AKAMAI

Maui Internship Symposium

August 9, 2013
Wailea Marriott Resort
Lokelani Ballroom

Program Information
Intern Abstracts

Advancing Hawaii college students into science and technology careers.

2013 Akamai Internship Program

Akamai Workforce Initiative
University of Hawaiʻi at Manoa Institute for Astronomy
Institute for Scientist & Engineer Educators, University of California Santa Cruz
University of Hawaiʻi at Maui College
University of Hawaiʻi at Hilo

Akamai – smart, clever

The Akamai Internship Program is a unique program that supports Hawaiʻi college students in completing an authentic science or technology project in a professional setting. Students are prepared through an intensive one-week short course, and then spend seven weeks at an observatory or industry setting where they complete a project under the guidance of a mentor. Throughout the entire eight-week program they complete a communication course that begins in the short course and continues through weekly meetings and intensive coaching sessions. The Akamai program uses an internship model designed by the Center for Adaptive Optics (CfAO) using National Science Foundation (NSF) Science and Technology Center funding, with the specific aim of developing a program to address the technical workforce needs in Hawaiʻi and advancing students from diverse backgrounds into science, technology, engineering or mathematics careers. In 2013, interns received credit from University of Hawaiʻi at Hilo.

The Akamai Internship Program includes:

40-hour short course
7-week project experience at a company, observatory, or government facility
Science & engineering communication course in which all interns prepare:
Oral presentation
Technical abstract
Personal statement
Résumé
Symposium
Ongoing educational and career support

2013 Maui Host Organizations

Akimeka
Air Force Research Labatory
HNu Photonics
Institute for Astronomy
Oceanit
Pacific Disaster Center
Trex Enterprises
2c4 Technologies

Akamai Workforce Initiative

Leadership Team:

Lisa Hunter - Director
UH Institute for Astronomy, University of California, Santa Cruz

Jeff Kuhn
Institute for Astronomy

Jerome Shaw
University of California, Santa Cruz

Mark Hoffman
University of Hawaii, Maui College

Joseph Janni
Advanced Maui Optical and Space Surveillance Technologies

Program Coordinators:

Lani LeBron - Institute for Astronomy
Samara Phillips - Institute for Astronomy
Diana Bisel - Cal Tech/Thirty Meter Telescope
Beth Walker - University of California, Santa Cruz
Elisabeth Dubuit - University of Hawaii, Maui College

2013 Akamai Short Course Instructors

David Harrington - Lead Instructor, UH Institute for Astronomy
Sarah Beganskas - University of California, Santa Cruz
Heather Kaluna, Ian Cunnyngham - UH Institute for Astronomy
Reza Rahimnejad - University of Hawaii, Manoa
Ehsan Yavari - University of Hawaii, Manoa
Brooks Thomas - University of Hawaii, Manoa Physics
Georgeanne Friend - Kauai Community College

2013 Communication Instructors

Michael Nassir - Lead Instructor, University of Hawaii at Manoa

Ryan Swindle - Instructor, UH Institute for Astronomy

Lisa Hunter - Institute for Astronomy, University of California, Santa Cruz

Jerome Shaw - University of California, Santa Cruz

Special Thanks . . .

The Akamai Workforce Initiative would like to thank the following individuals for their commitment and support of the 2013 Maui Akamai Internship Program:

James Gaines – Univ. of Hawai‘i
Günther Hasinger – UH Institute for Astronomy
Skip Williams – Air Force Research Laboratory
Daniel Evans – National Science Foundation
Sandra Dawson – Thirty Meter Telescope
Donald Straney – Univ. of Hawai‘i
Robert McLaren - Univ. of Hawai‘i
Kevin Kelly - Univ. of Hawai‘i
Mark Hoffman – UH Maui College
Elisabeth Reader – UH Maui College
Joseph Janni - AMOS
Todd Lawson – 2c4 Technologies
Mikol Westling – 2c4 / Hawaii Resource Group
Michael Strack – 2c4 / Hawaii Resource Group
Jacklyn Sugiyama – 2c4 / Hawaii Resource Group
Matt Granger - Akimeka
Cami Ichiki - Akimeka
Peter Konohia – Akimeka
Matt Brumley – Akimeka
Lakulish Patel – Akimeka
Richard Pascual – Akimeka
Carl “Joey” Andrews – Akimeka
Riley Aumiller – HNu Photonics
Richard Pultar – HNu Photonics
Michael Reiley – HNu Photonics
Johanna Estrella - UH Institute for Astronomy
Laura Fiorentino - UH Institute for Astronomy
Cindy Giebink – UH Institute for Astronomy
Jeffrey Kuhn – UH Institute for Astronomy
Dan O’Gara – UH Institute for Astronomy
Joseph Ritter – UH Institute for Astronomy
John Messersmith – UH Institute for Astronomy
J.D. Armstrong – UH Institute for Astronomy
Stan Truitt – UH Institute for Astronomy
Wade Bortz – UH Institute for Astronomy
Michael Bush – Oceanit
Rita Cognion – Oceanit
Brooke Gibson – Oceanit
Tiare Martin – Oceanit
Allister Knox – Oceanit
Scott Libert – Oceanit
Steve Kunitzer – Pacific Disaster Center
Sharon Mielbrecht – Pacific Disaster Center
Jen Stolpe - Pacific Disaster Center
Ned Davis – Trex Enterprises
Mike Engelmann – Trex Enterprises
Jeff Huebotter – Trex Enterprises
Gwen Rivera – Trex Enterprises
Stacie Williams – Air Force Research Laboratory
John Valliant – AFRL / Boeing
Steve Griffen – AFRL / Boeing
Imiloa Astronomy Center
Gary Sanders – Thirty Meter Telescope
Pamela Lau – UH Institute for Astronomy
William Walters – UH Institute for Astronomy

Presentation Schedule

Opening Remarks

Jeffrey Kuhn
UH Institute for Astronomy
Associate Director, Akamai Workforce Initiative

Lisa Hunter
Director, Akamai Workforce Initiative
UH Institute for Astronomy and UCSC Institute for Scientist & Engineer Educators

Concurrent Session I

Trex Enterprises

Magnetically Actuated Valves:
Investigating Use of Halbach Arrays for Enhanced Torque and Fabrication of High-Temperature Ball Valves for Sanitary Applications
Kyra Vila — *Virginia Tech*

Wave Energy Power-Management Circuitry
Kimberly Tabac — *Univ. of Portland*

Design of Buoy and Sea-Anchor Deployment Mechanisms
Sophia Wuest — *Univ. of Portland*

Akimeka

An Application for Monitoring Status of a Data Mart Containing Military Medical Records for Overseas Bases
Helaman Tafua — *UH Hilo*

A Follow-Me-at-a-Distance Algorithm for DroidPlanner
Joseph Thorpe — *UH Hilo*

~ Intermission ~

Pacific Disaster Center

A Dashboard Web Application for Viewing the Status of PDC Databases
Troy Kobayashi-Bautista — *UH Mānoa*

Oceanit

Atmospheric Modeling for Daytime Telescopic Observation
Katrina Schenk — *UH Mānoa*

Dome Control Automation: An Innovative Approach with Inertial Navigation Sensors
Kirsten Makanui — *UH Mānoa*

Designing a Complete Personal Observatory System for Commercialization
Jessica Lee — *UH Mānoa*

Concurrent Session II

UH Institute for Astronomy

Coelostat Characterization to Optimize Tracking
Zane Vergara — *UH Maui College*

Preventing the Illumination of Aircraft by a Laser Ranging System
Jasmine Hoapili — *Honolulu CC*

2c4 Technologies

Creating a Web-Based User Interface Database Storage for ITEC Resources and Metrics
Katriel Chiu — *UH Mānoa*

HNu Photonics

Confocal Microscope Characterization and Optimization
Styson Koide — *Northern Arizona Univ.*

UH Institute for Astronomy (cont'd)

Development of an Automated Robotic Laser-Tracker System for Performing Mirror Surface Metrology
Dylan Emley — *Univ. of Miami*

~ Intermission ~

Air Force Research Laboratory

Developing Sun Mitigation Solutions for the 3.6-m AEOS Telescope
Kanoe Hardin — *UH Maui College*

Evaluation of Dynamic Wind Loading on Rigid vs. Non-Rigid Baffle Materials
Derrick Saito — *San Francisco State Univ.*

UH Institute for Astronomy (cont'd)

An Optimal Baffle-System Design for the Harlingten H-80 Telescope
Chriselle Galapon — *UH Mānoa*

Developing a Parallax Ranging Method for Point-Source Objects
Alexis Acohido — *UH Mānoa*

ABSTRACTS

Magnetically Actuated Valves:
Investigating Use of Halbach Arrays for Enhanced Torque and Fabrication of High-Temperature Ball Valves for Sanitary Applications

Kyra H. Vila
Virginia Polytechnic Institute and State University

Trex Enterprises
Mentor: Gwen Rivera

On a government contract, Trex Enterprises has designed a magnetically coupled valve for the United States Navy. A magnetic coupling was designed by arranging neodymium magnets in a Halbach Array, resulting in a 73% increase in overall magnetic strength over the current arrangement. Typical neodymium rare-earth magnets have a maximum working temperature of 80°C. In order to withstand standard sterilization temperatures, a high-temperature ball valve was designed and fabricated. A stainless-steel ball valve was disassembled and redesigned to be retrofitted to withstand sanitary and high-temperature applications. The final valve will have a set of neodymium rare-earth magnets attached to the valve stem. The seal of the valve will be removed and a valve bonnet will be fabricated out of impact-resistant polycarbonate to hold a magnet puck sealed with food grade epoxy. A matching magnet puck will be used outside the sealed bonnet to open and close the valve. This magnetic coupling is expected to produce 5.6 ft-lb of torque, well exceeding the necessary 2 ft-lb of torque needed to open a standard stainless steel ball valve. Once the valve is fully fabricated, final tests will be administered, and its overall performance recorded.

Kyra Vila

Kyra was born and raised in Kihei, Maui. In 2012, she graduated from Maui HS, where she was very active with her high school's FIRST and VEX robotics teams, and with the Maui Economic Development Board's Women In Technology Program. Kyra is currently attending Virginia Polytechnic Institute and State University (Virginia Tech), where she studies Industrial and Systems Engineering. In her spare time, Kyra enjoys spending time with family and friends, catching up on TV shows, and learning to play the ukulele.

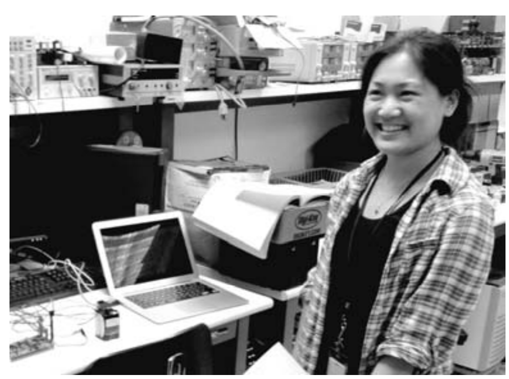
Wave Energy Power-Management Circuitry

Kimberly Tabac
University of Portland

Trex Enterprises
Mentors: Ned Davis, Michael Engelmann, Jeff Huebotter
Collaborator: Sophia Wuest

A Submarine Emergency Position Indicating Radio Beacon (SEPIRB) transmits data to rescue services in the event of an emergency occurring on a submarine. One drawback of the current SEPIRB design is that it has a relatively short 48-hour battery life. Trex Enterprises has addressed this battery-life issue by developing a prototype that harvests and utilizes wave energy to prolong the SEPIRB's operation. In operation, a wave lifts a buoy attached to the top of the SEPIRB, which pulls against an opposing force provided by a submerged sea anchor. This pulls out an anchor line, which spins a generator to produce electricity. After the wave passes, an electronic retraction mechanism rewinds the anchor line for the next wave. We have designed, constructed, and tested a power-management system for the compact wave-energy machine, in which low-voltage DC power is distributed to various components, including a charging circuit used to recharge a 12.8-V $LiFePO_4$ battery pack, a load simulator to represent the radio transmitter (the real SEPIRB radio should only be activated in true emergencies), and an electronic retraction mechanism. In addition, the power management system also provides battery power to a load-simulator circuit that represents the power needed for a radio transmitter. The load simulator switches on a 6-W load lasting approximately 0.5 s, once every 50 s, to replicate the power consumption features of the SEPIRB, and an LED is used to indicate when a simulated transmission would be sent. The electronic retract charge and load simulator circuits were constructed on breadboards and were tested independently for functionality. They were later integrated together, and all components operated properly when the system was tested for functionality. Other modules, such as a saltwater switch that activates the load-simulator circuit when in contact with ocean water, were added to the power management system, and the system components are currently being fabricated on to vector boards that will be placed in the prototype; the system will later be tested for func-

Kimberly Tabac



Kimberly was born and raised on the Big Island. She is a graduate of Honokaʻa HS, and she developed her interest in engineering and technology through participation in her high school's robotics club. Kimberly now attends the University of Portland, where she is majoring in Electrical Engineering, with a minor in Computer Science. She is particularly interested in renewable energy, robotics, and the design of digital systems. In her free time, Kimberly enjoys writing, and listening to and playing music.

