AKAMAI

Maui Internship Symposium

August 4, 2009
Pacific Disaster Center

Program Information
&
Intern Abstracts

2009 Maui Akamai Internship Program

Institute for Astronomy
Center for Adaptive Optics
Maui Community College
Air Force Maui Optical & Supercomputing Site

Akamai – smart, clever

The Maui Akamai Internship Program is a unique program that combines research experiences, coursework, communication skill building, and mentoring. Through the Akamai Program, 10-15 college students from Hawaiʻi are placed in the Maui high-tech industry for the summer, and then are provided with guidance and mentoring as they advance in their education and careers. The Akamai program is based on 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 and piloting a program to address the workforce needs related to astronomical research and technology in Hawaiʻi.

The Maui Akamai Internship Program includes:

40-hour optics and workforce preparation short course
7-week research experience at a Maui technical facility
Science & Engineering Communication course in which all interns prepare:
- Oral presentation
- Poster presentation
- Technical abstract
- Personal statement
- Résumé

Symposium and many other opportunities for students to present their work
Ongoing educational and career support
3 units credit from Maui Community College

2009 Intern Host Organizations

Akimeka, hν Photonics, Institute for Astronomy, Oceanit, Pacific Disaster Center, Textron, and Trex Enterprises.

2009 Maui Akamai Program
People and Partners

Institute for Astronomy
Jeff Kuhn, Lisa Hunter, Lani LeBron

Center for Adaptive Optics
Lisa Hunter, Scott Seagroves, Lynne Raschke

Maui Community College
Mark Hoffman, Elisabeth Reader, Jung Park

Air Force Maui Optical and Supercomputing Site
Joseph Janni

2009 Akamai Maui Short Course Instructors

Dave Harrington - Lead Instructor
University of Hawaiʻi at Mānoa, Institute for Astronomy

Mike Foley - Instructor
University of Hawaiʻi at Mānoa

Mark Pitts - Instructor
University of Hawaiʻi at Mānoa, Institute for Astronomy

2009 Science Communication Instructors

Nina Arnberg – Lead Instructor
University of California, Santa Cruz

Mike Nassir – Instructor
University of Hawaii at Manoa, Institute for Astronomy

Special Thanks…

The Maui Akamai Program would like to thank the following individuals for their commitment and support of the 2009 Akamai Internship Program.

Rick Anderson -Trex
JD Armstrong - IfA
Herson Bagay - Akamai 2009
Austin Barnes - Akamai 2009
Bryan Berkowitz -Akimeka
Joe Mark Cabuco - Akamai 2009
Chris Calpito - Akamai 2009
Chris Chiesa - PDC
Steve Chun - IfA
Rita Cognion - Oceanit
Ray Corpuz - Akamai 2009
Pam Cowher - PDC
Ned Davis - Trex
Dennis Douglas - Trex
David Elies - Akamai 2009
Johanna Estrella - IfA
Mike Foley - UH Manoa
James Frith - Oceanit
James Gaines - UH
Deanna Garcia - Akimeka
Tim Georges - Textron
Luke Gers - Oceanit
Brooke Gibson - Oceanit
Randy Goebbert - Textron
Dave Harrington - IfA
Les Hieda - IfA
Zoran Ivankovich - Akimeka
Jeff Jacobs - Akimeka
Luana Kaawa - KSM
Kevin Kelly - UH
MonicaKelsey - Hnu
David Kim - Hnu
Tam Kim - Trex
NathanKimura- Textron
Russell Knox - Oceanit
Curtis Krupp - Textron
Rolf Kudritzki - IfA
Todd Lawson - Akimeka
Marc Lefebvre - Akimeka
Curt Leonard - Oceanit
Bob Lercari - Textron
Mary Liang - Hnu
Ted Liu - DBEDT
Dylan Lynn -Akamai 2009
Ross Matoi - Textron
Casey McGinty- Akimeka
SharonMielbrecht - PDC
Shanoa Miller - PDC
Tara Nakashima - IfA
Richard Nezelek - PDC
Garry Nitta - IfA
Bob Nolan - Textron
Dan O'Connell - Hnu
Devin Ortal - Akamai 2009
Kim Oyama - Akamai 2009
Chris Paris - Akimeka
Jung Park - MCC
Lisa Phillips - Akamai 2009
Mark Pitts - IfA
Richard Puga - Hnu
Elisabeth Reader - MCC
Rob Reed - Akimeka
Gwen Rivera - Trex
Don Ruffatto - Textron
John Ryan - Hnu
Clyde Sakamoto - MCC
Steve Schweibinz - Akimeka
Jeanne Skog - MEDB
Laurie Tamura - Trex
Jarret Toyama - Akimeka
Wes Ueoka - Trex
John Valiant - IfA
Leslie Wilkins—MEDB
Gale Yamada - IfA
Jasmine Yoshimoto - Akamai 2009

PRESENTATION SCHEDULE

Opening Remarks

Metrology: Characterizing Optical Quality on CVC SiC
Devin Ortal (UH Manoa) – Trex

Graphic User Interface for a Target Simulation Program
Kimberly Oyama (UH Hilo) – Textron

Effects of Socioeconomic Factors on the Magnitudes of International Disasters
Chelsea Schneider (California Lutheran University) – Pacific Disaster Center

Sun Tracker: Telescope Mount Auto-Guiding
&
South Pole Telescope: Temp Sensor Board

Joe Mark Cabuco (Maui Community College) – Institute for Astronomy

A More Efficient Wave Energy Retraction Mechanism
Jasmine Yoshimoto (UH Manoa) – Trex

Improving Image Download Speed through Compression and Decompression
David Elies (Maui Community College) – Akimeka

Break

Cross Domain File Transfer Solutions: Performance Analysis
Dylan Lynn (University of California Berkeley) – Akimeka

Characterization of Photovoltaic Components
Christopher Calpito (UH Manoa) – hv Photonics

Microtag Ultrasonic Characterization
Raynel Corpuz (UH Manoa) – Trex

Optimizing the Throughput of an Optical System
Elizabeth Phillips (Maui Community College) – Textron

Off-Axis Equatorial Telescope Design
Herson Bagay (Honolulu Community College) – Institute for Astonomy

Testing and Fine-Tuning HANDS' Automated Photometric Pipeline
Austin Barnes (Harvard University) – Oceanit

Closing Remarks

ABSTRACTS

Metrology: Characterizing Optical Quality on CVC SiC

Devin Ortal

Trex Enterprises
Advisor: Dennis Douglas
Collaborators: Rick Anderson and Chet Johnston
Home Institution: University of Hawai'i at Manoa

Glass materials are typically used for high quality optical mirror applications. These materials have a proven track record for exceptional surface finish and generally maintain low Coefficient of Thermal Expansion (CTE) properties, the capability to expand minimally when heated. For most applications glass optics are desired due to cost and manufacturing considerations. However, novel advanced materials are required for high performance space flight optics, reactionless fast steering mirror systems, and high-energy laser applications. Chemical Vapor Composite Silicon Carbide (CVC SiC) materials are in demand for these specific applications. CVC SiC dissipates heat quickly, is lightweight, maintains low CTE, and possesses high stiffness. The CVC SiC's greatest strength, its high stiffness, is also its greatest weakness when it is polished because it takes comparatively more time and effort to oppose it. There are current polished CVC SiC samples available by which metrology will be used to determine which polishing method is best for these materials. Thorough understanding of optical surface quality parameters is obtained and applied to procurement of lab hardware, which includes an Interferometer Alignment Mount designed with SolidWorks, suitable for measuring final polished CVC SiC optics. Due to the complexity of the polishing process, full in-house metrology capability is highly desired to verify vendor polishing results.

Devin Ortal was born on the island of Kauai. He is currently pursuing a Bachelor's degree in Mechanical Engineering at the University of Hawaii, Manoa. He is also the president and founder of the table tennis club on campus and has been playing table tennis competitively for over 2 years.

Graphic User Interface for a Target Simulation Program

Kimberly Oyama

Textron Systems
Advisor: Randy Goebbert
Mentor: Ross Matoi
Home Institution: University of Hawai'i at Hilo

Textron built a C program that simulates targets to test the tracking systems of their telescope mounts. This program (SIM) can simulate up to ten objects on four sensors using a target ephemeris, which describes each object and its characteristics. At the moment SIM is run using a command line interface, which makes it difficult to use. My goal for this project was to write a Graphic User Interface (GUI) for SIM to make it more user-friendly. The GUI, written in Tcl/Tk (a high level scripting language), is interfaced to SIM so the user can enter their data and press a button instead of entering multiple command lines. Boxes for data entry, labels for output display, and update buttons make it easy for the user to interact with SIM. I have also included other functions: sending SIM the name of the file to open, set a Missile launch time or launch immediately, and alerting the user of input errors. SIM stores data but it sends information to the GUI that does not need to be displayed immediately. The GUI can store such data in arrays of lists so the information is available if the user decides to display it. The widgets were tested by running the GUI through different situations, comparing the input to SIM and the output from SIM to those when SIM is run at the command line. In the future SIM and its GUI will expand to include databases for satellites and stars. This will provide a greater variety in testing and training scenarios for telescope operators using SIM.

