In 1996 the workshop transformed into the website to assist educators and resource specialists around the globe.



PSRD -- <http://www.psrdr.hawaii.edu>

Our Space Grant team of Jeff Taylor and Linda Martel also produce the educational website Planetary Science Research Discoveries, nicknamed PSRD. Co-supported by Hawai'i Space Grant and the Cosmochemistry Program of NASA's Science Mission Directorate, this site received about 60,000 hits/month last year. We've received quite an assortment of comments.

"I've been reading the material on your website for quite a few years now. I just wanted to compliment you both on the knack that you have for translating what are often quite complex scientific concepts into a form suitable for a lay audience. Not only do you get the text right, but the images and diagrams are always well chosen. You also manage to convey the excitement of the science. I don't know of another site quite like yours but I can say that I've yet to see one that matches the quality of yours, year in, year out."

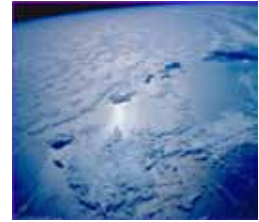
"Thank you very much for the articles on the WWW! I think it is amazing what careful research tells us about the beginning of our Solar System. The articles combine both my interests in geology and astronomy. I hope you will continue this series for a long time!"

"Thank you...great article on the Sweden meteorites... we all thought they were very small...great pictures. Anyway ...one thing led to another...and I spent 3 wonderful hours exploring other articles and what you are all doing."

©

Strategic Planning

-- Inspiring the Next Generation of Engineers & Scientists Through Scholastic Robotics



The Hawaii Space Grant Consortium has been a critical community partner and sponsor in the initiation and growth of scholastic robotics in Hawaii (www.robotics.hawaii.gov) with a 300 per cent increase in schools and teams participating in one or more of six programs offered in Hawaii, in the past three years. Demand is outpacing access in most programs currently.

Robotics outcomes include:

1. Building critical life skills in teamwork, problem solving, time management and effective communication.
2. Raising expectations and benchmarks through national and international competitions, providing a measurable standard.
3. Catalyzes interest in science, technology, engineering and mathematics by making abstract concepts concrete and making learning relevant and engaging.
4. Provides skill sets in developing and motivating interest in a technically and scientifically literate work force.
5. Builds relationships and partnerships with government, corporate and other agencies as mutual sponsors and supporters of developing the identified work force needs.

Hawaii Space Grant has directly supported:

1. Botball robotics (www.botball.org) through coordination of team recruitment and communication, sponsorship of two-day workshop and tournament, recruitment of needed volunteers and on-site production. The Hawaii Botball program, initiated by Hawaii Space Grant, in partnership with the University of Hawaii's College of Engineering and the Hawaii Convention Center, now in its 7th year, is the largest in the United States with 40 middle and high school teams participating. Through legislation for funding, developed in concert with the legislature and the Office of the Governor, and a contract with the Department of Business, Economic Development and Tourism and the Department of Human Services, team registration was provided to all eligible schools.
2. FIRST robotics (<http://www.usfirst.org/roboticsprograms/frc/default.aspx?id=966>) through having assisted in establishing the program 13 years ago with the first two schools to

participate, has partnered with the Office of the Governor, the University of Hawaii, industrial partners (Hawaiian Electric Company, BAE Systems), and NASA. The Hawaii FIRST Robotics Regional Tournament was established in 2008; Hawaii Space Grant Consortium assisted in identifying and recruiting new participating schools, resulting in increasing the number of Hawaii schools participating from four to 20, the largest increase of new teams in a single regional in the United States.

3. VEX robotics (<http://www.vexrobotics.com/vex-competitions.shtml>) through directly initiating and funding two tournaments, applied for grants to sponsor two other tournaments and helped initiate the first Pan Pacific VEX Championship, resulting in 200 teams participating. Through legislative funds and Temporary Aid for Needy Families federal funds along with corporate contributions, nine tournament fields and 120 kits of VEX components were provided resulting in Hawaii having the third largest number of teams among all states in the United States.