Design of Buoy and Sea-Anchor Deployment Mechanisms

Sophia Wuest
University of Portland

Trex Enterprises
Mentors: Ned Davis, Mike Engelmann, Jeff Huebotter
Collaborator: Kimberly Tabac

A Submarine Emergency Position Indicating Radio Beacon (SEPIRB) is a device that transmits a distress signal and GPS coordinates to aid in search and rescue operations. Trex is developing a self-powered SEPIRB that will harness kinetic energy generated by waves to extend the operating life of the device beyond 48 hours. Trex's design requires deployment of an inflatable buoy and a sea anchor to provide drag against the motion of the waves. The problem analyzed was the buoy and sea anchor designs and deployment mechanisms. Various designs were considered for the buoy and sea anchor. Once the actual designs were figured out, a way to deploy them was examined. The size of the system is a key design constraint to the SEPIRB; it has to be housed in a three inch diameter tube that can be up to a meter long. All of the buoy and sea anchor materials need to fit in this tube, and be deployed once the SEPIRB leaves the submarine. In the chosen deployment approach, the SEPIRB arms itself through a reed switch which is attached to the housing compartment in the submarine. Once it senses saltwater, it activates a timing circuit that introduces up to a two day delay. After the delay, it actuates two CO_2 cartridges via two gear motors. One of the CO_2 cartridges inflates the buoy, which will force the cap off and deploy itself. The other CO_2 cartridge pressurizes the sea anchor compartment, which releases the bottom cap and the sea anchor slides out the bottom and opens up into a drag chute. This design is just a prototype, so there is a lot of room for improvement in the future. The SEPIRB can be made more compact and less electronically reliant in further prototypes.

Sophia Wuest

Sophia was born and raised on Maui, where she graduated from St. Anthony High School in 2011. She is currently majoring in Electrical Engineering at the University of Portland. After college, she would like to pursue an engineering career at a major company like Intel. In her free time, she likes to hang out with friends, read, or play music.

An Application for Monitoring Status of a Data Mart Containing Military Medical Records for Overseas Bases

Helaman Tafua
University of Hawaiʻi at Hilo

Akimeka LLC
Mentor: Peter Konohia
Collaborator: Richard Pascual

This project is about developing a web-based application that monitors the transfer of data which resides in a database, a data warehouse, and a data mart. The records in the data mart are derived from the data warehouse, which in turn came from the database; this procedure for transferring the data is known as an ETL (Extract, Transform, and Load) process. The application being built for this project will keep track of the data as it is being transferred during the ETL process and report to the user any anomalies it encounters, such as missing or corrupted records. The end-users of the application are the database developers at Akimeka in Maui and the technicians at the Department of Health headquarters in Washington D.C. who monitor the database and fix problems for military establishments outside of the United States. With this application the users will be able to quickly and more easily visualize errors that may occur during the ETL process, compared to manually going through the data mart, data warehouse, and database querying in SQL for errors. This application can be built upon by cleaning up the user interface and adding in more features, like a searchable knowledge base of errors and their solutions.

Helaman Toa Golden Tafua

Helaman is of Irish and Samoan descent, and has lived most of his life in the Hawaiian Islands, including the Big Island since the age of eight. He has also traveled to England, Ireland, and Australia, where he lived for one year. Helaman graduated from Pahoa HS in 2010, and enrolled soon afterward at UH Hilo. He is majoring in Computer Science, and plans someday to become a video game/app developer. For fun, Helaman likes to spend time with his family, play video games, improve his programming skills, and practice Samoan fire knife dancing.

A Follow-Me-at-a-Distance Algorithm for DroidPlanner

Joseph Thorpe
University of Hawai'i at Hilo

Akimeka LLC
Mentor: Lakulish Patel

Persistent problems exist in micro UAV development including limited range, connectivity in high density environments, intuitive command interfaces, and ease of training. DroidPlanner was developed to provide drone operators with a mobile ground control station (GCS) for ArduPilot with the goal of alleviating some of these issues. The GCS was created on an open source platform, which is easily modified and can be tailored to different situations. DroidPlanner archives these goals by utilizing Android based devices and accessing their extensive library. Since Android phones and tablets contain their own GPS, it is possible to relay this data to the micro UAV and have the UAV follow the device. We implemented a simple menu interface that makes it possible to select the cardinal direction and distance that the UAV should follow. The GCS then places a waypoint for the UAV to follow; ArduPilot then autonomously flies the UAV to this waypoint. This method works as expected, and the UAV responds as predicted. Future developments will be to increase the range of options provided during the selection menu to include non-cardinal directions.

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.Joseph Thorpe

Joe was born in Michigan, where he attended Our Lady of the Lakes Catholic High School. Three days after graduation, he joined the military, where he served in the 1st Ranger Battalion for six years, including overseas deployments. Afterward, he earned a degree in Criminal Justice and became a police officer in Hilo. Joe is now attending UH Hilo to complete a degree in Computer Science. He is currently a CS tutor, and serves as chair of the UH Board of Media Broadcasting. His future goal is to work with military technologies in the field of AI research. In his free time, Joe works on his hobby farm with his wife and children, and enjoys reading about futurism.

A Dashboard Web Application for Viewing the Status of PDC Databases

Troy S. Kobayashi-Bautista
University of Hawaiʻi at Mānoa

Pacific Disaster Center
Mentor: Steve Kunitzer

The Pacific Disaster Center (PDC) compiles global data on disasters and distributes information to disaster management groups. For an organization like the PDC, where disaster information is received from numerous sources, the flow of data is vital. Disaster information is processed in tiers by the PDC ranging from informational and observational data to life threatening hazard information that requires notifications to be sent to subscribers. When the chain of data processing is interrupted, essential information can fail to reach both clients and the public. The goal of this project was to design a dashboard web application to allow PDC employees to locate problems within the processing chain of the Dynamic Data Processor and Publication (D2P2) engine. In the D2P2 engine, information is processed through three tiers in the chain and stored in a data table at each tier. The project web application is able to retrieve and display information from each of the data tables. Each table entry indicates the success or failure of its information processing. By scanning these indicators, the application can show the user where in the processing chain any error(s) occurred. The application is deployed internally at the PDC and is intended for use only by the PDC employees, who will utilize the application for diagnosis when information that should be reaching PDC DisasterAWARE products fails to display. The software development team at the PDC will continue to enhance the application for usability and integration with the rest of the PDC systems.

Troy Kobayashi-Bautista

Born and raised on Maui, Troy graduated from Baldwin HS in 2010. He is currently majoring in Computer Science at UH Mānoa. After earning his BS degree, Troy plans to attain his master's degree before pursuing a career in software engineering, application development, or game design. In his leisure time, Troy enjoys photography, art, and playing video games.

Atmospheric Modeling for Daytime Telescopic Observation

Katrina Schenk
University of Hawaiʻi at Mānoa

Oceanit
Mentor: Rita Cognion

Telescope placement is exceptionally important for observations in the short-wave infrared (SWIR) outside of the Earth's atmosphere from the ground. Optimal placement for an SWIR telescope has limited atmospheric radiance and high transmittance in the wavelengths of interest. Using atmospheric modeling software MODTRAN (MODerate resolution atmospheric TRANsmission), we will be able to characterize candidate locations for tracking geosynchronous satellites in the daytime. Radiosonde data and other site specific information will be simulated from the visible to the near IR, 0.3 to 5.0 microns, using a set of look angles and times of day for each location. This data will be run through three MODTRAN models: mid-winter latitude, user-specified with real weather and radiosonde data, and a user-specified model that includes additional atmospheric data taken from the mid-winter latitude results. These three results will be compared to actual measurements to see which model is most accurate. Then, site data will be compared based on atmospheric quality of the location and how many days out of the year it is usable. These analyses will support the decision-making process for future telescope deployment.

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Katrina Schenk

Katrina was born and raised on Maui, and graduated from Baldwin HS in 2010. She will graduate in Spring 2015 from UH Mānoa with a BS in Computer Science. Afterward, Katrina plans to start her career as a software engineer, and hopes to work with an organization that encourages young women to choose STEM careers.

Dome Control Automation: An Innovative Approach with Inertial Navigation Sensors

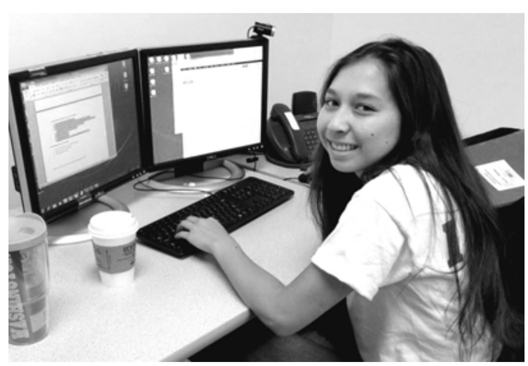
Kirsten K. Makanui
University of Hawaiʻi at Mānoa

Oceanit
Mentors: Allister Knox, Michael Bush
Collaborator: Scott Libert

When observing the night sky, the mount slews the telescope to track satellites that orbit the earth. In an observatory, when the telescope slews to new azimuth, the dome slit must move with and remain in front of the telescope's field of view, allowing an unimpeded imaging of the sky. To ensure the dome slit and telescope move synchronously, a system needs to be implemented to automate the dome. Rather than using the mount software to send serial commands directly to the dome motor controller, the system will utilize inertial movement sensors to track the motion of the telescope and move the dome to the correct azimuth. This system will decouple the mount control software from dome control. Accelerometers are placed on the telescope to measure the linear acceleration of the telescope. Simple simulations in SolidWorks were used to visualize and compute the possible movements of the telescope. The project will continue by attaching the accelerometer to telescope and develop a code to interpret output data into movement of the dome. After system implementation, testing, and calibration, the dome will be automated and move correctly while the telescope is tracking. Depending on the positional accuracy of the initial implementation, the company may continue to improve on the system by editing the written code, to enhance the interpretation of data from the accelerometer.

Kirsten Makanui

Originally from Maryland, Kirsten moved to Hawaiʻi to attend college at UH Mānoa, where she is currently majoring in Mechanical Engineering. After she completes her bachelor's degree in Spring 2014, she plans to return to school to obtain a master's degree. In her free time, she works as a server and likes to play volleyball.