Kimberly Oyama is currently a Computer Science major at the University of Hawaii, Hilo. She was raised on Lanai where she graduated from Lanai High School as the 2008 valedictorian. Kimberly enjoys reading as well as sports and other outdoor activities such as hiking, hunting, diving, fishing, and horseback riding.

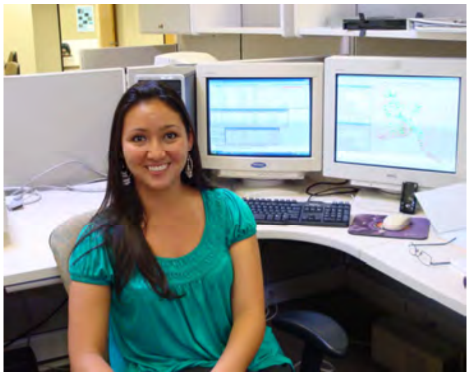
Effects of Socioeconomic Factors on the Magnitudes of International Disasters

Chelsea Schneider

Pacific Disaster Center
Mentor: Pam Cowher
Advisor: Chris Chiesa
Home Institution: California Lutheran University

One of the fundamental capabilities of the Pacific Disaster Center is the use of historical disaster data to better assess disaster risks and impacts. The goal of this project is to analyze whether certain socioeconomic factors (i.e. gross domestic product, access to healthcare, literacy rates, etc.) have an effect on the degree of distress suffered by a population from an international disaster. An essential element of this project was the utilization of Geographic Information Systems (GIS) which allowed the spatial representation of disaster affected locations in the Emergency Events Database (EM-DAT). With ESRI ArcGIS software, geographic identifiers were assigned to the centroids of a disaster so that the distribution of events could be evident. Altogether, there were 6125 geographic identifiers that were plotted in 44 different countries. The final product will be added as a map layer in the Pacific Disaster Center's Hazards and Vulnerability Atlas.

Chelsea Schneider was born and raised on Maui. Following graduation from H.P. Baldwin High School in 2005, she attended California Lutheran University where she received her Bachelor's degree in Environmental Science with a minor in Philosophy in May 2009. Chelsea is an avid traveler. Her travels have led her to Japan, Australia, New Zealand, Fiji, Costa Rica, Mexico and throughout the United States where she has competed in an international Ki-Aikido competition, skydived, bungee jumped, rappelled, zip-lined and ATVed. All of her travels have helped her to appreciate the beauty of our island home and have inspired her to protect and preserve the environment.



Sun Tracker: Telescope Mount Auto-Guiding and South Pole Telescope: Temp Sensor Board

Joe Mark Cabuco

Institute for Astronomy
Advisors: Haosheng Lin & Stuart Jefferies
Mentor: Les Hieda
Home Institution: Maui Community College

Sometimes poor alignment, wrong speed, or a worn gear will affect the telescope mount tracker and give inaccurate results. The goal is to design a sun guider to make tracking the sun faster, easier, and accurate. Four photodiodes were used as sensors, which were placed on a mount. The photodiodes output voltage amplitudes due to the intensity of light that strikes them. The voltages are amplified by a quad sum and difference amplifier relative to the Sun's position. The voltages are read by a LabJack, a USB/Ethernet based Digital Signal Processing device, which sends information to a program on a laptop. The program commands the LabJack and output digital signals to the telescope controller, keeping the telescope locked onto the Sun. As an added feature a wireless connection is used instead of running wires to the telescope. Using the program, the sun tracker setup can work autonomously or be operated manually. The tracking system provides a solution for accurate tracking, ease of use, and flexibility.

South Pole Project

The South Pole Project (SPP) telescopes will observe calcium, sodium, potassium, and helium spectral lines in the solar atmosphere to learn more about the temperature structure of the Sun. My task was to make a temperature sensor circuit board for one of the telescopes. When temperatures inside the telescope are not ideal, the data will be compromised. An example is when heat from the Charged Coupled Device (CCD) camera creates hotspots which affect image quality. After reading and analyzing the circuit schematic, I soldered the wires, connectors, and tested the board before soldering the components to their placements. The Temp sensor board's job is to amplify the signals from the temperature sensors and send the amplified signals to a LabJack. The LabJack reads the signals and sends them to a computer to be monitored and processed to control a cooling system to regulate the temperatures within the telescope.

Joe Mark Cabuco was born in the Philippines. He graduated from Lahainaluna High School in 2006. Currently, Joe is pursuing an A.S. degree in the Electronics and Computer Engineering Technology program at Maui Community College. His interests include working on computers, car stereos, and home audio.

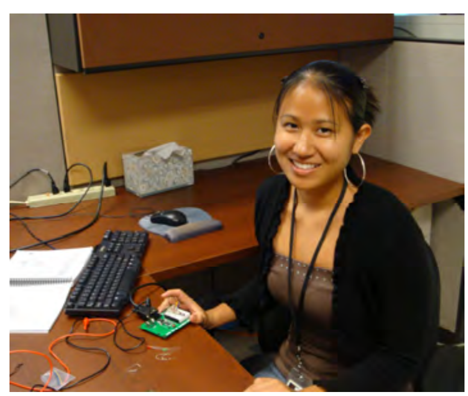
A More Efficient Wave Energy Retraction Mechanism

Jasmine Yoshimoto

Trex Enterprises Corporation
Advisor: Ned Davis
Home Institution: University of Hawai'i at Manoa

As the world becomes more conscious of the environment, clean, renewable energy sources hold great promise. One abundant resource to be utilized is the energy in ocean waves, commonly known as wave energy. Various wave energy-harvesting devices are currently in development. One type in particular utilizes a float or buoy to harvest energy as a wave passes, and then uses springs or counterweights to return to its initial position, waiting for the next wave. However, it is difficult to find a one size fits all solution efficient for various wave heights and current conditions. Developing an active retraction mechanism to return the device to its initial position between waves will increase the efficiency of wave energy harvesting devices. This mechanism uses a smart microcontroller to receive information about the wave from a sensor, interpret the data, and then engage a motorized mechanism to complete the retraction. I have completed the design of this retract mechanism and mounted the hardware into a prototype wave energy harvesting device. After implementing the software specifications, I tested this system by means of the prototype, and it is planned to incorporate this active retract mechanism into future wave energy devices. By efficiently harvesting the ocean's energy, a more sustainable environment may become a reality. Since the ocean encompasses about 70% of the Earth, wave energy may ultimately be the future of renewable energy.

Jasmine Yoshimoto was born and raised on the island of Oahu. She graduated from Hanalani Schools in 2006 and is currently pursuing a Bachelor's degree in Electrical Engineering at the University of Hawaii, Manoa. In her spare time, Jasmine enjoys playing basketball, bowling, and football in addition to cooking and baking for her family.



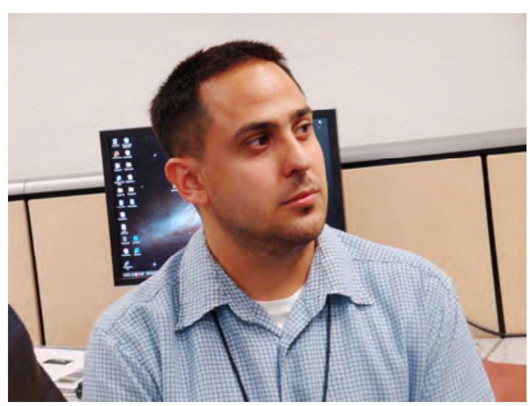
.Improving Image Download Speed through Compression and Decompression

David Elies

Akimeka, LLC.
Advisor: Steve Schweibinz
Mentor: Rob Reed
Home Institution: Maui Community College

The Medical Situational Awareness in the Theater (MSAT) project brings together and presents military medical information from multiple sources in a user-friendly and coherent web-enabled structure. MSAT combines operational data with relevant medical information in order to assist military medical units and commanders in making accurate and timely assessments. To aid in visualizing the location of facilities, events, and other pertinent data, MSAT includes satellite imagery of the Earth presented on a virtual 3D globe. This globe has rotation and zoom capabilities. As the map is zoomed in, higher-resolution images are downloaded to show greater detail. These high-resolution images can be relatively large, and thus slow to download. Since timeliness of data delivery is one of the primary goals of MSAT, it was advisable to find a way to limit the delivery time of these images. The image file format was analyzed and an image conversion tool was developed to compress the images before transmission, making them smaller and faster to transmit. This appears to have resulted in an improvement in the speed of transmission. More study is needed to determine if this solution is viable in the scope of the MSAT project

David Elies is currently an Electronics and Computer Engineering Technology program student at Maui Community College working towards his A.S. degree. He enjoys hiking, cooking and computer programming. David loves to travel and has traveled to 49 of the 50 United States as well as Europe and the Philippines. David grew up in Lahaina and also lived in Las Vegas for 5 years. He is an active member of Lahaina Christian Fellowship where he teaches Sunday School.