Collaborating partners include the Hawaii Electric Light Company, the Maui Electric Company, the Hawaiian Electric Company, the College of Engineering, and the Hawaii Convention Center.

4. Micro robotics (<http://www.waiakearobotics.com/>) through a grant to the Waiakea High School Robotics Club for consumables and other materials, coordinating with the College of Engineering to access legislative funds for developing kits of parts for other schools, and writing and receiving funds from the Thirty Meter Telescope to provide materials for an extensive outreach and professional development program which has provided training and materials for 200 teachers, the first BrushBot tournament in the world, and funds to participate in the International Micro Robot Maze Contest at Nagoya University, Japan, for their third consecutive year.
5. FIRST Lego League robotics (<http://www.hawaiiifll.org/>) through applying for a grant from the Hawaii Electric Light Company to fund and host the FIRST Lego League tournament on the Island of Hawaii. ☺

Calendar

October 2009

- 3 BrushBot Robotics Student and Parent Workshop
- 15 Space Explorers Science FESTival at Stevenson Middle School
- 16 to 17 SOEST Openhouse
- 21 to 25 National Council for Space Grant Director's Meeting in Portland
- 24 2009 Astronaut Lacy Veach Day of Discovery at Punahou High School
- 24 West Oahu VEX Competition at Moanalua High School
- 31 to Nov.4 Ritsumeitan Super Science Fair in Kyoto, Japan

November 2009

- 7 FIRST Lego League
- 11 East Oahu VEX Tournament at Iolani School and Moanalua High School
- 21 Fall Fellowship and Traineeship Symposium/ Associate Director's Meeting
- 21 2nd Annual HELCo Big Island VEX Robotics Tournament

December 2009

- 1 Spring 2010 Fellowship & Traineeship Program Application Deadline
- 2 Brushbot FESTival Family Science Night at Pearl City Elementary School
- 3 to 5 2nd Annual Pan Pacific VEX Robotics Tournament
- 10 Last Day of Instruction for FALL Semester 2009
- 15 Space Explorers Science FESTival at Laie Elementary

January 2010

- 9 FIRST Robotics National Kickoff at McKinley High
- 11 First Day of Instruction for SPRING Semester 2010
- 12 Space Explorers Science FESTival at Holualoa Elementary School
- 13 Space Explorers Science FESTival at Konawaelo Elementary School
- 20 BrushBot FESTival Family Science Night at Gus Webling Elementary School
- 22 Fellowship and Traineeship Orientation
- 23 2010 Astronaut Ellison Onizuka Science Day in Hilo

February 2010

- 11 BrushBot FESTival Family Science Night at Manoa Elementary School
- 13 to 14 Botball Training Workshop
- 17 Space Explorers Science FESTival at Hahaione Elementary School
- 20 Demonstration/ Exhibit at Kahala Mall for Engineering Week
- 25 Math Science Partnership Workshop at Windward Community College

March 2010

- 2 Math Science Partnership Workshop at Stevenson Middle school
- 4 to 6 National Council for Space Grant Director's Meeting in Washington D.C.
- 25 to 27 FIRST Robotics Competition Hawaii Regional

April 2010

- 17 BrushBot Teachers Workshop
- 29 to May1 Botball Regional Tournament at Hawaii Convention Center

May 2010

- 1 Botball Regional Tournament at Hawaii Convention Center
- 5 Last Day of Instruction SPRING Semester 2010
- 24 to July2 Summer Session I

June 2010

- 12 to 13 20th Annual Future Flight Hawaii: Mission to the Blue Planet
- 15 Fall 2010 Fellowship & Traineeship Program Application Deadline

July 2010

- 6 to Aug, 13 Summer Session II
- 16 to 19 International Micrbot Conference in Hilo

August 2010

- 23 First Day of Instruction for FALL Semester 2010

September 2010

- 14 to 16 Western Region Conference in Nebraska