Designing a Complete Personal Observatory System for Commercialization

Jessica S. Lee
University of Hawaiʻi at Mānoa

Oceanit
Mentor: Michael Bush
Collaborators: Rita Cognion, Brooke Gibson, Tiare Martin, Allister Knox

As space observation technology evolves, the cost of telescopes and other various space-exploring equipment has dropped. Thus, the age of personal observatories started. However, building a personal observatory without being an expert in astronomy could be very difficult. Many people encounter technical problems, such as compatibility issues, as they were putting together different parts of the observatory. To address this problem, the project of designing a ready-to-use backyard observatory began. With a budget of $7000, requirements and test plans were established. Trade studies for different observatory components were done. The project will continue with a purchase order. After the materials have been received, implementation and testing will begin. The result of this initial effort will be an automated observatory with a simplified setup, but without weather protection. The company will make further enhancements to the system such as “easy button” setup and automated image processing. The company has a long term goal of selling the backyard observatory as a commercial product.

Jessica Lee

Jessica was born in Honolulu, but lived in South Korea from the age of 4, until she moved back to Hawaiʻi at age 12. She graduated from McKinley HS in 2012, and is now attending UH Mānoa, double-majoring in Computer Science and Korean. Afterward, Jessica wishes to continue her education at Carnegie Mellon University, to pursue an MS in Software Engineering. Her ultimate career goal is to design a programming platform that makes programming less intimidating to new learners. In her free time, Jessica likes to collect and watch movies; her favorite directors are Stanley Kubrick and Christopher Nolan.

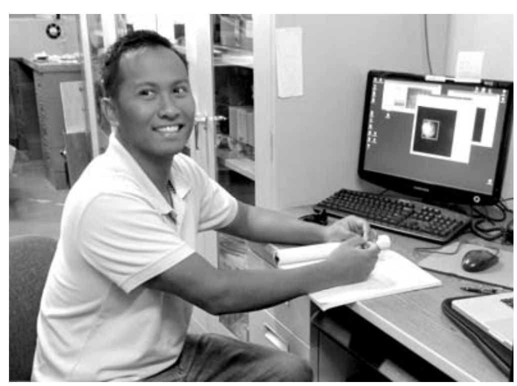
Coelostat Characterization to Optimize Tracking

Zane Julius G. Vergara
University of Hawaiʻi Maui College

UH Institute for Astronomy
Mentor: John Messersmith
Collaborators: Ryan Swindle, J.D. Armstrong, Joe Ritter

Summit time can be costly if your equipment is not operating the way it should. The coelostat at the Institute for Astronomy aids in ensuring equipment is working properly before it is deployed to the summit. The coelostat is a plane mirror that reflects light from a celestial object to a fixed telescope and tracks that object by adjusting to compensate for the rotation of the Earth. To ensure accurate data is retrieved, the coelostat needs to be tracking at its optimum level. The project proposed to measure how well the coelostat tracking and guiding operates in conjunction with the real-time ephemeris software package, TheSky. Using a simple camera, I characterized the coelostat tracking performance by acquiring images and recording how much, on average, these images drifted from a reference image. To determine the best way to optimize the coelostat, we first need to determine how good or how bad the tracking is. This is done by plotting the x and y offsets of the Sun over a period of time while the tracking is on. The offsets are given in units of pixels to measure image shift in the x and y axis. The coelostat guiding program, which is a refinement of the tracking, uses cross-correlation to calculate these offsets. We found a trend in the guiding which revealed that the guiding consistently had a bias of 1 in the x-axis and -1 in the y-axis, contributing to the image drift. To correct for this bias we implemented an over-correction in the guiding code. Our implementation reduced the offsets by 67% thus greatly improving the guiding performance. Future improvements can be to characterize the drift of other celestial objects such as the Moon, planets, and stars leading to a more versatile tracking and guiding mechanism.

Zane Julius Vergara



Zane was born and raised on Maui, where he graduated from Baldwin HS in 2003. After graduation, he joined the U.S. Air Force, where he served for six years as an aerospace maintenance technician. While serving in the military, he earned an associate degree in Aviation Maintenance Technology and the rank of Staff Sergeant (E-5). In 2010, Zane moved back to Maui to continue his education in the Electronics and Computer Engineering Technology (ECET) program at UH Maui College. He hopes obtain a job as an engineer or technician at one of Maui's high-tech companies. Zane also enjoys surfing, diving, photography, and spending time with his wife and daughter.

Preventing the Illumination of Aircraft by a Laser Ranging System

Jasmine L. K. Hoapili
Honolulu Community College

UH Institute for Astronomy
Mentors: Dan O'Gara, Cindy Giebink

The TLRS 4 is a laser ranging system that is used to measure the distance to artificial Earth satellites. This is accomplished by sending short pulses of green laser light outwards and timing how long it takes to come back. The goal of this project is to develop a system to ensure that planes are not illuminated by this laser. This laser is dangerous if it comes in contact with a pilot or passengers eyeball. Currently, there is a human plane spotter, who looks for planes seen close to the laser beam. If the plane is too close, then T4 is turned off. To accomplish this goal I will translate programs written in Fortran and another in C to Python. A radio receiver will be placed on the summit of Haleakala in order to capture plane GPS position data, as a part of the next generation air transportation system, allowing me to gather and analyze data. I have accomplished this goal by using computer programming, linear algebra, and analytic geometry.

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Jasmine Hoapili

Jasmine was born and raised on the island of O'ahu. She graduated from Kailua HS in 2012, and is currently attending Honolulu CC. She is enrolled in the Computing, Electronics & Networking Technologies (CENT) program, where she enjoys the opportunity to explore computer hardware and acquire new programming skills.

Creating a Web-Based User Interface Database Storage for ITEC Resources and Metrics

Katriel Chiu
University of Hawaiʻi at Mānoa

2c4 Technologies/Hawaii Resource Group
Mentors: Mikol Westling, Michael Strack
Collaborator: Jacklyn Sugiyama

2c4 Technologies and Hawaii Resource Group are companies that work alongside the Pacific JITC (Joint Information Technology Center) and ITEC (Integrated Test & Evaluation Center) in providing services for the Department of Defense. Some of these services include creating and customizing virtual environments to the needs of the customer. As such, the company has to purchase hardware systems in order to provide a storage center and networks for their clients. Each person in the company manages and monitors various aspects of their systems and only collects the data related to their position. Therefore, the creation and development of database storage will allow everyone within the ITEC to consolidate all their information into one place and display it for others. Since this project will eventually benefit the company in the future, each individual inputted their perspective on specific statistical reports that should be included in this storage center. Several people already have an application that monitors these metrics for them. After spending time researching the features and architecture of the applications, we narrowed down our options of a database design. Of our designs, we have considered creating data connectors, which will directly link our database to the information in an application and pull it from there. We felt that this was the easiest route as many of these applications exposed APIs (Application Programming Interface), which provided built-in functions that directly accessed the information we wanted and as a result, made it easier for us to code.

Katriel Chiu

Katriel was born and raised in Honolulu, where he graduated from McKinley HS in 2011. He is currently a junior at UH Mānoa, pursuing a BS degree in Computer Engineering. He also plans to minor in Computer Science. Katriel works on campus as a math tutor, and he is a student member of IEEE. His career goal is to be a software engineer. In his free time, Katriel enjoys playing video games on his computer, playing piano and clarinet, bowling, and attending church and church fellowship.

Confocal Microscope Characterization and Optimization

Styson Koide
Northern Arizona University

HNu Photonics
Mentors: Riley Aumiller, Richard Pultar

HNu Photonics is currently constructing a confocal microscope for the Defense Advance Research Project Agency (DARPA). This microscope is designed to achieve super high resolution at a fraction of the cost of most commercially available systems. This confocal microscope is also designed to be uniquely achromatic in operation and be able to optically resolve features that are less than one micron in size. To achieve this level of resolution, HNu Photonics has developed a unique solution. This requires an exceptionally accurate specimen positioner and highly accurate measurements. The focus of this project concentrates on three objectives: testing of the AEROtech nano-positioner, aid in constructing the graphical user interface (GUI) for this positioner, and testing as well as optimization of the overall device. Through testing that uses an interferometer, data shows that the AEROtech nano-positioner is accurate when moving in 100nm increments. This was also verified using a standarized US Air Force target and optical imaging. However, further analysis in a more stable environment is required to determine if this device is accurate for smaller step sizes. Currently, the GUI for this positioner is also near completion and has basic movement functionality and scanning capabilities. It is anticipated that this device will have its mechanical setup near complete along with its accompanying GUI within the next few weeks.

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Styson Koide

Styson was born and raised on the Big Island, and graduated from Honoka‘a HS in 2008. He then attended UH Hilo for two years while majoring in Pre-Engineering. While participating in the National Student Exchange program at Northern Arizona University, he decided to remain at NAU, and he recently completed his bachelor’s degree in Mechanical Engineering. For hobbies, Styson enjoys snowboarding, cooking, and watching movies.

Development of an Automated Robotic Laser-Tracker System for Performing Mirror Surface Metrology

Dylan Emley
University of Miami

UH Institute for Astronomy
Mentors: Joe Ritter, Jeff Kuhn
Collaborator: Wade Bortz

Telescope mirrors are continually getting thinner as advancements in active optics allow mirrors to maintain their shape even with larger mirror diameters. With larger diameter mirrors, the telescopes can take in more light allowing for higher resolution imagery of fainter and more distant objects. However, experimental thin mirrors are more likely to sag and distort and thus there is an increased need to verify that the mirrors meet the proper surface specifications. With this need, the surface figure of the mirrors must be accurately mapped. This project focused on designing, assembling, and testing an autonomous machine and process that can accurately map the surface of a small mirror. The tools used to complete this task were a laser tracker and a CNC router. Over the course of the project, a CNC router was converted to mount a corner cube, which acts as a reflector for a laser tracker. In order to implement this mount, it had to be properly designed and fabricated. The CNC machine, capable of movement within a defined x-y-z range, is able to maneuver the corner cube along the surface of the mirror as the tracker takes positional data points. With these data points, the laser tracker software can then fit the points to a three dimensional shape, such as a paraboloid, and quantify errors from the ideal shape. This project not only involved the design and assembly of the machine, whether it be machining or wiring, but also creating a program to complete the mirror scan. This program required coding for motors to move the mount, sensors to locate the mirror's surface height and edges, switches to detect contact with the mirror, and the laser tracker to take readings at the proper intervals. All of the involved components, CNC machine motors, sensors, switches, laser tracker, and three independent computers, needed to be programmed to work in unison to complete the task. Overall, this design could also be implemented in larger models, utilizing larger stages which would be able to map much larger telescope mirrors, like the Institute for Astronomy's two meter PLANETS telescope.

Dylan Emley

Dylan was born on Maui, but was raised on the Big Island. He graduated from Parker School in 2009, then attended the University of Miami in Florida. He completed his bachelor's degree in Mechanical Engineering in 2013.

Developing Sun Mitigation Solutions for the 3.6-m AEOS Telescope

Kanoe Hardin
University of Hawai'i Maui College

Air Force Research Laboratory
Mentor: Stacie Williams
The Boeing Company
Mentor: John Valliant

The 3.6-m Advanced Electro-Optical System (AEOS) is the largest optical telescope in the Department of Defense. AEOS is used to track and image satellites, many of which are Sun-synchronous and can only be imaged during the day. Unfortunately, AEOS has limited daylight imaging capabilities; therefore a team of scientists and engineers from the Air Force Research Laboratory and Boeing are designing a Sun mitigation system to increase daytime use. The proposed solutions are a baffle and a parasol. A baffle is attached to the telescope and minimizes stray light from entering the telescope, and a parasol is a disk that physically blocks sunlight from impinging on the telescope. A series of tests were conducted on a commercial small-scale telescope with a similar open truss design to AEOS in order to determine which solution best improved imaging. Early tests favored the parasol, but since it would cost approximately ten times more than the baffle, it was important to quantitatively evaluate the difference. This experiment was done in two parts. In the first part, images were taken on a Basler plA640-2103 CCD camera connected to an Orion SkyQuest XX12g GoTo Dobsonian telescope. Data was collected under three telescope configurations: no Sun protection, with a baffle, and with a parasol. The images were compared for the three telescope configurations to estimate resolution improvement. In the second part, sky intensity as a function of angle from the Sun was measured to determine which solution enabled the smallest Sun exclusion angle. These results will assist the Daylight Imaging team in determining which Sun mitigation system to implement.