.

Cross Domain File Transfer Solutions: Performance Analysis

Dylan Lynn

Akimeka, LLC.
Advisor: Chris Paris
University of California at Berkeley

Traditionally when we transfer files from one computer to another we use devices such as USB flash drives and compact discs. The problem with this method of file transfer is that it puts the receiving computer at risk for things such as malware. My team has been contracted to evaluate the performance of a guard that will allow for secure file transfers across domains. A guard is a device that scans files being sent from a low to a high domain, or from an unclassified to a classified machine. We have designed a series of tests to evaluate the overall performance of the guard and how it deals with various factors. The tests we will be running include sending through different file loads, stressing the guard with a large load, spiking a steady stream of files with a greater load of files, and testing the guard's endurance. Not only will theses tests provide information about the overall performance but they will also show specifically how the guard handles varying file types and sizes. The goal of our comprehensive performance analysis is to supply our customer with a greater understanding of this guard so that they can successfully use it for secure cross domain file transfers.

Dylan Lynn grew up on the Big Island of Hawaii. She finished her sophomore year at Mount Holyoke College where she is studying Statistics and Studio Art. Dylan has recently transferred to the University of California, Berkeley where she will combine her two interests in the field of data visualization. In her free time she enjoys cooking, skateboarding, and playing scrabble.

Characterization of Photovoltaic Components

Christopher Calpito

hv Photonics
Advisor: Dan O'Connell
Mentor: Richard Puga
Collaborators: David Kim and Mary Liang
Home Institution: University of Hawai'i at Mānoa

In a single day, the sun can provide more than 10 times the energy used by everyone on earth. Photovoltaic systems have been designed to harness that incoming energy and are typically composed of photovoltaic (PV) modules, inverters, and tracking systems. Power inverters are critical for the proper utilization of energy generated by solar panels. An inverter converts the direct current generated by the module to alternating current, a form of energy that can be directly connected to the electrical grid. A tracking system moves the PV modules to follow the sun's path in order to optimize system output. By introducing a tracking system, it is suggested that overall efficiency can increase by up to 40%. Performance ratings for photovoltaic components are commonly based on Standard Testing Conditions. Such ratings are idealized and are performed under controlled indoor conditions. Real world testing introduces factors such as dust and dirt, DC and AC wire losses as well as rapidly changing weather patterns. The purpose of this project is to characterize the performance of a micro-inverter system to be used in conjunction with a polar tracking system under actual weather conditions. A test setup consisting of two Solarworld SW175 modules, two Enphase M-175 Microinverters, and a polar tracking system were used to obtain characteristics of system performance based on real world conditions. The conversion efficiency of the inverter over varying levels of irradiance was determined by comparing module power output (DC) to inverter power output (AC). Also, power output was compared between a fixed PV system and a tracked system to determine the increase in efficiency.

Chris Calpito was born on the island of Molokai and raised on the island of Maui. He is currently pursuing a Bachelor's degree in Mechanical Engineering at the University of Hawaii, Manoa and plans to graduate in Spring 2010. He hopes his internship with the Akamai Program will give him valuable experience in the real world. In his free time, he enjoys playing basketball, lifting weights, playing guitar and listening to music.

Microtag Ultrasonic Characterization

Raynel Corpuz

Trex Enterprises
Advisor: Tam Kim
Collaborators: Gwen Rivera, Dianne Butay, and Wes Ueoka
Home Institution: University of Hawai'i at Manoa

Raynel Ulit Corpuz was born and raised on Oahu. He graduated from Waipahu High in June 2002. He is currently a senior at the University of Hawaii, Manoa, majoring in Electrical Engineering and will graduate in Fall 2009. He plans to continue his education in graduate school with a M.S. and Ph.D. in Electrical Engineering. His current interests include in signal processing, support vector machines, and wireless communications. When he isn't studying, he enjoys playing basketball, watching Jet Li movies, and finding about new Toyota truck models.

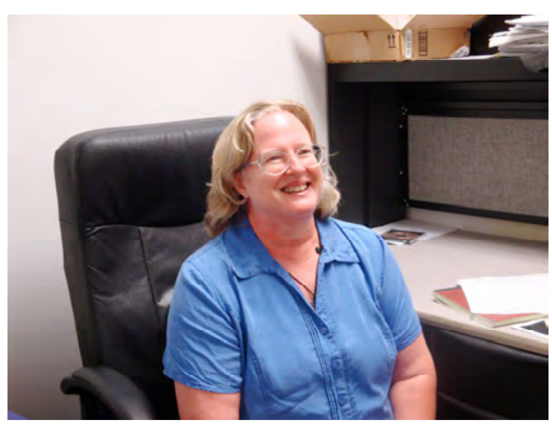
Optimizing the Throughput of an Optical System

Elizabeth Phillips

Textron Systems
Advisor: Robert Lercari
Mentor: Robert Nolan
Home Institution: *Maui Community College*

The Air Force plans to develop active imaging ladar systems to support their mission of tracking and identifying dim space objects. Textron Systems has developed technology to specifically support this mission. The Laser Beam Director (LBD) transmitting telescope, found at the Maui Space Surveillance Site, is an important part of the Air Force's mission because it is capable of projecting a laser beam into space, illuminating objects of interest. The LBD consists of 3 subsystems: a laser, telescope, and beam relay optics system. The beam relay optics system directs the laser beam from the laser to the LBD transmitting telescope and consists of several mirrors, two beam expanders, and a cube beam splitter. Our goal was to maximize the throughput of the beam relay optics system to increase the amount of light illuminating the object of interest. First, we measured the power of the light incident on an optical component (Power In) and transmitted through the component (Power Out) and then calculated the light throughput efficiency. The higher the light throughput efficiency of the component, the more light will be transmitted to the telescope for illumination of the object of interest. We explored the light throughput of the cube beam splitter, which splits the laser beam and sends a part of the incident beam to a camera. The light throughput efficiency of the cube beam splitter was 80%. The 20% of the incident light reflecting off the cube beam splitter was more light than the camera required, so we decided to explore the use of a pellicle in place of the cube beam splitter. The light throughput efficiency of the pellicle chosen was 94%. This pellicle would be an appropriate replacement for the cube beam splitter since 6% of the incident light was all that was required for the camera and the light throughput efficiency of the beam relay optics system would increase by 14%. Other components of the beam relay optics system will be explored as time permits.

Elizabeth Phillips moved to Maui in 2002 with her husband and two of her four sons. Currently she attends Maui Community College in pursuit of an A.S. degree in the Electronics and Computer Engineering Technology program. She plans to use her ECET degree along with her Bachelor's degree in Physics to work in the technology field on Maui. When she is not studying, she enjoys spending time with her husband, solving puzzles, gardening and doing needlework.



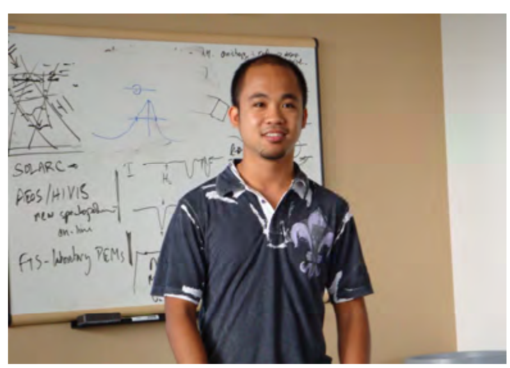
Off-Axis Equatorial Telescope Design

Herson Bagay

Institute for Astronomy
Advisor: Jeff Kuhn
Mentor: Garry Nitta
Home Institution: Honolulu Community College

The advancement of mirror grinding and polishing technology set off a new era of bigger and, consequently, heavier mirrors. In addition to the increase in primary mirror diameter, there is also a need for heavier and more rigid telescope mechanical systems for support. In this case, heavier is not better. Responding to the requirements of a two-meter class off-axis equatorial telescope, we designed a lightweight telescope mounting system that includes: 1) the substructures supporting the primary and secondary mirrors and instrumentation and 2) the equatorial tracking mechanism. Variables such as the type of material and the overall geometry of the support structure were considered. Using AUTODESK® Inventor Professional, I designed, modeled, and evaluated several geometric configurations, materials, support diameters and thicknesses that will result in the least maximum deflection on any part of the telescope. Using the software's finite element analysis package, I ran static structural simulations on forces acting on the telescope within its operating range. Through iterative design optimization, we identified critical areas and apply the necessary fix to eliminate the problem. Several iterations of the design yielded us an overall nested truss-like frame consisting of steel truss members that is both rigid and cost effective for its efficient use of materials.

Herson Bagay is currently working towards a Computing, Electronics and Networking Technology degree at Honolulu Community College. He first came to Hawaii in 1999 from the Philippines but went back to finish up his mechanical engineering degree at the University of the Philippines. He officially moved to the islands in 2005. He enjoys playing online, jogging and cruising on his bike. He plans on attending University of Hawaii to pursue a degree in computer science.



Testing and Fine-Tuning HANDS' Automated Photometric Pipeline

Austin Barnes

Oceanit
Advisors: Rita Cognion and Curt Leonard
Mentor: Russell Knox
Home Institution: Harvard University

At a time when there are more than 19,000 pieces of debris large enough to cause catastrophic damage to the 3,000 pieces of functional equipment orbiting the Earth, space situational awareness is more important than ever. There is increasing pressure and necessity worldwide to improve the ability to identify and track objects in orbit. Oceanit's High Accuracy Network Determination System (HANDS) offers an effective and affordable solution. HANDS is a network of robotic telescopes at ground stations around the world, allowing global object-tracking coverage. Oceanit's science team has written a data pipeline designed to quickly and automatically process the stream of incoming images in order to obtain photometric signatures of satellites. The calibration star correlator, a section of the pipeline, matches stars from images taken by the HANDS telescopes to stars in the Landolt catalogue, a standard for stellar magnitudes or brightness. These matches are processed to calibrate the HANDS data. We analyzed star field images to determine the most appropriate tolerance values on coordinate and magnitude matches of catalogued stars. I created a Matlab script that extracted data from images taken by a HANDS site at Kirtland Air Force Base, NM and plotted magnitude offsets of correlated stars as a function of their coordinate offsets. By identifying obvious outliers on the graph as incorrectly correlated stars, we determined at what tolerance values stars from the HANDS images have most likely been correctly correlated with catalogued stars. The analysis concluded that a configurable magnitude offset tolerance is the most effective way to remove incorrectly correlated stars from the calibration process. The calibration coefficients calculated from these correlated stars are imperative for correctly identifying tracked items, a necessary step in improving our awareness of orbital objects.

Austin Barnes is from Aiea, on the island of O'ahu. He graduated from Iolani School in 2006 and currently attends Harvard University, pursuing a Bachelor's degree in Astrophysics and Chemistry, graduating in 2010. He also loves to surf and of course dabble in astronomy when he can.

Akamai Workforce Initiative

University of Hawai‘i Institute for Astronomy (IfA)
Center for Adaptive Optics (CfAO)
Maui Community College (MCC)

The Akamai Workforce Initiative (AWI) partners industry, observatories, educational institutions, and community to meet needs in astronomy, remote sensing, and other technology industries in Hawai‘i. The AWI includes internships, the Teaching and Curriculum Collaborative, development of engineering technology courses, and outreach to high schools.

The AWI will advance *akamai* – smart, clever, expert – students into the technology workforce on Maui, and more broadly in Hawai‘i.

AWI includes internships on Maui and Hawaii Island

Maui Akamai Internship

University of Hawai‘i Institute for Astronomy (IfA)
Maui Community College (MCC)
Center for Adaptive Optics (CfAO)
Air Force Maui Optical and Supercomputing Site (AMOS)
Maui High Tech Industry Partners

Hawai‘i Akamai Internship

Center for Adaptive Optics (CfAO)
Hawaii Community College (Hawaii CC)
W. M. Keck Observatory
University of Hawaii, Hilo
Mauna Kea Observatories

The AWI has received funding from:

The National Science Foundation funded Center for Adaptive Optics (NSF#AST-987678)
University of Hawai‘i
Department of Business, Economic Development, and Tourism
National Science Foundation (NSF# AST-0710699)
Air Force Office of Scientific Research (NSF# AST-0710699, through interagency transfer)
Air Force Research Laboratory
Thirty Meter Telescope Corporation
National Science Foundation (NSF# AST-0850532)

For information please contact:
Lisa Hunter, Director, Akamai Workforce Initiative,
Institute for Astronomy & Center for Adaptive Optics,
(808) 573-9542, hunter@ifa.hawaii.edu

Akamai Workforce Initiative Headquarters

IfA Advanced Technology Research Center
34 Ohia Ku Street * Pukalani, HI * 96768

Lisa Hunter, Director, Akamai Workforce Initiative
808-573-9542 * hunter@ifa.hawaii.edu

Lani LeBron, Program Assistant, Akamai Workforce Initiative
808-573-9534 * klebron@ifa.hawaii.edu

http://www.ifa.hawaii.edu/haleakalanew/akamai/akamai.shtml

AKAMAI

Hawaii Island Observatory Student Internship Symposium

August 7, 2009
Institute for Astronomy Auditorium

Program Information
&
Intern Abstracts

Hawai‘i Island Akamai Observatory Internship Program

Akamai – smart, clever

The Hawai‘i Island Akamai Observatory Internship Program is a unique program that combines research experiences, coursework, communication skill building, and mentoring. Through the Akamai Program, 10-15 college students from Hawai‘i are placed in the observatory community for the summer, and then are provided with guidance and mentoring as they advance in their education and careers. The Akamai program is based on 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 and piloting a program to address the workforce needs related to astronomical research and technology in Hawai‘i. Partner institutions include the W.M. Keck Observatory, Hawai‘i Community College and the UH Institute for Astronomy. Led by the CfAO, the Akamai Observatory Internship Program includes:

- 40-hour Akamai Observatory Short Course
- 7-week research experience at an observatory facility
- Science and Engineering Communication course in which all interns prepare:
    - Oral presentation
    - Poster presentation
    - Technical abstract
    - Personal statement
    - Résumé
- Symposium and many other opportunities for students to present their work
- Ongoing educational and career support
- 3 units credit from Hawai‘i Community College

2009 Intern Host Organizations

Canada-France-Hawai‘i Telescope
Gemini Observatory
Institute for Astronomy
W.M. Keck Observatory
Smithsonian Submillimeter Array
Subaru Telescope
University of Hawai‘i at Hilo

2009 Akamai Observatory Internship Program Selection Committee

The Akamai Program Selection Committee reviews applications and selects students to be accepted into the program.

Lisa Hunter, Akamai Workforce Initiative
Sarah Anderson, Hawaii Island Akamai Observatory Internship Coordinator
Scott Seagroves, Center for Adaptive Optics
Colin Aspin, Institute for Astronomy, Associate Specialist
Annie Brown, Associate Professor, Information Computer Technology/
Information Technology Hawaii Community College
Robert Fox: Department of Astronomy and Physics Department Chair,
University of Hawaii at Hilo

2009 Akamai Observatory Short Course Instructors

Mike Cooney - Lead Instructor
University of Hawaiʻi at Mānoa

John Hamilton - Instructor
University of Hawaiʻi at Hilo

Betsy Mills - Instructor
University of California, Los Angeles

Sarah Sonnet - Instructor
University of Hawaiʻi at Mānoa

2009 Science Communication Instructors

Nina Arnberg - Instructor
University of California, Santa Cruz

Mike Nassir - Instructor
University of Hawaii at Mānoa, Institute for Astronomy

Special Thanks…

The Hawai'i Island Akamai Program would like to thank the following individuals for their commitment and support of the 2009 Akamai Internship Program.

James Ah Heong – UH Hilo
Christian Anderson - UH Hilo
Robert Albarran – Akamai 2009
Taft Amandroff – Keck
Colin Aspin – IfA
Chauncey Banasihan – Akamai 2009
Marc Baril – CFHT
Greg Barrick – CFHT
Bill Bates – Keck
Jim Bell – Keck
Tom Benedict – CFHT
Mike Bolte – TMT
Annie Brown – Hawai'i CC
Dennis Callan – Keck
Chas Cavedoni – Gemini
Wei-Hann Chen – Akamai 2009
Billie Chitwood – SMA
Jason Choi – Akamai 2009
Mike Cooney – UH Mānoa
Kevin Cornwell – UH IfA
Steven Coss – Akamai 2009
Sandra Dawson – TMT
Eric Dela Rosa – Akamai 2007 Alumnus
Justen Dela Cruz – Akamai 2009
Doug Dykstra – Hawai'i CC
Shara English – Keck
Vincent Fesquet – Gemini
Rockne Freitas – Hawai'i CC
Dorothy Fukushima – Akamai 2009
James Gaines - UH
Sarah Gajadhar – CFHT
Olivier Guyon – Subaru
Richard Ha
Linden Hale – Akamai 2009
John Hamilton – UH Hilo
Grant Hill – Keck
Kevin Ho – CFHT
Klaus Hodapp – UH IfA
Eric James – Gemini
Heather Kaluna – UH IfA
Marc Kassis – Keck
Kevin Kelly - UH
Kyle Kinoshita – Keck
Leslie Kissner – Keck
Ron Koehler – MKSS
Felix Kraemer – Gemini
Derek Kubo – SMA
Rolf Kudritzki – UH IfA
Florian Lang – UH IfA
Hilton Lewis – Keck
Ted Liu - DBEDT
David Lynn – Keck
Dorianna Manuel-Cortes – Hawai'i CC
Robert McLaren -- UH IfA
Frantz Martinache – Subaru
Grant Matsushige – CFHT
John Maute – SMA
Drew Medeiros – Keck
Betsy Mills – UCLA
Randy Mogenson – Keck
Harvey Motomura – Hawai'i CC
Craig Nance – Keck
Adrienne Notley – Gemini
Joni Onishi – Hawai'i CC
Richard Oram – Gemini
Richard Ordonez – Akamai 2009
Lucia Polakova – Akamai 2009
Lucio Ramos – Subaru
Bill Randolph – Keck
Matthew Rippa – Gemini
Amanda Ross – Akamai 2009
Rodolf Sabalburo – Akamai 2009
Michael Sheehan – Gemini
Stephanie Shinohara – Akamai 2009
Sarah Sonnett – IfA
Edwin Sousa – UH IfA
Kevin Tsubota – Keck
Kalei Tsuha
Klaus Ulander – Keck
Vasu Upadhya – Gemini
Tom Vermeulen – CFHT
Jermaine Vitales – Akamai 2009
Kirk Wah Yick – Akamai 2009
Josh Walawender – UH IfA
William Walters – UH IfA
Ed Wetherell – Keck
Paul Yamaguchi – SMA
Tyler Yoshiyama – Akamai 2009