Kanoe Hardin

Kanoe is a senior studying Engineering Technology at UH Maui College. She is the secretary of the UHMC IEEE Student Chapter and a member of the Phi Theta Kappa Honor Society. She is working toward a career in scientific programming or software engineering, where she hopes to combine her computer skills with her interest in science. She holds an AS degree in Electronic and Computer Engineering Technology (ECET) from UHMC, and a BA in Creative Writing from Linfield College. In her spare time, Kanoe enjoys traveling, reading, and studying languages.

Evaluation of Dynamic Wind Loading on Rigid vs. Non-Rigid Baffle Materials

Derrick Saito
San Francisco State University

Air Force Research Laboratory
Mentor: Stacie Williams
The Boeing Company
Mentor: Steve Griffen, John Valliant

A light baffle will be introduced to the Advanced Electro Optical System (AEOS) Telescope, and the increase in surface area is expected to amplify negative effects of dynamic wind loading on the telescope structure. Dynamic wind loading—fluctuations in wind pressure—contributes to degradation of telescope images due to pointing and focus errors. In order to minimize these effects in baffle design, an analysis was conducted to determine performance differences between rigid vs non-rigid baffle materials in hopes of reducing wind loading and jitter transmission to the primary telescope structure induced by the baffle. To quantify this, a 6' frame was constructed to simulate the AEOS truss while ply and tarp baffles measuring 3' by 3' were fitted to the frame through strap attachments at each corner. Piezoelectric force transducers were used to measure the change in force of each strap with respect to time, and power spectral density plots were used to evaluate performance of both baffle materials. Flexibility of the tarp baffle is expected to dampen high frequency transmission to the telescope allowing the mount control system to reject remaining wind load effects. On the other hand, due to the rigidity of ply material, its power spectral density plot is suspected to have a less pronounced roll off of frequencies above 2 Hz—frequencies that cannot be rejected by the telescopes active control loop—and is therefore more likely to negatively impact image quality.

Derrick Saito

Originally from Wailuku, Maui, Derrick currently resides in San Francisco, and is in the final year of his Civil Engineering degree at San Francisco State University. With an interest in geotechnical engineering, Derrick hopes to gain work experience before returning to obtain a graduate degree. In his free time, Derrick enjoys diving and baseball, and loves being back home, surrounded by the beautiful nature of Hawai'i.

An Optimal Baffle-System Design for the Harlingten H-80 Telescope

Chriselle Galapon
University of Hawai'i at Mānoa

UH Institute for Astronomy
Mentors: Stan Truitt, Jeff Kuhn

The objective of the project was to design an easily modified baffle system prototype for the Harlingten H-80 telescope that would eliminate most of the stray light entering the sensor without limiting the contrast and resolution of the object that will be viewed. Baffles were designed for the H-80 with sensors which have one or five arc-minute field of view. The baffles were also designed to be rigid enough to withstand operating wind conditions. Furthermore, relatively low central obstructions for the telescope were also considered in the design of the primary and secondary baffles. In order to calculate for the best baffle design for the H-80, the optimal telescope parameters were first determined using Zemax, a ray-tracing program. Then using an algorithm that utilized ray-tracing formulas in a two-mirror telescope based on arbitrary positions of the aperture stop the baffle design parameters were found. After determining the baffle length and diameters, a mounting system that would allow the baffles to be easily attached and modified was also considered to complete the baffle system design. Finally, baffles were fabricated in order to test the effectiveness of the design. Additionally, the current H-80 secondary mirror will be replaced; therefore, the optical design as well as the baffle design had to be re-optimized and modified for a different secondary mirror. In the future, modifications will need to be done in the to the baffle design to allow for various fields of view.

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Chriselle Galapon

Chriselle was born in the Philippines, raised on the island of Maui, and moved to O'ahu for college. She is currently an undergraduate at UH Mānoa, pursuing her BS degree in Mechanical Engineering. Chriselle is an SAE International member, and has recently participated in the SAE Micro Aero Competition, which involved designing and manufacturing a small, unmanned aircraft vehicle. In her spare time, Chriselle enjoys hanging out with her friends and family, drawing, hiking, and listening to music.

Developing a Parallax Ranging Method for Point-Source Objects

Alexis Ann Acohido
University of Hawaiʻi at Mānoa

UH Institute for Astronomy
Mentor: JD Armstrong
Collaborator: Marco Micheli

Parallax is the relative shift in position when looking at the same object from two different points in space. The angle that the parallax shift creates can be used to measure how far away that object is. The goal of the project was to develop a parallax ranging method to measure the distance to point source objects. Asteroids were used as a test bed to determine whether or not this parallax ranging method would be effective in measuring the distance to satellites. The asteroids were observed from the Cerra Tololo telescope in Chile and the McDonald Observatory in Texas over a period of approximately 15 minutes at the same time. Right ascension and declination were measured from both sites. From that information, the parallax angle and unit vector to the asteroid were calculated. A baseline was established, and the distance was calculated by dividing the baseline with the sine of the parallax angle. The distances were reported with an error of about ±0.05”. Further works with this project would be to see if it is possible to measure the distance to satellites using this ranging method.

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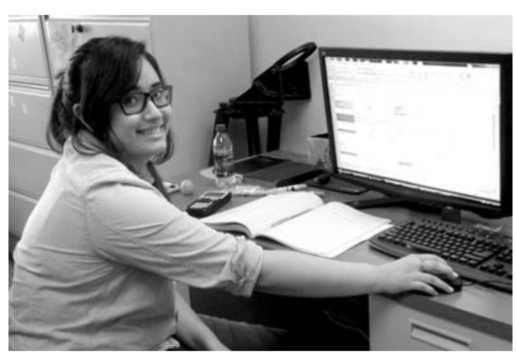
Alexis Acohido



Alexis was born and raised in Honolulu, and graduated from Kamehameha Schools Kapālama Campus in 2011. She currently attends UH Mānoa, where she plans to graduate with a BS in Mathematics. After earning her degree, she would like to attend graduate school. Alexis also enjoys reading, playing video games, and spending time with her friends.

Akamai Workforce Initiative

University of Hawai‘i at Manoa Institute for Astronomy (IfA)
University of California, Santa Cruz Institute for Scientist & Engineer Educators (ISEE)
University of Hawai‘i Maui College
University of Hawai‘i at Hilo

The AWI advances Akamai (smart, clever) students into the Hawai‘i technical and scientific workforce. AWI partners industry, observatories, government, educational institutions, and community to meet workforce needs in astronomy, remote sensing, and other science and technology industries in Hawai‘i. The Akamai Internship Program is one of the major programs of the Akamai Workforce Initiative.

The 2013 Akamai Internship Program placed college students from Hawaii at the following organizations to complete a seven-week project:

Akimeka, hv Photonics, Institute for Astronomy/Maui, Pacific Disaster Center, Pacific Joint Information Technology Center, Trex Enterprises, Canada-France-Hawaii Telescope, Gemini Observatory, University of Hawaii, Institute for Astronomy/Hilo, Smithsonian Submillimeter Array, Subaru Telescope, W.M. Keck Observatory, Hawaii Natural Energy Laboratory of Hawaii Authority, Big Island Abalone Corporation, Thirty Meter Telescope.

The AWI has received funding from:

The National Science Foundation (AST#0836053)
Air Force Office of Scientific Research (FA9550-10-1-044)
University of Hawaii
Air Force Research Laboratory
Kamehameha Schools
Thirty Meter Telescope Corporation
National Solar Observatory

For more information please contact:

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Akamai Workforce Initiative Headquarters

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http://akamaihawaii.org

AKAMAI

Student Internship Symposium

Hilo

August 6, 2013
UH Hilo (UCB 100)

Waimea

August 7, 2013
W.M. Keck Observatory
Hualalai Public Conference Room

Program Information
Intern Abstracts

Advancing Hawaii college students into science and technology careers.

2013 Akamai Internship Program

Akamai Workforce Initiative
University of Hawai‘i at Manoa Institute for Astronomy
Institute for Scientist & Engineer Educators, University of California Santa Cruz
University of Hawai‘i at Maui College
University of Hawai‘i at Hilo

Akamai – smart, clever

The Akamai Internship Program is a unique program that supports Hawai‘i college students in completing an authentic science or technology project in a professional setting. Students are prepared through an intensive one-week short course, and then spend seven weeks at an observatory or industry setting where they complete a project under the guidance of a mentor. Throughout the entire eight-week program they complete a communication course that begins in the short course and continues through weekly meetings and intensive coaching sessions. The Akamai program uses an internship model designed by the Center for Adaptive Optics (CfAO) using National Science Foundation (NSF) Science and Technology Center funding, with the specific aim of developing a program to address the technical workforce needs in Hawai‘i and advancing students from diverse backgrounds into science, technology, engineering or mathematics careers. In 2013, interns received credit from University of Hawai‘i at Hilo.

The Akamai Internship Program includes:

40-hour short course
7-week project experience at a company, observatory, or government facility
Science & engineering communication course in which all interns prepare:
Oral presentation
Technical abstract
Personal statement
Résumé
Symposium
Ongoing educational and career support

2013 Big Island Host Organizations

- Hilo -

Gemini Observatory
University of Hawaii, Hilo
Institute for Astronomy
Smithsonian Submillimeter Array
Subaru Telescope

- Waimea -

Canada-France Hawaii Telescope
W.M. Keck Observatory

- Kona -

Hawaii Natural Energy Laboratory of Hawaii Authority
Big Island Abalone

Akamai Workforce Initiative

Leadership Team:

Lisa Hunter - Director
UH Institute for Astronomy, University of California, Santa Cruz

Jeff Kuhn
Institute for Astronomy

Jerome Shaw
University of California, Santa Cruz

Mark Hoffman
University of Hawaii, Maui College

Joseph Janni
Advanced Maui Optical and Space Surveillance Technologies

Program Coordinators:

Lani LeBron - Institute for Astronomy
Samara Phillips - Institute for Astronomy
Diana Bisel - Cal Tech/Thirty Meter Telescope
Beth Walker - University of California, Santa Cruz
Elisabeth Dubuit - University of Hawaii, Maui College

2013 Akamai Short Course Instructors

David Harrington - Lead Instructor, UH Institute for Astronomy
Sarah Beganskas - University of California, Santa Cruz
Heather Kaluna, Ian Cunnyngham - UH Institute for Astronomy
Reza Rahimnejad - University of Hawaii, Manoa
Ehsan Yavari - University of Hawaii, Manoa
Brooks Thomas - University of Hawaii, Manoa Physics
Georgeanne Friend - Kauai Community College

2013 Communication Instructors

Michael Nassir - Lead Instructor, University of Hawaii at Manoa

Ryan Swindle - Instructor, UH Institute for Astronomy

Lisa Hunter - Institute for Astronomy, University of California, Santa Cruz

Jerome Shaw - University of California, Santa Cruz

Special Thanks . . .