PRESENTATION SCHEDULE

Opening Remarks

A Photometric Monitoring Camera for the UH 88-Inch Telescope
Richard Ordonez (UH Mānoa)

Protecting the IfA Cybersphere
Kirk Wah Yick (Hawai‘i CC)

Keeping Up with the Sun: Optimizing Solaris System and Software Configuration
Jermaine Vitales (Hawai‘i CC)

Optimizing the Air-Handler Simulator
Stephanie Shinohara (Univ. of Southern California)

Distance Learning: Remotely Monitoring Test Points at SMA
Jason Choi (Kaua‘i CC)

Reimagining the SMA Electronics Lab: Optimizing Dynamics of Use
Chauncey Banasihan (Kaua‘i CC)

An Intelligent Version-Control Framework
Tyler Yoshiyama (UH Hilo)

A Study and Demonstration of Local Seeing Control Strategies
Wei-Hann Chen (UH Hilo)

Wave-Plate Rotator Upgrade to the Gemini North Laser
Lucia Poláková (Santa Clara Univ.)

Break

Characterization of a Segmented Deformable Mirror Using Phase-Diversity
Robert Albarran (UH Hilo)

Mirror, Mirror: Improving CFHT’s Aluminizing Procedure
Justen Dela Cruz (UH Mānoa)

“What’s in the Air Up There?”: An Automated Remote Airborne-Particle Counter
Rodolf Sabalburo (Honolulu CC)

Dust in the Dome: Characterizing the Dust at Keck Observatory
Dorothy Fukushima (UH Hilo)

Design Foundations: 3-D Modeling of Keck II
Amanda Ross (Mt. Holyoke College)

Improving Inventory Efficiency at the Keck Interferometer
Steven Coss (UH Hilo)

Finding Metallicities of Old Open Clusters
Linden Hale (Univ of Washington, Seattle)

Closing Remarks

ABSTRACTS

A Photometric Monitoring Camera for the UH 88-Inch Telescope

Richard Ordonez

Institute for Astronomy
Mentor: Colin Aspin
Collaborator: Alex Laurich
Home Institution: University of Hawaii at Mānoa

During astronomical observations of the night sky, weather phenomena, such as clouds or haze, can result in images that are abnormally faint, noisy, or variable. As a result, photometric measurements of a star's brightness appear dimmer than they should be. Any observational biases due to weather must be identified, so that later photometric corrections can be applied and the intrinsic brightness of the target source can be determined. In order to monitor atmospheric disturbances, I have designed and constructed the University of Hawaii 88-Inch Photometric Monitoring Camera (UH88PMC). The system uses astronomical software to automatically measure photometric changes in stars, and the data is subsequently posted on a website that allows users to track photometric variations in real time. I chose to use a commercial Canon Rebel XSi DSLR camera with an 85-mm, f/1.8 lens, in order to observe a fairly large field of view (roughly 3˚ ´ 4˚) while applying a fast focal ratio to quickly image faint objects. I fabricated a lightweight aluminum camera mount, and with the help of the telescope's day crew, co-aligned the camera on the middle of secondary plate of the 88-Inch Telescope, so that the camera always records a region of the sky encompassing the telescope's current pointing location. I also assembled a computer from component parts, and it will store the images in a raw digital format to enable subsequent data reduction. This computer is mounted on the bottom of the telescope, but will be accessed remotely from IfA Hilo. In conclusion, the UH88PMC uses an approach that is low-cost, familiar, and beneficial to telescope end-users. Observers will be able to collect real-time data on photometric variations that can later be used to correct their images and photometric measurements.

Richard Ordonez was born in New York, but currently resides on O‘ahu. He is entering his senior year this fall, working toward a B.S. in Electrical Engineering at the University of Hawai‘i at Mānoa. Richard was recently employed at the Leeward Community College Observatories, where he conducted astronomy research, maintained a large telescope, and organized community outreach programs. Through his early experience, he has developed a great respect towards astronomy and all of its ideas. In Richard's future, he would like to help advance space exploration. During his free time he likes to swim, surf, run, ride his bicycle, listen to music, hang out with friends, and stargaze.

Protecting the IfA Cybersphere

Kirk Wah Yick

Institute for Astronomy
Mentor: Kevin Cornwell
Home Institution: Hawaii Community College

Information Technology (IT) security is all around us. From identity theft to software piracy, we are all affected in one way or another. I was assigned the challenge of improving the IT security at the Institute for Astronomy (IfA). Open ports on a computer can give hackers access to data and resources that they could take advantage of and commit malicious acts. My solution to this problem was to install a system that monitors activities on the IfA-Hilo network. By recording and tracking trends in the network's activities, we created a norm of events that occur on a regular basis. Any event outside of this norm was investigated. If an activity was discovered to be illegitimate, the corresponding port was closed. Hopefully, this project has led to a more proactive and efficient way to monitor any network to prevent future security breaches. There are simpler ways to protect a network, such as firewalls, but with 80% of security breaches occurring internally, managing each individual open port is the most fail-safe way to ensure a secure network.

Kirk Wah Yick was born in Kona and raised in Hilo on the Big Island of Hawaii. He grew up as a child active in martial arts — he has practiced judo since the age of five, obtaining his black belt, and more recently with Brazilian Jiu-jitsu, his brown belt. He has enjoyed his martial arts experience, exploring a bit of Mixed Martial Arts and sporting a record of 3-1. Kirk spent four years in the United States Navy, pursuing a dream of traveling the world. He was honored with the "Give 'Em Hell Hero Award" during Operation Iraqi Freedom, for saving a shipmate's life during flight operations. Kirk plans to pursue a career in Information Technology in hopes of helping and educating people in a field that fascinates him.

Keeping Up with the Sun: Optimizing Solaris System and Software Configuration

Jermaine Vitales

Institute for Astronomy
Mentor: Kevin Cornwell
Home Institution: Hawai'i Community College

In order for any organization to perform efficiently, its computer systems need to be configured correctly and operate effectively. To pursue such a task, operating systems and program applications must be properly selected and configured to the benefit of the intended users. This became the predominant focus of my project: optimizing computer systems and program applications configuration. I started with a Sun Microsystems server computer running under Solaris 8, a Unix operating system. I set up the server computer and properly connected it to the Institute for Astronomy (IfA) network. On the Sun server, I installed and configured a Web server called *Apache*, a server application that allows files to be accessed via an Internet browser. Using *Apache*, I was then able to install and configure an application called *iOffice* on the server. This application is a group-oriented suite used to increase cooperative productivity in a group atmosphere. *iOffice* allows groups to work together effectively and includes features like schedule planning, to-do lists, discussion boards, and project management tools to facilitate progress in the work environment. Installing software applications often requires more than simply copying files — in most cases, it was necessary to install and configure multiple files in order to enable certain program functionalities, or to use compilers to translate the written code into an executable program file. I also edited configuration files to allow access to particular data or resources, while I set other restrictions as a security measure to prevent unauthorized change of system and program configuration. All of these techniques were incorporated in my project to create a more effective and efficient computer system for the IfA.

Jermaine Vitales has just finished his freshman year in the Information Technology program at Hawai'i Community College. He was born in the Philippines, moved to Hawai'i when he was six years old, and was raised in the town of Waimea on the Big Island. He plans to go to the University of Hawai'i at Hilo and earn a B.S. degree in Computer Science. He enjoys the simple things in life, like spending time with his family and friends, listening to music, and occasionally singing in the shower.

Optimizing the Air-Handler Simulator

Stephanie Shinohara

Smithsonian Submillimeter Array

Mentor: Billie Chitwood

Home Institution: University of Southern California

The Smithsonian Astrophysical Observatory's Submillimeter Array (SMA) currently uses a cooling system for their antennas called the "air handler." Each handler is responsible for keeping its antenna cabin temperature constant to within a few hundredths of a degree centigrade in order for the antenna's electronics to function properly. Last summer, another Akamai intern, Kyle Loo, designed and fabricated a test replica (simulator) of an air handler in order for SMA staff to be able to test and debug the units in Hilo, rather than traveling up to the summit of Mauna Kea every time. My project was (1) to take Kyle's design and improve upon it by adding key components that he did not have time to incorporate, (2) improve the overall efficiency of the design, and (3) use the simulator to test a device that will help determine if a filter needs to be replaced. In order to make the simulator more efficient, I rearranged the motors and several of the wires so that they no longer obstructed access to key components and so that opening and closing the hatch was an easier process. I then installed the differential pressure sensor, pressure switch, and a weighted vent, three key components that the actual air handlers have but the earlier simulator did not. The differential pressure sensor measures the difference in pressure on either side of the handler's filters. The pressure switch detects the change in pressure when the hatch is opened and automatically turns off the handler's heater. The weighted vent allows air to escape from the handler when the air pressure is too high due to the recirculating air damper being 100% closed. With my test data showing the difference in pressure at various levels of filter blockage, the SMA will be able to use the differential pressure sensor on each antenna air handler in the future to determine if their filters are too dirty and need to be replaced.

Born and raised in Honolulu, Stephanie Shinohara has just finished her sophomore year at the University of Southern California in pursuit of a degree in Electrical Engineering. A graduate of ʻIolani School, she has always had a passion for math and science-related classes. She enjoys attending USC football games and exploring Los Angeles (including trips to Beverly Hills and Disneyland), and she is an active member and officer of the USC Hawaii Club. Stephanie has been thoroughly looking forward to her Akamai internship this summer.

Distance Learning: Remotely Monitoring Test Points at SMA

Jason Choi

Smithsonian Submillimeter Array
Mentors: Derek Kubo & Paul Yamaguchi
Home Institution: Kauaʻi Community College

The Smithsonian Submillimeter Array (SMA) is an interferometric telescope that consists of eight movable antennas. Troubleshooting these antennas can take hours, as technicians must travel to the summit and manually search at each antenna for the cause of a problem, using test points that are located in sealed enclosures. To remedy this, a remote antenna monitoring system (AMS) is being implemented to monitor key RF test points that convey the health and status of the receiver and the intermediate frequency/local oscillator (IF/LO) system. With the AMS in place, up to 20 signals can be monitored in minutes, and software can automatically capture signals to show trends in the data. My project was to build a component for the AMS that allows a technician to choose which test point to observe. It consists of a DC power supply, an Ethernet interface to relay communications, and a relay unit called the "ADAM 5000" that selects the particular signal to be viewed. The build process was split into three phases. First, I modified the metal housing to accommodate the components and external connections. Next, I constructed a series of circuit boards for the ADAM unit to facilitate signal selection. Finally, I fabricated the necessary cabling to make the internal connections and assembled the unit. Once completed, I installed the completed housing in Antenna 6 on the summit of Mauna Kea. With the completed AMS in place, troubleshooting the receiver in the antenna cabin at SMA will become far more efficient.

Jason Choi was born on Oahu and raised on Kauaʻi, where he graduated from Waimea High School. He just graduated from the Electronics Technology program at Kauaʻi Community College. Jason enjoys cooking, playing music, video games, traveling, and going to the gym. Just kidding, he hates the gym (but he goes anyway).

Reimagining the SMA Electronics Lab: Optimizing Dynamics of Use

Chauncey Banasihan

Smithsonian Submillimeter Array
Mentor: John Maute
Advisor: Derek Kubo
Home Institution: Kaua'i Community College

At the Smithsonian Submillimeter Array (SMA), the Electronics Laboratory is filled with parts, supplies, and tools. The laboratory is an active working environment, but it was suffering from a number of problems: it lacked organization, it did not have much room to work, and parts were sometimes hard to find. My goal was to find a solution that would make it easier for workers to work in the lab, and easier for them to find something when they need it. First, using Microsoft *Visio,* I created a scale layout of the Electronics Laboratory, and I electronically rearranged the lab to make it easier to access parts and supplies located in cabinets, drawers, and storage units. Once I determined the optimal layout of the lab (and checked that it did not violate any building restrictions), I physically moved the furniture into its new configuration. Second, I created a parts inventory list for the lab, including each part's manufacturer/vendor name, part number, military number, description, primary function, and location. I chose a Microsoft *Excel*-based system for the inventory, primarily for *Excel*'s powerful sorting functions that make it faster and easier to find and keep track of parts. Also, *Excel* is a commonly used program at SMA, so minimal training is required. Finally, I consolidated parts and items that were spread out across various cabinets and storage units, collecting and labeling them in an organized fashion. With a lab that is now organized and has its own inventory, workers can focus on completing their projects, rather than wasting valuable time searching for hard-to-find items. In addition, the lab now has much more usable workspace, and there is a functioning inventory system that can only benefit the future of the Electronics Laboratory at the SMA.

Chauncey Banasihan was born on the island of Kaua'i. He is currently enrolled in the Electronics Technology and Cisco Networking Academy program at Kaua'i Community College, and will be graduating in spring 2010. Chauncey is a hard working young man who loves to learn new things. His ultimate goal is to find a great job in a field that he enjoys, have a successful career, and make enough money to support his family. He is also a paddler who loves the ocean, and is currently paddling men's long distance for the Kilohana Canoe Club. Making music is also one of his passions — he enjoys playing drums and bass and likes to learn new instruments.

An Intelligent Version-Control Framework

Tyler Yoshiyama

Gemini Observatory
Mentors: Felix Kraemer & Mathew Rippa
Advisor: Vasu Upadhya
Home Institution: University of Hawai'i at Hilo

In software development, it is important to manage and record the evolution of a program. Integrating version control seamlessly into the software build cycle gives developers a framework that has the integrity to recover from disasters such as data loss. Such a framework is especially valuable at Gemini Observatory, where telescope downtime can cost up to $2 per second. Gemini presently uses *Subversion* (SVN) to manage their framework. However, Gemini's SVN scheme is currently unable to intelligently track module differences due solely to factors such as operating system or architecture. The purpose of my project was to enhance the existing framework to provide that intelligence. First, I learned how to use MySQL, BASH (Bourne-Again SHell), and SVN. Next, I created a MySQL database to store information about the latest versions of Gemini's programs. I then created and modified BASH and MySQL scripts to work with both the database and SVN. The scripts helped define a standard protocol that developers will follow when they update and upload their work. Lastly, I integrated the database into a Web interface that provides quick and easy access to the information. The framework has yet to be deployed at Gemini, as more fine-tuning is required to make sure that it integrates seamlessly. The framework will continue to evolve as Gemini's development team discusses the standards for their software.

Tyler Yoshiyama is a student at the University of Hawai'i at Hilo, majoring in Computer Science. Born and raised in Hilo, Tyler has excelled in academics from a young age, and was a valedictorian of Hilo High School. Tyler has also regularly worked on his family's coffee farm for 15 years. He previously participated in the 2008 Maui Akamai Program and has been looking forward to being challenged in this year's Big Island Program.

An Evaluation of Local Seeing at Gemini Observatory

Wei-Hann Chen

Gemini Observatory
Mentor: Chas Cavedoni
Home Institution: University of Hawai'i at Hilo

What makes stars twinkle? Convective turbulence in the Earth's atmosphere causes fluctuations in the refractive index of the air. This randomly bends the path of incoming starlight, causing degradation of the quality of astronomical images, also known as "seeing." Astronomers divide seeing into two regimes: natural atmospheric seeing and self-induced (man-made) seeing. The objective of this project is to understand self-induced seeing at Gemini, and to make recommendations to Gemini on how to improve it. Analysis of Gemini South (GS) Differential Image Motion Monitor (DIMM) data gives purely natural atmospheric seeing, while data from the GS on-instrument wave-front sensor (OIWFS) provide the total seeing. By taking the difference of these two values, I obtained the self-induced, man-made component of the seeing. Astronomical engineers identify three main sources of self-induced seeing: mirror seeing, dome seeing, and enclosure seeing. In each case, the magnitude of the seeing is a function of the temperature difference between the object and the ambient air. In order to quantify these three sources of self-induced seeing, I analyzed GS temperature data and searched for correlations between seeing quality and thermal conditions. Unfortunately, sparse and/or missing data, due to insufficient and/or inactive sensors, adversely affected the process and prevented a complete analysis. Hence, fortifying the GS sensor array is one of my primary recommendations for the future. Finally, as part of my engineering study, I researched Gemini's scientific requirements and "error budget" to determine constraints on image quality, and I studied prior engineering strategies that were implemented to reduce self-induced seeing.

As an immigrant who moved to the United States in the fall of 2005, Wei-Hann Chen is now exploring and experiencing his new life journey on the Big Island. A city boy who grew up in Taiwan, Wei-Hann was born and raised in Taipei, where he graduated in 2005 from a high school with a specially-designed fine arts program. Currently a junior-year Mathematics major at the University of Hawai'i at Hilo, Wei-Hann plans to transfer to UH Mānoa in fall 2009 for further study and to add a second major in Mechanical Engineering. He is an enthusiastic beginner in his field, and he has been looking forward to better determining his future path through an Akamai internship.