The Akamai Workforce Initiative would like to thank the following individuals for their commitment and support of the 2013 Big Island Akamai Internship Program:

James Gaines – Univ. of Hawai‘i
Günther Hasinger – UH Institute for Astronomy
Daniel Evans – National Science Foundation
Sandra Dawson – Thirty Meter Telescope
Donald Straney – Univ. of Hawai‘I, Hilo
Matthew Platz - Univ. of Hawai‘I, Hilo
Robert McLaren – UH Institute for Astronomy
Kevin Kelly - Univ. of Hawai‘i
Jay Booth – Big Island Abalone Corp.
Cecilia Viljoen – Big Island Abalone Corp.
Greg Barrick – Canada-France-Hawaii Telescope
Grant Matsushige – Canada-France-Hawaii Telescope
Brandon Metz – Canada-France-Hawaii Telescope
Tom Vermeulen – Canada-France-Hawaii Telescope
Tom Benedict – Canada-France-Hawaii Telescope
Doug Simons - Canada-France-Hawaii Telescope
Chas Cavedoni – Gemini Observatory
Chris Yamasaki – Gemini Observatory
Tim Minick – Gemini Observatory
Stacy Kang – Gemini Observatory
Eduardo Tapia – Gemini Observatory
Marcel Tognetti – Gemini Observatory
Adrienne Notley – Gemini Observatory
Markus Kissler-Patig Gemini Observatory
Klaus Hodapp - UH Institute for Astronomy
Colin Aspin – UH Institute for Astronomy
Mark Chun – UH Institute for Astronomy
Marc Cotter – UH Institute for Astronomy
Jason Chin – W.M. Keck Observatory
Ed Wetherell – W.M. Keck Observatory
Rachel Rampy – W.M. Keck Observatory / UCSC
Randy Campbell – W.M. Keck Observatory
Luca Rizzi – W.M. Keck Observatory
John Baldwin – W.M. Keck Observatory
Mark Devenot – W.M. Keck Observatory
Rich Matsuda – W.M. Keck Observatory
Justin Pitts – W.M. Keck Observatory
Taft Armandroff – W.M. Keck Observatory
Hilton Lewis - W.M. Keck Observatory
Keith Olson – NELHA
Billie Chitwood – Smithsonian Submillimeter Array
Derek Kubo – Smithsonian Submillimeter Array
John Kuroda – Smithsonian Submillimeter Array
Ranjani Srinivasan – Smithsonian Submillimeter Array
Lucio Ramos – Subaru Telescope
Kiaina Schubert – Subaru Telescope
Brendan Hora – Subaru Telescope
Tony Travouillon – Thirty Meter Telescope
Warren Skidmore – Thirty Meter Telescope
Virginia Ford – Thirty Meter Telescope
Marianne Takamiya – Univ. of Hawaii at Hilo
Forest Bremer – Univ. of Hawaii at Hilo
Aaron McDonald – Univ. of Hawaii at Hilo
Daniel Berke – Univ. of Hawaii at Hilo / JAC
John Hamilton – Univ. of Hawaii at Hilo / PISCES
Wilfred T. Gee – Univ. of Hawaii at Hilo / PISCES
Imiloa Astronomy Center
Gary Sanders – Thirty Meter Telescope
Pamela Lau – UH Institute for Astronomy
William Walters – UH Institute for Astronomy
Mark Hoffman - UH Maui College
Elisabeth Reader – UH Maui College

Presentation Schedule

August 6, 2013
UH Hilo - UCB 100

Gemini Observatory
Institute for Astronomy
Smithsonian Submillimeter Array
Subaru Telescope
Thirty Meter Telescope
University of Hawaii, Hilo

Opening Remarks

Donald Straney
Chancellor, University of Hawaii at Hilo

Lisa Hunter
Director, Akamai Workforce Initiative
UH Institute for Astronomy and UCSC Institute for Scientist & Engineer Educators

<u>Univ. of Hawaii at Hilo</u>

Monitoring the Moon for Meteor Impacts
Krystal Schlechter — *UH Hilo*

Star Formation Processes Visualized Using Object-Oriented Databases
Kevin Hu — *UH Mānoa*

<u>Smithsonian Submillimeter Array</u>

Heater Upgrade for a Summit Precipitation Gauge
Jeffrey Batangan — *Kaua'i CC*

Temperature Regulation of Electronic Components via a Cascaded PID Control System
Jake Tsuyemura — *UH Mānoa*

<u>Gemini Observatory</u>

Improving the Current Design of a Vacuum Pump Station Cart
Ryan Wong — *Kauai CC*

Designing a Vibration Isolation Mount Assembly for a Closed-Cycle Cooler
Lee Do — UH *Mānoa*

<u>Subaru Telescope</u>

Automatic Backup ISP Failover Solutions for the Subaru Telescope Network
Rocel Gomez — *Honolulu CC / UH West O'ahu*

~ Intermission ~

<u>Subaru Telescope (continued)</u>

Building a Simulator of the FMOS Programmable Logic Controller
Randolf Uclaray — *Univ. of Southern California*

<u>Thirty Meter Telescope</u>

Correction of Sonic Anemometer Data for Analysis of Near-Ground Optical Turbulence
Darcy Bibb — *UH Mānoa*

Designing a Mirror-Cell Handling Cart
Ryan Saito — *UH Mānoa*

<u>UH Institute for Astronomy</u>

Designing a Telescope Simulator for the UH 2.2-meter Telescope
E'Lisa Lee — *UH Hilo*

An Upgrade for the UH 88-inch Telescope Mirror-Cover Actuator System
Thomas Kackley — *Seattle Univ.*

Assembling an Adaptive-Optics Demonstration Kit for UH Hilo
Emily Peavy — *UH Hilo*

ABSTRACTS

Monitoring the Moon for Meteor Impacts

Krystal Schlechter
University of Hawai'i at Hilo

PISCES — Univ. of Hawai'i at Hilo
Mentor: John Hamilton
Collaborator: Wilfred T. Gee

Lunar Atmosphere Dust Environment Explorer (*LADEE*) is a NASA satellite scheduled to launch into the Moon's orbit on September 6, 2013. Using a variety instruments, it will examine the surface-boundary exosphere of the moon and hope to answer questions about the composition of the exosphere, as well as the low horizon glow that Apollo 12 astronauts witnessed. A likely contributor to the exosphere are the many meteors that impact the surface of the Moon and eject dust. In order to get a full archive of these lunar impacts, NASA is asking amateur astronomers around the world to monitor the Moon and record the time, date, and location of each meteor impact detected. The observations provide information on the number of impacts in a given time period, as well as how much debris is ejected into the exosphere of the moon. To monitor these impacts, we used two 11-inch Celestron telescopes with high-speed video cameras. After each observing night, we ran the digitized video files through LunarScan, reduction software provided by NASA for detecting bright flashes in the given video. We cross-referenced the two telescopes' data with each other to account for hot pixels, point meteors, and other misleading phenomena. All remaining candidate impacts are sent to the NASA archives for further confirmation and analysis.

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Krystal Schlechter

Krystal was born and raised Portland, Oregon, where she graduated from Centennial Learning Center in 2011 and immediately moved to Hawai'i.
Krystal is currently an Astronomy major at UH Hilo, where she plans to graduate in 2015. She plans to continue on to the Master of Arts in Teaching program to study elementary education.
In the future, she also plans on attending graduate school in astronomy, and would like to have both research and teaching options available to her. She is excited to participate in this project not only because she has prior experience with lunar monitoring, but because the moon is our closest celestial neighbor — as much as we do know about it, there is still so much more to learn!

Star Formation Processes Visualized Using Object-Oriented Databases

Kevin Hu

University of Hawai'i at Mānoa

Univ. of Hawai'i at Hilo

Mentor: Marianne Takamiya

Collaborators: Forest Bremer, Aaron McDonald & Daniel Berke

Understanding star formation processes throughout distant galaxies requires analyzing and identifying correlations among the properties of star-forming regions (HII regions). A large database of observations of HII regions, including star formation rate and dust extinction, has been compiled. This database, however, is solely text-based, so my task was to identify correlations among the data science products. Creating and implementing an object-oriented database to plot and visualize all the data will allow the astronomical community to comprehend what is happening among more than 30,000 different spectra. Completing such a task required understanding the scientific background of the data, proficiency with data-mining software, and a Web-based interactive user-interface for data visualization. To accomplish this, I selected and implemented a data-mining program called *Orange*, which allows visualization of data through a multitude of methods, including generating on-demand scatter plots. After extensive familiarization with this program, I developed a tutorial document to aid new members of the astronomy research group with using *Orange.* I also learned Python and incorporated routines that allow for the generation of 3-D plots, a function that *Orange* does not easily provide. Members of the astronomical research team are already incorporating recently generated plots into a Web interface. These newly discovered trends will help us understand more about star formation rates in galaxies, and therefore more about our cosmic environment and galactic evolution.

Kevin Hu

Kevin was born and raised in Honolulu, where he graduated from Kaimuki HS in 2009. He is currently a senior at the University of Hawai'i at Mānoa, working toward concurrent degrees in Computer Engineering and in Studio Art with a focus in Graphic Design. Kevin's future goal is to apply creativity to computer software and technology to better enrich society. In his spare time, Kevin enjoys freelance graphic designing, playing piano and French horn, photography, video gaming, karaoke, and eating his heart out!

Heater Upgrade for a Summit Precipitation Gauge

Jeffrey Batangan
Kauai Community College

Smithsonian Submillimeter Array
Mentor: Billie Chitwood

Like all observatories, the Smithsonian Submillimeter Array (SMA) must accurately monitor ambient weather conditions, including precipitation, for a number of reasons. SMA staff and observers work at the summit around the clock, so weather must be monitored to ensure the safety of personnel. Also, precipitation, or simply high levels of atmospheric water vapor, causes the atmosphere to be opaque to submillimeter waves, inhibiting observations. Finally, heavy rainfall can cause the intrusion of moisture into electrical equipment, causing electrical damage to the antennas. The SMA facility has an existing rain gauge located at the Mauna Kea summit, but since temperatures at the summit frequently drop below freezing, precipitation can freeze before it can be measured by the gauge. To address this problem, we are designing, building, and installing an electrical unit to provide power to a new rain gauge with a built-in heater. When the temperature at the summit drops below 45˚F, the thermostat will begin to cycle. After construction and installation of the electrical box, testing will be conducted to record and check the accuracy of precipitation data from the new heated gauge.

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Jeffrey Batangan

Jeff was born and raised on the island of Kauai. He is currently attending the Electronics Technology program at Kauai CC, pursuing his associate degree. He is also an Infantryman with the Hawaii Army National Guard and plans to reclass to a different military occupational specialty (MOS) in the electronic communications field after graduating from college. Jeff has always had a passion for electronics, understanding devices, and learning how they function. In his spare time, he enjoys hiking, camping, the beach, weight training, and spending time with family and friends.

Temperature Regulation of Electronic Components via a Cascaded PID Control System

Jake Tsuyemura
University of Hawaiʻi at Mānoa

Smithsonian Submillimeter Array
Mentors: Derek Kubo, John Kuroda & Ranjani Srinivasan

The performance of all enclosed electronic equipment can be affected by large temperature fluctuations. This is especially critical when observing the performance of microwave components, such as amplifiers, whose gain can vary up to ±3 dB under the current temperature control system located on the summit of Mauna Kea. A change of +3 dB will result in double the desired output power, which can wreak havoc on the sensitive equipment located inside the enclosure. The solution is to design a more responsive control system that will keep the internal temperature fluctuations of the system to within 1˚C, peak-to-peak. This will be implemented with a Cascaded Proportional Integral and Derivative (PID) control system, which will be responsive to both sudden internal temperature disturbances and slower external variations. This project started with building a small-scale model using a simulated heat source and a variable speed fan. The control system was programmed with an inexpensive Arduino microcontroller utilizing a single PID loop, which servo-ed the fan speed to maintain the desired temperature. Once the specifications were met, a similar full-scale model was constructed to reproduce the results. A secondary PID loop was added in cascade with the first loop to increase the response time of the system and help meet specification. In this arrangement, the output of the primary loop changes the setpoint of the secondary loop. This increases the responsiveness of the system to slower temperature changes, such as daily heating and cooling due to the sun. Open Loop data was collected and imported to Matlab's System Identification Toolbox, which generated a transfer function that was used in conjunction with the PID autotune tool. The generated coefficients provided a starting point to the tuning process, and minor changes were made in order for the system to meet specification. This control system is expected to perform on the summit and be implemented in various systems where thermal regulation is paramount.