Wave-Plate Rotator Upgrade to the Gemini North Laser

Lucia Poláková

Gemini Observatory
Mentors: Richard Oram & Vincent Fesquet
Collaborators: Jeff Jarboe & Robert Wyman
Home Institution: Santa Clara University

Gemini North Observatory is performing upgrades to their existing 12-watt sodium laser guide-star system, in order to improve reliability and to prevent against laser self-damage. One of the upgrades involves installing a wave-plate rotator that will attenuate the IR laser beam during the first three hours after the laser is powered on. During this warm-up period, the laser system has the potential to switch from stable mode-locking to Q-switch mode where power spikes can occur, damaging the Sum-Frequency Generator (SFG) crystal that combines the 1319-nm and 1064-nm IR laser beams to produce the 589-nm yellow laser beam. The main objective of this project was to characterize and test a wave-plate rotator containing a 1064-nm half-wave plate. This was done using a low-power test laser, a thin-film polarizer (TFP), a polarimeter, and two photodetectors. First, tests were run to characterize the performance of the wave-plate rotator such as the backlash, hysteresis, and how the number of steps input by the user relates to the output in degrees of rotation. Then, further tests were carried out to characterize the behavior of the wave plate, such as recording the change in power of the laser beam transmitted through the wave plate (and reflected off a TFP) as the wave plate was rotated. A relationship between the angle of the wave plate and the power of the transmitted beam was determined. This relationship was used to determine the angle at which to set the wave plate to send the laser beam power toward either the power meter or the SFG crystal. The next phase of this project will be to install the wave-plate rotator on the laser optics bench on the summit at the Gemini North telescope, and to integrate its controls into the existing *LabVIEW* software.

Lucia Poláková was born in Honoka‘a on the Big Island of Hawai‘i and was raised in Waimea. She just graduated from Santa Clara University with a degree in Mechanical Engineering and a minor in Dance. She is very happy to be back in Hawai‘i working for Gemini this summer, after having worked for CFHT last summer. She would like to move back to Hawai‘i and continue working here. Lucia enjoys horseback riding, mountain biking, dancing, singing, and spending time with family and friends. She would like to pursue a career someday in alternative energy, particularly solar energy.

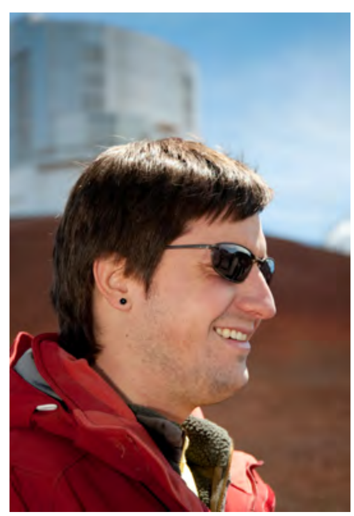
Characterization of a Segmented Deformable Mirror Using Phase-Diversity

Robert M. Albarran

Subaru Telescope
Mentor: Frantz Martinache
Advisor: Olivier Guyon & Lucio Ramos
Collaborator: Yosef Razin
Home Institution: University of Hawai'i at Hilo

Density variations in the Earth's atmosphere, due to atmospheric convection and turbulence, yield astronomical images with poor spatial resolution, preventing large telescopes from achieving their ideal diffraction-limited high resolution. Today, large optical and infrared ground-based observatories use a technique known as Adaptive Optics (AO) to correct for the distortion of light induced by our atmosphere, thereby producing diffraction-limited images. Deformable Mirrors (DM) and wavefront-control devices are critical AO system components, from which more and more is being demanded. During my internship at Subaru Telescope, I have designed and assembled an optical bench to characterize the surface quality of one such DM with 37 individual segments, each of which may be driven in piston and tip-tilt. I characterized the DM by using the technique of phase-diversity: by programming a CCD camera to take a series of images, in and out of focus, of the reflected light of the DM, an algorithm developed at Subaru may then be used to drive the DM. This DM optical configuration will serve as a testbed for advanced wavefront-control techniques in part of the extreme-AO system currently being assembled at Subaru. Future implications of segmented mirror technology may extend to projects such as the Thirty Meter Telescope and the James Webb Space Telescope.

Robert M. Albarran graduated from the American School Foundation in Mexico City. After studying biology at Suffolk University, he transferred to the University of Hawai'i at Hilo to study astronomy. Today, Robert is a planetarium operator at the 'Imiloa Astronomy Center of Hawai'i. Robert also gives summit and star tours at the Visitor Information Station of Mauna Kea, coordinates the Sigma Alpha Pi chapter of the National Society of Leadership and Success, and enjoys discussing breakthroughs in space science. Robert plans to pursue a PhD in cosmology and to push the frontiers of early universe cosmology.



Mirror, Mirror: Improving CFHT's Aluminizing Procedure

Justen Dela Cruz

Canada-France-Hawaii Telescope
Mentors: Tom Benedict & Marc Baril
Advisors: Kevin Ho & Gregory Barrick
Home Institution: University of Hawaii at Mānoa

Having a uniformly coated mirror with a sufficient thickness (900 to 1000 Å) of a reflective metal is important to guarantee its longevity and to provide the best possible image quality for the telescope. The mirrors of the Canada-France-Hawaii Telescope (CFHT) are coated inside a high vacuum chamber where several hot tungsten filaments vaporize aluminum, which then deposits on the glass. Inconsistent wicking of aluminum onto the tungsten filaments has been a constant problem with the CFHT aluminizing chambers. Since preparation time for the large chamber takes longer than for the small chamber, testing was done with the small coating chamber to investigate the problem. Initial tests compared two different ways to hang aluminum clips on the tungsten filament. Each filament consist of five helical loops in the center and one semi-circular dip on either side of the central loops. Our tests showed that hanging the aluminum clips in a "splay" (widely separated) configuration produced a thicker coat than with the clips in the close-together configuration. In addition, during these initial tests, we found that degassing the filament was a necessary step in the coating process. Secondary tests were done (using the splay configuration of the aluminum clips) with different tungsten filament designs: a filament with dips closer to the helical loops, and a filament with no dips. After numerous tests and a modified coating procedure, the no-dip filaments proved to give a thicker coat than tests done with the closer-dip filaments. From the data received, it shows that it is possible to get a coat of at least 100 Å thicker with the no-dip filaments than with the closer-dip filaments. The results also show that this new clip and filament geometry give a more consistent coating. With testing still ongoing, hopefully soon the splay configuration with the no-dip filaments will be tried with the large coating chamber.

Justen Dela Cruz is currently a senior at the University of Hawaii at Mānoa, majoring in Mechanical Engineering. He is a graduate of Mililani High School, and was born and raised on the island of O'ahu. He is thrilled about his opportunity to intern on the Big Island. In his free time, Justen enjoys music, going to the gym, playing sports, and hanging out with family and friends.

“What’s in the Air Up There?”: An Automated Remote Airborne-Particle Counter

Rodolf Sabalburo

Canada-France-Hawaii Telescope
Mentors: Greg Barrick, Grant Matsushige, and Tom Vermeulen
Advisor: Sarah Gajadhar
Collaborator: Dorothy Fukushima
Home Institution: Honolulu Community College

The Canada-France-Hawaii Telescope (CFHT) is in the process of implementing its Observatory Automation Project (OAP). The goal of the OAP is to enable remote monitoring and control of observatory subsystems, to allow operation of the telescope from the headquarters in Waimea without personnel at the summit. Weather sensing is one of many subprojects contained within the OAP, including the continuous monitoring of airborne particles (“dust”). Dust presents a potential hazard to the telescope; however, a baseline for unsafe dust levels has not yet been established. This project focused on configuring and benchmarking an airborne-particle counter to measure the concentration of micron-scale dust in the air surrounding the telescope. This device was configured via PC using a serial communications protocol called Modbus. A program written in C language was created to continuously poll measurements from the particle counter, sampling once per minute and saving to a monitoring database. The airborne-particle counter was then mounted within the observatory dome and connected to CFHT’s internal network. Particle measurements are now graphed and archived every minute in CFHT’s monitoring database. Over time, the archived measurements will be used to establish a baseline for unsafe dust levels. These data, combined with other weather-sensing information, will allow engineers to determine remotely whether environmental conditions at the summit are safe enough to open the dome and operate the telescope.

Rodolf Sabalburo is a Computer Electronics & Networking Technology (CENT) student at Honolulu Community College. He has been excited about the Akamai Internship because he enjoys applying himself to new challenges. Originally from Minnesota, Rodolf likes digital photography, playing cello, and learning more about networking and information security systems. He hopes one day to have a career as a network security analyst or auditor.

Dust in the Dome: Characterizing the Dust at Keck Observatory

Dorothy Fukushima

W.M. Keck Observatory
Mentors: Klaus Ulander & Craig Nance
Collaborator: Rodolf Sabalburo
Home Institution: University of Hawai‘i at Hilo

How often should one’s home get cleaned for dust: once a day, once a week, or once a month? The W.M. Keck Observatory’s own domes are no exception to this common question. Without knowing the dust levels, Keck has historically cleaned its mirrors and instruments of dust once a month. Although this is a widely accepted and utilized method, my project was undertaken to determine if a better cleaning procedure could be found. If, for example, there were a particularly dusty period immediately after the monthly cleaning, the dust would sit on the mirrors for an entire month. The dust particles would have a greater chance of bonding to the mirror, damaging the coating and degrading the quality of observations. In order to assess the effectiveness of the current cleaning method, Keck used the Aerocet 531 — a user-friendly handheld dust monitor that can run for two and a half days, allowing for easy collection of dust particles. The monitor records dust concentration as a function of particle size and mass, sampled once per minute. Dust monitors were placed in different locations around the observatory to test the dust levels. The data were then analyzed to see if there were particular times when the dust levels spiked, and why. This method would allow Keck to clean the affected mirrors and instruments as soon as possible following significant dust exposure, to mitigate potential damage to coatings by dust. Observatories around the world were contacted to obtain their methods for ensuring the cleanliness of their mirrors and instruments. The inquiry revealed that most dust-monitoring programs are in the developmental stages; observatories are struggling to determine dome-closure policies and cleaning frequency for dust. This project suggests that Keck should install permanent dust monitors to continuously survey the dust. The telescope optics can be cleaned the morning after a dusty night, and the dome can be closed should a rare extreme-dust event occur.

Dorothy Fukushima was born and raised in Pahoa on the Big Island. She will be a senior this fall, pursuing a Bachelor of Science degree in Astronomy at the University of Hawai‘i at Hilo. She plans to attend graduate school in astronomy upon completion of her degree. Her hobbies include reading, writing, and exercising.

Design Foundations: 3-D Modeling of Keck II

Amanda Ross

W.M. Keck Observatory
Mentors: Bill Randolph, Drew Medeiros, and Jim Bell
Home Institution: Mt. Holyoke College

Science, and more particularly astronomy, must continue to advance as technology improves. Mirrors must get bigger, images clearer, and laser guide stars more plentiful, if the technology to create them exists. However, in order to improve something, one must possess accurate knowledge of its existing state. Before the design process begins for Keck II's Next Generation of Adaptive Optics (NGAO), a new system that allows for much clearer images by correcting for atmospheric disturbances, the documentation of its proposed site must be fully completed. The goal of my project was to use the CAD software for mechanical design, SolidWorks, to complete a portion of the 3-D representation of the entire Keck II telescope. I focused primarily on the structure beneath the left Nasmyth platform, home to the current AO bench. In total, I modeled 11 structural beams, three sets of stairs, and the mirror-cell access and elevation-drive access platforms. Once verified with the as-builts on the summit, my models were assembled and added to the existing telescope model, then released to the Keck vault, where they will serve as a guide to the designers of NGAO.

Amanda Ross was born and raised in Kailua-Kona on the Big Island. In 2007, she graduated from Hawaii Preparatory Academy, and she will enter her junior year at Mount Holyoke College this fall. Amanda enjoys riding horses, listening to music, and being at home in Kona with her friends and family. She is a double major in Architecture and Mathematics, and hopes one day to attend graduate school and pursue a career in Architecture.

Improving Inventory Efficiency at the Keck Interferometer

Steven Coss

W.M. Keck Observatory
Mentors: Kevin Tsubota & Ed Wetherell
Home Institution: University of Hawai'i at Hilo

One of the challenges of the information age is the storage and display of increasingly large amounts of information in an efficient manner. The interferometry lab at Keck Observatory is no exception: the laboratory has hundreds of devices, ranging from lenses to the actuators that move the lenses to the CPUs that control them. Information detailing each of these devices is currently stored within an *Excel* file, including a full description of all devices, their locations, their drivers, and the other devices they are connected to. Over time, the file has become somewhat bloated, and navigating it to look up specific information can be cumbersome. As this file is constantly used for troubleshooting, slow access has become a problem for the interferometry lab. In order to optimize both the data storage and reporting functionality, I converted the *Excel* file into a *MySQL* database. In addition, I wrote a Web-based interface in PHP to access and alter the database. Once the performance requirements of both the database and the interface were defined, I created and implemented a design for each. Finally, I added code to the PHP interface to handle many of the interface requirements, like parsing the data from a field to create a Web link. My new database format eliminates redundancy and maintains data integrity: rather than needing to pass around copies of an *Excel* file, the Web interface is available to everyone as long as Keck's internal network is active. Also, the interface itself is straightforward and easy to use — the lab inventory data is now much easier to examine, update, and use when troubleshooting devices. This project will serve as the first step toward creating a consolidated, observatory-wide inventory database. Also, the Next Generation Adaptive Optics project will be employing an inventory database modeled on this project.

Steven Coss was born and raised near Sacramento, California. He moved to the island of Hawai'i to attend college at the University of Hawai'i at Hilo, where he majors in Computer Science. In his free time, Steven enjoys spending time with friends, watching TV shows via the web, playing video games, and generally having a good time.

Finding Metallicities of Old Open Clusters

Linden Hale

W.M. Keck Observatory
Mentor: Marc Kassis
Home Institution: University of Washington at Seattle

Open clusters—groupings of stars that have formed at the same time, from the same molecular cloud, and remain loosely gravitationally bound to each other—are excellent tracers of the formation and evolution of the Galactic disk. Because star clusters reflect the age, composition, and other properties of the interstellar clouds from which they formed, observing the properties of the stars within these clusters informs our knowledge of the Galaxy at the time period and location of their formation. The oldest open clusters were born during an era of transition from even older globular-cluster formation to open-cluster formation. This unique position in Galactic history, as well as the clusters' generally large galactocentric radius, height above the disk plane, and sensitivity to the gravitational effects of surrounding masses, make the study of the surviving old clusters a topic of particular interest. For this project, I was presented with multi-object spectra of two of these old open clusters, Berkeley 54 and NGC 7789. The spectra were collected using LRIS (Low Resolution Imaging Spectrometer), mounted at the Cassegrain focus of Keck I. NGC 7789, for the purposes of this project, was used as a standard cluster whose galactocentric radius, relative age, radial velocity, and metallicity (elemental content of the stars within the cluster) have been previously determined and set to a standardized abundance scale published by Friel et al. The spectra of both clusters were reduced using *IRAF* (Image Reduction and Analysis Facility), and I created a program that used the reduced data to determine the abundances of various metals (primarily iron) for each star within the clusters. It is expected that Berkeley 54 will follow previously observed abundance gradients, showing a decrease of cluster metallicity with distance from the Galactic center, and a lack of correlation between metallicity and cluster age.

Born in Washington State, Linden Hale moved with her family to the Big Island at age 10, where she began to cultivate her fascination with the natural world and the cosmos. After graduating from Parker School in Kamuela, she moved to Seattle to attend the University of Washington. Without really meaning to, she ended up in an introductory astronomy class, which became the true ignition for her decision to pursue a double major in Astronomy and Physics. Entering her sophomore year this fall at UW, Linden enjoys dancing, doing yoga, and photography.

Akamai Workforce Initiative

University of Hawai‘i Institute for Astronomy (IfA)
Center for Adaptive Optics (CfAO)
Maui Community College (MCC)

The Akamai Workforce Initiative (AWI) partners industry, observatories, educational institutions, and community to meet needs in astronomy, remote sensing, and other technology industries in Hawai‘i. The AWI includes internships, the Teaching and Curriculum Collaborative, development of engineering technology courses, and outreach to high schools.

The AWI will advance *akamai* – smart, clever, expert – students into the technology workforce on Maui, and more broadly in Hawai‘i.

AWI includes internships on Maui and Hawaii Island

Maui Akamai Internship

University of Hawai‘i Institute for Astronomy (IfA)
Maui Community College (MCC)
Center for Adaptive Optics (CfAO)
Air Force Maui Optical and Supercomputing Site (AMOS)
Maui High Tech Industry Partners

Hawai‘i Akamai Internship

Center for Adaptive Optics (CfAO)
Hawaii Community College
W. M. Keck Observatory
University of Hawaii, Hilo
Mauna Kea Observatories

The AWI has received funding from:

The National Science Foundation funded Center for Adaptive Optics (NSF#AST-987678)
University of Hawai‘i
Department of Business, Economic Development, and Tourism
National Science Foundation (NSF# AST-0710699)
Air Force Office of Scientific Research (NSF# AST-0710699, through interagency transfer)
Air Force Research Laboratory
Thirty Meter Telescope Corporation
National Science Foundation (NSF# AST-0850532)

For information please contact:
Lisa Hunter, Director, Akamai Workforce Initiative,
Institute for Astronomy & Center for Adaptive Optics,
(808) 573-9542, hunter@ifa.hawaii.edu

Akamai Workforce Initiative Headquarters

IfA Advanced Technology Research Center
34 Ohia Ku Street * Pukalani, HI * 96768

Lisa Hunter, Director, Akamai Workforce Initiative
808-573-9542 * hunter@ifa.hawaii.edu

Lani LeBron, Program Assistant, Akamai Workforce Initiative
808-573-9534 * klebron@ifa.hawaii.edu

http://www.ifa.hawaii.edu/haleakalanew/akamai/akamai.shtml