Jake Tsuyemura

Jake was born in Hilo and graduated from Honokaʻa HS in 2009. Jake's interest in engineering stemmed from his participation in high school robotics programs, and he is currently completing his bachelor's degree in Electrical Engineering at UH Mānoa. His future goal is to become employed by a company specializing in radio-frequency (RF) engineering. In his spare time, Jake enjoys reading, hiking, and spending time with friends and family.

Improving the Current Design of a Vacuum Pump Station Cart

Ryan Wong
Kauai Community College

Gemini Observatory
Mentor: Chris Yamasaki

Many scientific instruments in the Gemini Observatory require vacuum technology. Vacuum pumps are used in astronomical instruments to create an environment that is suitable for proper detector operation. When vacuum is applied to a sealed vessel, undesired gas molecules are removed to prevent the formation of liquid or ice at very low temperatures. Gemini instruments regularly operate at low temperatures within this cryogenic range; a vacuum pump station is essential to meet their operational criteria. This project is to redesign, fabricate, and assemble a new vacuum cart with improved ergonomics and serviceability. The design is intended to reduce operator fatigue and discomfort and also increase service accessibility to components located on the cart. Currently, the existing design model does not meet user requirements. The current design is unable to be transported onto the Instrument Platform Lift (IPL) because the ramp is too narrow and also unable to go through standard doorway openings. There are six stages of this project to redesign this cart: (1) identify the parts and components; (2) design the mounting components of the cart using AutoCAD LT 2014; (3) identify and procure components and perform construction; (4) transfer electrical components and re-wire components; (5) test the final assembly and verify the system's performance; (6) deliver documentation of the final product, including AutoCAD drawings, material lists, and cost analysis.

Ryan Wong

Ryan grew up in Wailua on the island of Kauai and graduated from Island School in 2008. He joined Kauai CC's electronics program in 2010, and he has just completed his AS degree in Electronics Technology. He plans to find work as a computer technician on Kauai. He is interested in studying digital and electronic circuits. Ryan also enjoys paddling, surfing, hiking, camping, and spending time with family.

Designing a Vibration Isolation Mount Assembly for a Closed-Cycle Cooler

Lee Do
University of Hawai'i at Mānoa

Gemini Observatory
Mentor: Chas Cavedoni
Collaborators: Stacy Kang, Marcel Tognetti & Eduardo Tapia

When an instrument is excited due to motion of machinery, it produces vibrations that can cause dysfunctional behavior in machines, and that cause components to break down over time. This requires time and money to repair. The motivation for this project is to construct a test assembly vibration mount that can predict information to help the telescope achieve the highest quality image as possible. A closed-cycle cooler (CCC) mount is used to cool instruments to cryogenic temperatures, which causes the instrument and telescope to produce vibration energy which would degrade quality of the image. Since standard commercial mounts are manufactured to operate at an inertial load of 30 lb of a closed-cycle cooler, an overload of weight subjected from a vacuum pull-in force at approx. 400 lb could easily cause standard commercial parts to break. The problem with standard parts is caused because not all isolation mounts can operate in all orientations with respect to gravity. With redesigning a new vibration isolation mount assembly, we could examine different components, such as donut-shaped elastomers that could be able to withstand vacuum pull-in forces. Elastomers are one of the most efficient ways to isolate vibrations from systems, but understanding the modulus of elasticity at high compressive loads would be critical for properly designing an isolator. In this project, we report the understanding, development, and early test results of a prototype CCC isolation mount incorporating donut-shaped elastomers to determine the compressive elasticity and stiffness of a rubber material.

Lee Do

Lee was born and raised in Honolulu. He graduated from Kaimuki High School in 2010 with a strong interest in pursuing a STEM career. In Spring 2013, he completed his AS degree in Pre-Engineering at Kapi'olani CC, and is now attending UH Mānoa for his bachelor's in Mechanical Engineering. In his free time, he enjoys hiking, fishing, swimming, and spending time with his friends and family.

Automatic Backup ISP Failover Solutions for the Subaru Telescope Network

Rocel Gomez

Honolulu Community College / Univ. of Hawaiʻi–West Oʻahu

Subaru Telescope

National Astronomical Observatory of Japan

Mentor: Kiaina Schubert

Internet connectivity failures cause major disruptions at Subaru Telescope — they lead to loss of productivity and large inconveniences for staff workers and researchers within the Hilo base facility. Currently, a manual cut-over method using a secondary Internet Service Provider (ISP) is applied in the event of service loss. Subaru's primary Internet service, a 1-Gb/s line through Institute for Astronomy at UH, can only be monitored from the Subaru base to the next hop; link states further upstream are unknown. This project involved researching and designing methods that would detect anomalies in upstream links and automatically re-route Internet traffic through a secondary ISP, a 10-Mb/s line through Hawaiian Telcom. The key factor that came into play through this type of networking design change is how well the system will work within a set of known and unknown rules. These knowns and unknowns included the current Subaru Telescope network (STN), and the third parties UH and Hawaiian Telcom. Ultimately, these factors decide a given plan's feasibility. Our first solution was to implement a dynamic routing protocol that would build and maintain routes automatically as upstream availability changes. Routers along the UH upstream path participate in dynamic routing and relay information of remote paths through one another. This is the preferred, industry-standard solution for this type of wide-area-network "failover" and was proven to work through our testing and simulation environments. The second solution involved use of a feature on the STN firewall called Path Monitoring through Policy-Based Forwarding. The firewall would be able to monitor a given IP address on the Internet through ICMP or "ping" messages, and take down or bring up a link as the monitor sends and receives replies of these messages. This setup required extensive testing as to how well it integrated into the current network. We were fortunate enough to be able to implement and test this solution into the live STN network during a scheduled UH Internet outage. Automatic cut-over was successfully established through this method, although full integration into STN needed to be fine-tuned.

Rocel Gomez

Rocel grew up on the island of Maui and graduated from H.P. Baldwin HS in 2008. He moved to Oʻahu and is currently attending Honolulu CC, majoring in Computing, Electronics & Networking Technologies (CENT). He will be transferring to UH West Oʻahu to complete his bachelor's degree. Rocel is studying for Cisco CCNA, CompTIA A+, and Security+ certifications, and he plans to pursue a career in networking and systems administration

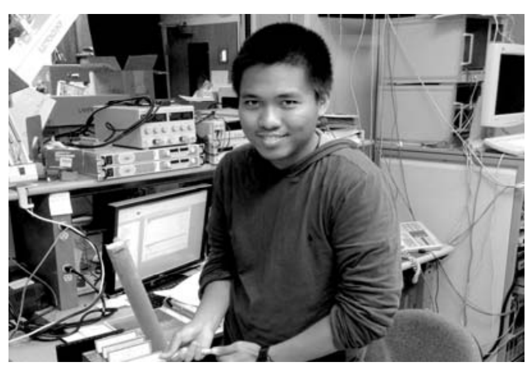
Building a Simulator of the FMOS Programmable Logic Controller

Randolf Uclaray
Univ. of Southern California

Subaru Telescope
National Astronomical Observatory of Japan
Mentor: Lucio Ramos
Collaborator: Brendan Hora

One of Subaru Telescope's observational instruments is the Fiber Multi-Object Spectrograph (FMOS). Within the FMOS system, one component that has been experiencing errors recently is the InfraRed Spectrograph 2 (IRS2). In order to be operational, the spectrograph's temperature is cooled down to approx. –50°C to –60°C. An Allen Bradley SLC 500 programmable logic controller (PLC) is installed within the system, accepting inputs from various sensors and sending control signals to manipulate the spectrograph temperature or environment. Given the lack of documentation, not very much is known about the exact inputs and outputs of the PLC, how the PLC is connected to the rest of the IRS2 system, or how to update the program that the PLC is currently running. If the IRS2 had any temperature sensor problems, or if the wiring system undergoes any issues, troubleshooting with limited knowledge about the system's PLC would be very challenging. To solve the ongoing documentation problem, intensive research was performed to understand the different components of a PLC, the structure of the ladder logic program, and how to communicate the PLC to the computer. Along with that, the ladder logic program currently in place was also examined to determine the inputs and outputs of the system. It was found that the digital inputs of the system include the status of the valves and chiller, while the analog inputs include signals from temperature, pressure, and dew-point sensors. The digital outputs represent the controls for the valves, and the chiller's mode. Following the investigations, a simulator was built consisting of panels mounted on a 19-inch rack. 32 switches on one panel represent the digital input module of the system, and 32 LEDs on another panel represent the digital output module. The last panel simulates two analog input modules, containing 32 switches connected to a potentiometer. The simulator is to demonstrate the capabilities of the PLC, and be useful in the future if the IRS2 once again undergoes any errors.

Randolf Uclaray



This fall, Randolf will be entering his senior year at the Univ. of Southern California. Prior to USC, he spent three years at Hawai'i Pacific University, enrolled in their 3-2 Engineering Program: upon completing his bachelor's degree in Electrical Engineering from USC, he will also receive a bachelor's degree in Applied Mathematics from HPU. After graduation, Randolf plans to gain significant industry experience before pursuing an MBA degree.

Correction of Sonic Anemometer Data for Analysis of Near-Ground Optical Turbulence

Darcy Bibb
University of Hawaiʻi at Mānoa

Thirty Meter Telescope
Mentors: Tony Travouillon & Warren Skidmore

Blurring and other effects caused by the turbulent mixing of the Earth's atmosphere is an important factor in the capabilities of ground-based telescopes. Sonic anemometers provide a means to measure this astronomical seeing. Being able to accurately measure this turbulence allows us to select ideal telescope sites, understand turbulence in the vicinity of a telescope, and possibly predict conditions for telescope observations. A sonic anemometer was used in such a manner during site testing for the Thirty Meter Telescope's campaign for site selection. However, the data collected from this instrument contains inherent errors due to its design and operation. Aliasing is present in the data due to the nature of digital sampling. Path-averaging errors appear due to measurements of temperature or wind speed within a sonic path of the instrument being averaged along the entire measurement path. Finally, pulse sequence delay errors occur due to the sequential, rather than simultaneous, firing of sonic pulses for measurement of wind speed and temperature. Mathematical corrections to these errors have been published, which were used in development of a program to apply these corrections to anemometer data sets. A five-day period of data was corrected using this program and analyzed to observe the effect of the corrections. We found that there was an average decrease of 16% in the calculated turbulence over this period, and that the magnitude of correction was correlated with the measured wind velocity.

Darcy Bibb

Darcy Bibb was born in South Korea, but grew up on the island of Maui. He graduated from Baldwin High School in 2006, and was part of the Electronic and Computer Engineering Technology (ECET) program at Maui CC (now UH Maui College). Darcy earned his BS degree in Electrical Engineering at UH Mānoa in Spring 2013, and plans to return to UH to pursue a master's degree in Electrical Engineering.

Designing a Mirror-Cell Handling Cart

Ryan Saito
University of Hawaiʻi at Mānoa

Thirty Meter Telescope
Mentor: Virginia Ford

The Thirty Meter Telescope (TMT) will have three types of mirror cells for the M1, M2, and M3 mirrors. Each mirror cell consists of the mirror itself, the structure that houses the mirror, and equipment used to manipulate the mirror. Telescope mirrors need to be removed from the telescope structure and resurfaced approximately once every two years. This project focused on the transport of the M2 and M3 mirror cells. The M2 mirror cell is approx. 3.6 meters in diameter and weighs approx. 5000 kg. The M3 mirror cell is an elliptical shape, approx. 2.9 by 4.1 meters, and weighs approx. 5500 kg. Both mirror cells have different mounting interfaces. The main element of this project was to design a cart that could safely receive the mirror cells from a crane and transport them to the recoating facility. The design for the handling cart was based on the preliminary designs made by other engineers who previously worked with TMT, other observatories' mirror-handling equipment, and handling practices for heavy equipment in the aerospace industry. An orientation of the telescope structure and the observatory dome that would place the mirrors closest to the resurfacing facility was determined to minimize risk to the mirrors. Finally, finding potential companies who could produce the mirror handling cart was also part of the research. The final cart design features its own drive system, protection screens for the mirror cell, a walk-along drive system, and a single rotating cradle that can attach to both types of mirror cells.

Ryan Saito

Ryan is a graduate of Kamehameha Schools Kapālama campus, after which he studied at Kapiʻolani CC, while also working as a peer mentor for the KCC STEM program. Ryan transferred to UH Mānoa in Fall 2012, where he is currently majoring in Mechanical Engineering. After completing his bachelor's degree, he hopes to attain a Professional Engineer (PE) license and work in the field of energy production. Ryan also volunteers as an assistant scoutmaster for the Boy Scouts of America with Troop 123. In his free time, he enjoys hiking, playing Airsoft, carpentry, and general tinkering with things.

Designing a Telescope Simulator for the UH 2.2-meter Telescope

E'Lisa Lee
University of Hawai'i at Hilo

UH Institute for Astronomy
Mentors: Colin Aspin & Marc Cotter

The successful and continued operation of an observatory depends on critical hardware components, such as the right ascension and declination axis control, and software, such as the high-level computer control software. Troubleshooting these various components is important to the continuous usability of an observatory. Thus, this project focuses on designing a telescope simulator for the University of Hawai'i 2.2-meter Telescope. The immediate goal of this project was to simulate the right ascension, declination, and the dome movement of the telescope. Therefore, this telescope simulator would only demonstrate motors rotating in a type of utilitarian design. When designing the telescope simulator, measurements were obtained of the telescope. After defining the scale of the telescope, we obtained the necessary components to simulate the movement of the observatory. The motors utilized to replicate the right ascension and declination drives were two Thorlabs CR1/M-Z7 360-degree continuous rotation servo motors. To control the movement of the motors, we utilized the Galil DMC 1830 motion controller card, Galil ICM 1900 breakout board, and designed three amplifier boards to amplify the signal coming from the motors. The motors were then wired to the Galil ICM 1900, which interfaced through an RS 232 port to a computer running Galiltools software. The whole system was then housed inside of a rack panel. Future goals of the project will be to design a working scale model of the University of Hawaii 2.2-meter telescope, as well as add other telescope components.

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E'Lisa Lee

E'Lisa is a junior majoring in Astronomy at UH Hilo, and a member of the University Astrophysics Club. While attending college, she works part-time at the Ellison Onizuka Center for International Astronomy on Mauna Kea, as the international student volunteer coordinator. She is interested in Japanese culture and has taken three years of Japanese language; she plans on going to graduate school either in the U.S. or Japan. In her free time, she enjoys stargazing, mountain biking, swimming, reading manga, and listening to music.

An Upgrade for the UH 88-inch Telescope Mirror-Cover Actuator System

Thomas Kackley
Seattle University

UH Institute for Astronomy
Mentors: Marc Cotter & Colin Aspin

The UH Institute for Astronomy (IfA) would like to upgrade the primary-mirror cover system on their 88-inch Telescope. Covers on the mirror are necessary to keep dust and other particulates in the air from falling on the mirror and degrading astronomical images. The current cover system is made up of eight triangular segments, all driven by separate motors, that meet at the center of the mirror when closed, and fold away from the mirror when open. It was designed and installed 40 years ago and has since stopped being effective. Through the use of modern materials and engineering tools, we were able to design, fabricate, and test a new mirror-cover actuator prototype for one triangular cover segment that will hopefully last another 40 years. There were many constraints for the new design, including weight, effectiveness, and size. As a result, we considered a few different designs until we found one that would be effective and satisfy all the design criteria. The final prototype weighs approximately 45 lb, a 42% decrease in weight, while still being functional and reliable.

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Thomas Kackley

"Tip" Kackley grew up in Hilo and attended Kamehameha Schools on the Big Island. He currently attends Seattle University, where he is majoring in Mechanical Engineering. After graduating in 2014, he hopes to further his education by going on to graduate school. Tip enjoys playing baseball, watching movies, and hanging out with friends.

Assembling an Adaptive-Optics Demonstration Kit for UH Hilo

Emily Peavy
Univ. of Hawai'i at Hilo

UH Institute for Astronomy
Mentor: Dr. Mark Chun

Adaptive optics is a relatively new technology being used by most large telescopes. These systems make the use of deformable mirrors (whose surfaces can change shape on small scales) to correct for distortions of light caused by turbulent air currents in the atmosphere. A small adaptive optics kit was purchased by the University of Hawai'i at Hilo through ThorLabs. This kit can be used for educational purposes and demonstrations of adaptive optics, but first it must be assembled. The kit is composed of a small deformable mirror and a wavefront sensor, both key components in adaptive optics. In addition to these vital elements, the kit contains a small laser to simulate an object, a beam splitter, and a series of lenses to simulate our telescope. Aberration plates were also constructed using Plexiglas and spray-on coatings — these can be introduced into the system to simulate turbulence in the atmosphere. The deformable mirror was characterized using a Zygo Interferometer to confirm that its shape would conform to expectations, and the focal lengths of the lenses were verified. When the system is aligned properly, it now automatically corrects for many of the aberrations as they are introduced.

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Emily Peavy

Emily is an Oregon native, currently working toward her bachelor's degree in Astronomy at UH Hilo. Emily loves explaining astronomical concepts, so she enjoys both working at 'Imiloa Planetarium and volunteering at the Mauna Kea Visitor Information Station. She is considering a career in astronomy education and outreach, and is eager to work with all aspects of the astronomy community. In her free time, Emily enjoys writing, watching movies, and maintaining her meager social life.

Presentation Schedule

August 7, 2013
W.M. Keck Observatory
Hualalai Conference Center

Canada-France Hawaii Telescope
W.M. Keck Observatory
Natural Energy Laboratory of Hawaii Authority
Big Island Abalone

Opening Remarks

Lisa Hunter
Director, Akamai Workforce Initiative
UH Institute for Astronomy and UCSC Institute for Scientist & Engineer Educators

<u>Canada-France-Hawaii Telescope</u>

Bringing the Canada-France-Hawaii Telescope into the 21st Century
While Improving Efficiency
Jeffrey Dorough — *Kauai CC*

Modernizing Mathcad Routines for Alignment of the
CFHT Primary and Secondary Mirrors
Jayson Hayworth — *Honolulu CC*

<u>W.M. Keck Observatory</u>

Development of Baseline Measurements and
a Routine Testing System for TBAD using TSIM
Isaac Lum — *UH Mānoa*

Keck II Laser Guide-Star Adaptive Optics: Integration of a Center Launch System
Marcus Yamaguchi — *Kauai CC*

~ Intermission ~

<u>W.M. Keck Observatory *(continued)*</u>

Reducing Keck Observatory Energy Consumption via
Mechanical and Behavioral Changes
Collin Au — *Leeward CC*

<u>Big Island Abalone Corp.</u>

A Prospective Polyculture of Abalone and Japanese Sea Cucumber:
A Study of Diurnal Water-Quality in Abalone Tanks
Michelle Rabara — *Univ. of Dayton*

<u>Natural Energy Laboratory of Hawaii Authority (NELHA)</u>

Optimizing Oxidation Techniques:
Measuring Nutrient Concentrations in Surface Seawater
Delaney Ross — *Barnard College, Columbia Univ.*

ABSTRACTS

Bringing the Canada-France-Hawaii Telescope into the 21st Century While Improving Efficiency

Jeffrey Dorough
Kauai Community College

Canada-France-Hawaii Telescope
Mentors: Grant Matsushige & Brandon Metz

The Canada-France-Hawaii Telescope began observing in 1979. Since then, numerous strides have been made to keep it up-to-date and relevant in the scientific community. This project addressed two such upgrades: a secondary mirror vacuum pressure monitor, and Improvements to the telescope's control and positioning system.

First, the secondary mirror's curvature is maintained using pressure regulators that control vacuum and pressure based on the telescope's position. Should these values change due to a leak or other failure while the secondary is in storage, it is usually only discovered at the time of reinstallation on the telescope, and the time needed to repair and recalibrate the secondary can be expensive. Some repairs can result in lost observing time, which is valued at up to $20k per night. To address this problem, we ran a cable and installed connectors to allow pressure values to be monitored while the secondary is in storage. We installed a cable from the fifth floor down to the fourth, and ran it across the outer edge of the summit observatory building. After it was successfully installed, we monitored the vacuum and pressure values to confirm that it accurately reads current values. Should the vacuum or pressure systems now fail, they can be repaired before the mirror is needed, which in turn saves telescope downtime.

Second, the telescope uses a control system that dates from the late 1970s and is obsolete by today's standards. Furthermore, the current system was not designed to be operated remotely, which has led to further problems in recent years: replacement parts are very hard to find; the reliability of the system has been in a slow decline, and its energy efficiency is fairly low; and finally, the old system is very large. We are building a newer system that will allow for more precise positioning, as well as better integration with CFHT's remote observation model. We also built several components to amplify the motor control signals, and that also allowed for precise manual control. The new system will be more energy efficient and will take up considerably less space, all while improving reliability and adding the ability for later expansion if needed.

Jeffrey Dorough

Jeff was born in California and moved to Oregon when he was 16. From there, he graduated from Waldport High School and attended a trade school in Utah for Automotive studies. After about 10 years, Jeff decided that it was time for a change, and in 2012, he returned to college to major in Electronics Technology at Kauai CC. Jeff now plans to continue on to pursue his bachelor's degree in Computer Science, at a college yet to be decided. In addition to his studies, Jeff also works for a local computer repair store.

Modernizing Mathcad Routines for Alignment of the CFHT Primary and Secondary Mirrors

Jayson-Micah K. Hayworth
Honolulu Community College

Canada-France-Hawaii Telescope
Mentor: Greg Barrick

The computer routines used to align the Canada-France-Hawaii Telescope primary and secondary mirrors are written in Mathcad, and hence are slowly becoming outdated in a modern, multi-user environment. The existing routines require a license to run, and they do not operate on all operating systems, such as Linux. As a result, these Mathcad routines are prohibited from running on many CFHT computers, including those at the summit that do not have a license, or those that may be running on an unsupported platform. To address this problem, we have replaced the Mathcad routines with mathematical replicas reprogrammed in C. This allows the routines to be flexible, so that they can run on any computer using the correct C compiler for that environment. However, instead of running the C routines locally on any computer, we compile and use them as a backbone on a Web server. These C routines are interfaced to a webpage, and data is sent back and forth through dynamically generated webpages comprised of HTML code, depending on the data processed and the routines the user has selected. The data is also checked for integrity and security before being sent through the C routines. We scan for any user input that may contain errors, and we return those errors to the user before inputting them into the C programs. This system will allow for easier alignment of the telescope mirrors by giving multiple users access to these routines without requiring any special software other than a Web browser and an Internet connection.

Jayson Hayworth

Jayson was born and raised on the island of O‘ahu. He graduated from Myron B. Thompson Academy in 2011 and currently attends Honolulu CC. He plans to complete his AS degree in Computing, Electronics & Networking Technologies (CENT) in Fall 2013, and continue on to UH West O‘ahu to earn his bachelor’s degree. He enjoys playing video games and going to the beach.

Development of Baseline Measurements and a Routine Testing System for TBAD using TSIM

Isaac B.K. Lum
University of Hawaiʻi at Mānoa

W.M. Keck Observatory
Mentors: Randy Campbell & Luca Rizzi

The W.M. Keck Observatory uses a 20-W laser to excite a sodium layer in the upper atmosphere, in order to create an artificial guide star for its adaptive optics system. This laser can potentially damage the vision of airplane pilots, or be a source of confusion for them. Because of this, the laser must be shuttered whenever an aircraft enters laser-affected airspace. The current detection method is to station human personnel outside the observatory to watch for aircraft by eye. To assist with this manual method (and eventually replace it, once fully tested and approved), Keck has acquired a new Transponder-Based Aircraft Detector (TBAD) system: since it is expected that virtually all aircraft will use a transponder that sends out a signal, or "squawk," for purposes of guidance and navigation, TBAD uses a patch-array antenna to acquire these signals and automatically shutter the laser beam when the aircraft enters potentially dangerous airspace. A log is generated by TBAD of relevant data, such as shutter state, time, telescope position, and squawk code. A TBAD simulator, TSIM, was created to test TBAD — the simulator generates a signal much like the ones generated by an aircraft, and can be used to test various aspects of TBAD's capabilities. We created a program to analyze the data received by TBAD during TSIM transmission. The data could then be used to develop baseline measurements that could be compared to routine testing data. A Python program was written to extract such information as minimum power detectable, beam width, and off-axis angles. The program's graphical output includes plots of variables such as signal strength vs. off-axis angle. Once TBAD is approved, Keck will be able to rely solely on TBAD as its main aircraft protection, and TSIM will be used to routinely test TBAD against baseline measurements.

Isaac Lum

Isaac was born in Kahaluʻu on the island of Oʻahu. He attended UH Hilo to complete his pre- engineering courses, then transferred to the UH Mānoa, where he is currently a senior in Electrical Engineering with an emphasis in Electrophysics. After he graduates in Spring 2014, he plans to pursue a PhD in radio-frequency (RF) engineering.

Keck II Laser Guide-Star Adaptive Optics: Integration of a Center Launch System

Marcus Yamaguchi
Kauai Community College

W.M. Keck Observatory
Mentors: Jason Chin, Ed Wetherell & Rachel Rampy

With the advent of adaptive optics, ground-based astronomical observation gained the ability to generate images with comparable quality to satellite-based images of extra-terrestrial sources. Adaptive optics systems require the use of a naturally bright guide star to make real-time wavefront measurements, which vary rapidly due to atmospheric aberrations. A deformable mirror is manipulated to compensate for the aberrations. Due to the limited availability of naturally bright guide stars, the development of artificially induced laser guide stars (LGS) was inspired to increase the effective sky-area accessible to astronomical observation using adaptive optics. The Keck II telescope currently operates a side-launched LGS. Due to its placement along the side of the telescope aperture, the introduction of elongation to the propagated beam relative to the plane of observation becomes a compromising element, which is currently one of the primary limitations to optimizing wave front sensing. To rectify this corruptive element, the Keck II telescope will be modified to accommodate a center-launch system (CLS), which will propagate outward from behind the secondary mirror, along the central axis of the telescope. The design and integration plans for the CLS modification have been finalized, and the integration process is in the initial stages. A primary parameter guiding the integration effort is defined by the efforts to align the beam from its source to its point-of-departure from the telescope. We will discuss the procedures and results of the attempts to quantify the parameters affecting the beam alignment, with the purpose of providing an alignment model that will become part of a template for the final implementation and operation of the CLS.

Marcus Yamaguchi

Marcus is currently a pre-engineering student enrolled at Kauai Community College and is an officer of the electronics club. Marcus has also worked on a research project with the Hawaii Space Flight Lab in addition to tutoring his classmates in electronics, physics and calculas Marcus has received his technician's class amateur ham radio license and will be studying to take the general class licensing test in February.

Reducing Keck Observatory Energy Consumption via Mechanical and Behavioral Changes

Collin Au
Leeward Community College

W.M. Keck Observatory
Mentors: John Baldwin & Mark Devenot
Advisor: Rich Matsuda
Collaborator: Justin Pitts

The business of conducting observational astronomy requires many mechanical and electrical components to gather the required data. This translates into high electrical consumption and costs. Every month, the two Keck telescopes use over $75,000 in electricity to operate both telescopes at the summit site. Each Keck telescope strives to keep the temperature and humidity levels regulated inside its dome, so that there will be little difference in temperature between the outside night air and the telescope. In order to maintain controlled environmental conditions, large air conditioning units are required. To reduce the overall consumption of electricity, we investigated both mechanical and behavioral modifications within the observatory:

First, we compared an air conditioning unit with both a variable frequency drive (VFD) and a high efficiency fan motor to a "standard" unit that had neither. VFDs can be run at lower speeds during cooler periods, resulting in less electricity consumption. Also, replacing existing mechanical motors (air conditioning fans, or otherwise) within the observatory with high-efficiency motors can increase power factor (PF). For example, when two glycol pumps were compared, it was found that the new higher-efficiency motor increased the PF by 20%.

Second, the Keck telescopes are currently programmed to have air conditioning units that run from 9 a.m. to 5 p.m., every day. To determine if there were a later time-of-day that the air conditioning units could be started, the start times were varied for two weeks. Through these tests, we found that adequate cooling was achieved when starting the air conditioners as late as 12 p.m. This can save 3 hours of operation every day, without affecting telescope throughput or image quality.

Collin Au

Collin graduated from Moanalua HS in 2008. He has completed his pre-engineering courses at Leeward CC and will be attending UH Mānoa starting in Fall 2013. Eventually he would like to obtain a doctorate in Electrical Engineering. Collin loves computers and is interested in alternative means of energy production. His hobbies are video games, going to the beach, and hanging out with friends.

A Prospective Polyculture of Abalone and Japanese Sea Cucumber: A Study of Diurnal Water-Quality in Abalone Tanks

Michelle S. Rabara
Univ. of Dayton

Big Island Abalone Corporation
Mentors: Cecilia Viljoen & Jay Booth

Japanese sea cucumber (*Apostichopus japonicus*) is considered a delicacy in Asia, especially in China, where it has an established market. In order to improve profit margins, Big Island Abalone Corporation (BIAC)—the first company to farm abalone in Hawaii—is looking to co-culture *A. japonicus* with abalone. This study was conducted to determine the viability of co-culturing this species in both juvenile and young abalone grow-out effluent tank water. Because *A. japonicus* has been successfully co-cultured with abalone in the past in Asia, the diurnal water quality of the tanks was hypothesized to be suitable for the growth of the prospective species. In order to test this conjecture, pH, salinity, dissolved oxygen content (DO), and temperature were monitored in four regions of the tanks: incoming, basket, bottom, and outgoing. Ammonia levels were also recorded in the basket/bottom of the tanks. Additionally, the effect of abalone feed type on ammonia and DO levels were also examined. An ANOVA was used to determine the statistical significance of the basket/bottom region between tanks, and a t-test was used to determine the statistical significance between the basket/bottom within a tank. The overarching hypothesis was supported by the results, in that the analyses illustrated the following: water conditions conducive to the growth of *A. japonicus*; lack of evidence showing statistical significance between the juvenile and young grow-out tanks; no overall statistical significance between basket/bottom regions of each tank because all t-test results (except J50 DO) yielded t-values that were within the critical value range. Overall, the viability of *A. japonicus* co-culture with abalone—given the tanks' water conditions—was demonstrated to be feasible.

Michelle Rabara

Michelle was born in the Philippines, but spent majority of her life growing up on the island of Maui. In 2012, she graduated from St. Anthony Junior-Senior HS in Wailuku. She is currently majoring in Biology at the University of Dayton in Ohio. After finishing her undergraduate studies, she ultimately plans to become a physician assistant. In her spare time, Michelle enjoys singing and playing guitar, spending quality time with her chums, going to the library, discovering local eateries, and having a good laugh.

Optimizing Oxidation Techniques: Measuring Nutrient Concentrations in Surface Seawater

Delaney Ross

Barnard College, Columbia Univ.

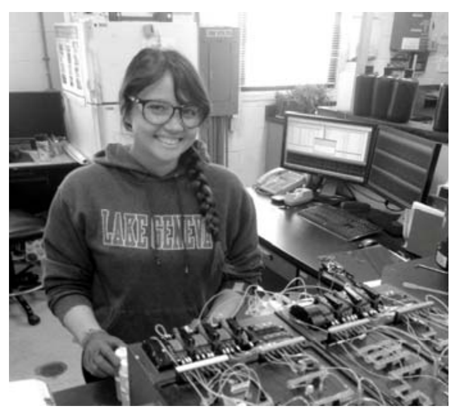
Natural Energy Laboratory of Hawaii Authority

Mentor: Keith Olson

The Natural Energy Lab of Hawaii Authority (NELHA) Water Quality Lab is responsible for monitoring the quality of ocean and groundwater surrounding the mariculture and aquaculture areas of the park. Nutrient analysis (nitrogen and phosphorus concentrations) is one of the key tests performed by the lab. NELHA's nutrient analyzer measures only inorganic material; to measure total nutrient concentrations, one must first oxidize the water samples to convert the nutrients into an inorganic form. Oxidation agents and UV radiation are used to produce this reaction. Traditionally, NELHA has used hydrogen peroxide as the oxidizing agent. In this experiment, a surface seawater sample was taken and oxidized using four different potassium persulfate agents, as well as hydrogen peroxide, to determine the best oxidation procedure. In addition to varying the oxidation agent, length of time spent in the oxidation chamber was also tested to optimize the oxidation method. Results indicated similar phosphorus concentration, regardless of oxidation agent. However, nitrogen concentrations were consistently lower when hydrogen peroxide was used compared to the potassium persulfate agents. Finally, a glycine solution was used to spike organic nitrogen levels prior to oxidation to measure a percent recovery for the additional nitrogen; the potassium persulfate recovery was 95%, while the hydrogen peroxide recovery was 77% (of a spike of 100 ppb of nitrogen). Due to limitations in accuracy of the instrument used to measure nutrient concentrations, results from this study remain inconclusive. Despite these challenges, the study achieved positive outcomes. A substantial body of data was collected that can be used in future analysis of oxidation techniques. Additionally, two of the four potassium persulfate methods were identified as unsuitable for NELHA's needs and eliminated from consideration. Future research should include further exploration of glycine as a check-standard for nitrogen, as well as the development of a check-standard for phosphorus levels.

Delaney Ross

Delaney was born and raised in Kona on the Big Island. She graduated from Hawai'i Preparatory Academy in 2012, and this fall, she will be a sophomore at Barnard College of Columbia University in New York City. She plans to earn her bachelor's degree in Environmental Biology and pursue a master's degree in Environmental Science and Policy. Delaney enjoys a cappella and classical voice as well as musical theatre, and plans to minor in Music.



Akamai Workforce Initiative

University of Hawai‘i at Manoa Institute for Astronomy (IfA)
University of California, Santa Cruz Institute for Scientist & Engineer Educators (ISEE)
University of Hawai‘i Maui College
University of Hawai‘i at Hilo

The AWI advances Akamai (smart, clever) students into the Hawai‘i technical and scientific workforce. AWI partners industry, observatories, government, educational institutions, and community to meet workforce needs in astronomy, remote sensing, and other science and technology industries in Hawai‘i. The Akamai Internship Program is one of the major programs of the Akamai Workforce Initiative.

The 2013 Akamai Internship Program placed college students from Hawaii at the following organizations to complete a seven-week project:

Akimeka, hv Photonics, Institute for Astronomy/Maui, Pacific Disaster Center, Pacific Joint Information Technology Center, Trex Enterprises, Canada-France-Hawaii Telescope, Gemini Observatory, University of Hawaii, Institute for Astronomy/Hilo, Smithsonian Submillimeter Array, Subaru Telescope, W.M. Keck Observatory, Hawaii Natural Energy Laboratory of Hawaii Authority, Big Island Abalone Corporation, Thirty Meter Telescope.

The AWI has received funding from:

The National Science Foundation (AST#0836053)
Air Force Office of Scientific Research (FA9550-10-1-044)
University of Hawaii
Air Force Research Laboratory
Kamehameha Schools
Thirty Meter Telescope Corporation
National Solar Observatory

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